USING REMAINING SERVICE LIFE AS THE NATIONAL PERFORMANCE MEASURE OF PAVEMENT ASSETS

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Using Remaining Service Life as the National Performance Measure of Pavement Assets

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ABSTRACT:

Contained in the Moving Ahead for Progress in the 21st Century (MAP-21) Transportation Legislation are three primary provisions that create a comprehensive, outcome based program for pavements. The objective of this program is for States to invest resources in projects that will collectively make progress toward achievement of national goals.

The principle provision – §150 National Goals and Performance Management Measures – requires that the United States Department of Transportation (USDOT) to develop performance measures and targets related to seven national goals, including maintaining the highway infrastructure assets in a state of good repair. The second provision – §119 National Highway Performance Program – requires the States to develop a risk-based asset management plan to improve or preserve the condition of assets through a program of projects that make progress toward achievement of the State targets for asset condition and performance of the system. The third provision – §135 Statewide and Nonmetropolitan Transportation planning – requires States to use a performance-based approach to transportation decision-making in their statewide transportation planning process to support the national goals.

This paper shows how States can address these three provisions for pavements by using a concept called Remaining Service Life or RSL. RSL is a measurement of the time until the next rehabilitation of a pavement section. It is useful as a Performance Measure because it enhances pavement condition data by including pavement deterioration information. It is useful as part of an Asset Management Plan because it ensures investments are made to improve the life and usefulness of the highway system and it is useful as part of an Effective Planning Process because it gives agencies the long term information they need, with reasonable accuracy, to plan future maintenance and rehabilitation needs cost effectively.
INTRODUCTION:

The Moving Ahead for Progress in the 21st Century (MAP-21) Federal Transportation Legislation (J) contained three major provisions that when combined, require that States develop a far-reaching Performance Based Management Program for Pavements. These provisions and their requirements with respect to pavements are:

Section 1203, §150 National Goals and Performance Management Measures
- Performance management will transform the Federal-aid highway program and provide a means to the most efficient investment of transportation funds. §150(a)
- USDOT is to develop performance measures and targets related to seven national goals – including maintaining the highway infrastructure asset system in a state of good repair. §150(b)
- USDOT must set minimum standards and establish measures for states to use to assess the condition and performance of pavements on both the Interstate System and the National Highway System (NHS). §150(c)
- The performance targets supporting the goals are to be set jointly by states, MPOs, regional planning organizations and public transit agencies. §150(d)

Section 1106, §119 National Highway Performance Program
- States shall develop a risk-based asset management plan for the NHS to improve or preserve the condition of the assets and the performance of the system. §119(e)(1)
- A State asset management plan shall include strategies leading to a program of projects that would make progress toward achievement of the State targets for asset condition and performance of the NHS… §119(e)(2)
- A state’s Asset Management Plan shall include at a minimum §119(e)(4)
  o Summary list of State’s NHS pavements and bridges with condition
  o Asset management objectives and measures
  o Performance gap identification
  o Lifecycle cost and risk management analysis
  o Financial plan
  o Investment strategies

Section 1202, §135 Statewide and Nonmetropolitan Transportation planning
- The statewide transportation planning process shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals… §135(d)(2)
- The performance measures and targets shall be considered by a State when developing policies, programs, and investment priorities reflected in the statewide transportation plan and statewide transportation improvement program. §135(d)(2)(D)
- State plans requiring pavement targets include Statewide Transportation Improvement Programs §135(g)(4) and State asset management plans under the National Highway Performance Program §119 (e). In addition, State and MPO targets should be included in Statewide transportation plans §135(f)(7)

While each provisions is separate, these author’s believe that the goal of the provisions is to link them into a long-term, strategically-driven, risk-based performance management approach that uses the measures and targets to direct the pavement investment strategies on individual projects that feed into the Statewide Planning Programs in order to meet the National Goals (Figure 1).
Between November 2012 and April 2013, the AASHTO Standing Committee on Performance Management Task Force on Performance Measure (SCOPM Task Force) came out with several recommendations for the National-Level Performance Measures and Target Setting for pavements. (2,3,4). In developing their recommended Measures and Targets, AASHTO recognized both the need to provide guidance on the National Measures, while also recognizing the differences on how States collect and use their existing pavement condition data.

**Performance Measure Recommendations**

1. **Interstate Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of 0.1 mile segments of Interstate pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.

2. **Non-Interstate NHS Pavement in Good, Fair and Poor Condition based on the International Roughness Index (IRI)**—Percentage of 0.1 mile segments of Interstate pavement mileage in good, fair and poor condition based on the following criteria: good if IRI<95, fair if IRI is between 95 and 170, and poor if IRI is greater than 170.

3. **Pavement Structural Heath Index**—Percentage of pavement which meet minimum criteria for pavement faulting, rutting and cracking.

**Target Setting Recommendations**

- State DOTs should be given maximum flexibility in setting performance targets. Every state faces different constraints and opportunities affecting their transportation system. Funding levels and sources vary, as do environmental conditions, population growth trends, and legislative and gubernatorial mandates and priorities. Flexibility in target setting allows states and municipalities to face the realities of their unique situations. Furthermore, accountability should be based on what states can accomplish with their shares of federal funding.

- States DOTs should be encouraged to adopt performance targets that are attainable and realistic. These targets should be periodically reevaluated and adjusted to reflect risks, revenue expectations, and strategic priorities. In addition, the State DOTs agree that...
consistent data collection and analysis methods are essential to ensure that national level measures and reporting use comparable data.

The establishment of performance targets can provide a focal point for action and a basis for accountability. However, it is important to recognize that for several of the national level performance measures, State DOTs have relatively limited control over outcomes. There are many externalities that could affect a State. DOT attaining certain performance targets from economic to social forces. Generally speaking, State DOTs have more control over achieving targets related to asset condition and less control over performance measures associated with safety and system performance. AASHTO recommends that rules and guidance to implement MAP 21's performance provisions reflect this reality.

The SCOPM Task Force recommended that IRI be used for the first two measures because it is ready for immediate implementation; can be used for both flexible and rigid pavements; is already being collected for Highway Performance Monitoring System; and it can be collected with a single piece of equipment (Error! Bookmark not defined.). However, they also pointed out that the IRI does not take into account the “structural” condition of the pavement and therefore proposed the third measure, the Pavement Structural Heath Index, be developed and implemented over the next 3 to 5 years.

**Potential Issues with the AASHTO Performance Measures:**

There are several potential issues with the AASHTO proposed National Performance Measures. First, as AASHTO correctly pointed out, pavement condition should be described in terms of both “functional” and “structural” condition. The functional condition of an existing pavement is its ability to serve the user comfortably and is being covered with IRI. The structural condition is a pavement’s ability to carry traffic and not deteriorate (i.e. no cracking). While AASHTO is recommending that the Pavement Structural Heath Index be developed and implemented over the next 3 to 5 years, doing so could be difficult. The reason for this is that there is not a universal measure for structural distress data or a standardized procedure to combine the data into a “health index.” This could mean that the structural distress data that the DOT’s have been collecting over the last 20+ years would probably not be used for several years, and therefore the National Performance Measures would not be comprehensive.

Second, the IRI (and potentially the Structural Heath Index) is a condition measurement that only tells what the current condition of the pavement network is (eg. what portion is in good, fair or poor condition). It does not have a time element that tells “how long” a pavement will remain in that condition or how it changes over time. For example, Pavement 1 may be in a “good” IRI condition, but it has a high rate of deterioration so that in a few years, it will be in a fair or poor condition. Pavement 2, on the other hand is pavement that is slightly above poor condition, but it has stayed in that condition for the last 20 years. While Pavement 1 is in better condition, there will be a large difference in rehabilitation requirements between the two pavements that cannot be quantified by using only condition. Adding a time element to the performance measure will distinguish between pavements that are stable and remaining in a given condition and pavements that are deteriorating quickly.

Finally, because the IRI (and again potentially the Structural Heath Index) is a condition measure, it is a “delayed performance indicator.” By the time the pavement reaches an unacceptable IRI threshold, rehabilitation should have already been performed. Furthermore, because these condition measures do not account for how long a pavement is in a given condition, there is no information on how to program the rehabilitation activities. This can result in developing treatments that are either over-designed or under-designed at the project level.
REMAINING SERVICE LIFE (RSL)

For the driving public, the top pavement performance concern is “Is the pavement in good condition and can I use it?” Drivers want roads that are in good condition and not under repair, which limits a driver’s access to the road. Remaining Service Life is a concept that tells the time, expressed in years, before rehabilitation is required for any given pavement section. It defines “how long” the public will be able to use the pavement (Figure 2(a)). A RSL=10 means that it will be 10 years until the next rehabilitation for that section of pavement. Correspondingly, the RSL of a new pavement is equal to the pavement design life and the RSL of pavement with a condition worse than the target condition is zero. By using RSL, agencies can answer several types of questions including:

- What is the current condition of my pavement network?
- How does the current condition compare to the required level of service/performance?
- Which individual pavement sections are critical to sustained performance?
- What are my best “operations and maintenance” and “capital improvement” investment strategies to ensure sustained performance over the short to medium time horizon?
- What is my best long-term funding strategy to ensure sustained performance?

Other advantages for using RSL are that it is easy to understand. Intuitively everyone understands that a pavement with a RSL=15 years is better than a pavement with a RSL=5 years (a pavement that is serving the public longer is serving the public better). Next, RSL is a “multi-conditional” Performance Measure that can be determined from any set of ride and structural condition data. This means RSL is flexible and can be developed using a State DOT’s current data and individual condition targets, which gives the states the “maximum flexibility” they were seeking in their “Target Setting Recommendations.” It also keeps USDOT from having to develop a universal or standardized procedure to measure pavement distress data in order to get a “Pavement Structural Heath Index” that will fit every State’s needs.

Finally, RSL has a time element in it to account for changing conditions and differentiate between pavements that are stable and those that are deteriorating. This allows agencies to distinguish between two pavements that have the same condition (IRI); but which will require very different management strategies (Figure 2(b)), and keeps them from doing “band aid solutions” that may or may not be cost effective.

It is important to note that RSL is not a substitute for condition measures such as IRI or distress data. Rather it builds on these condition measures to provide deeper insight by converting “condition measures” into an “operational performance” measure that tell how well or long the

![FIGURE 2 Depiction of Remaining Service Life (RSL).](image-url)
pavement will be serving the public. This makes it an ideal tool to address the Transportation Planning and Performance Management Criteria requirements of the MAP-21 law.

Remaining Service Life as a Performance Measure

MAP-21 requires the development of performance measures and targets related to seven national goals – including maintaining the highway infrastructure asset system in a state of good repair – § § 150(b), 150(c). While pavement condition data (such as IRI, cracking, rutting, etc.) is an important element of a Performance Measure, by themselves they do not provide a thorough picture. RSL takes this condition data and enhances it by showing how long the pavement will serve the public.

To determine RSL, a State DOT takes their pavement condition data, and for each distress that they collect and measure (eg IRI, cracking, rutting, etc), they set a target criterion as to what is acceptable and not acceptable (eg IRI=170, cracking=15%, rutting=0.2 inches, etc). These target criteria indicate when rehabilitation will be done based on each distress. Each state will set its own limit based on the distresses it collects, and if desired, the DOT can set different targets for different parts of the network (urban vs, rural, interstates vs state roads, etc.). Then for each pavement segment, the DOT projects the “Time to Next Rehabilitation” of each distress by determining when that specific distress will hit the distress condition limit. Fortunately there are a number of models, modeling techniques and data sets (eg Pavement-ME models, LTPP Models, FHWA’s Pavement Health Tracker, state models, state PMS data, straight line predictions, etc.) that can help do this prediction. Once the RSL for each distress is determined, the RSL for the segment is equal to the lowest RSL value.

Figure 3(a) is an example of the condition data for a concrete pavement that has had IRI, cracking and faulting data collected on it since the year 2000. (Note that these are the diamond points on the IRI, cracking and joint faulting graphs in Figure 3(a). The vertical axis describes the amount of the given distress and the horizontal axis is Year. The red line is the Target for that particular distress as defined by the State. Using this data, the “time to next rehabilitation” or RSL for each distress is projected (RSL_{IRI}=16 years, RSL_{cracking}=12 years, and RSL_{faulting}=10 years). In this case, the faulting RSL is the lowest so the segment RSL is 10 years.

Once RSL is determined, it does not matter from a programing or funding perspective, what distress controls the time to rehabilitation because all distresses will be addressed when the section is rehabilitated. All that matters is that the pavement segment RSL=10. One nuance that is important to be aware of is that at different evaluation times, the distress triggering the RSL for a section may change if the deterioration rate of a specific distress changes.

Once RSL is determined for each individual segment, the data is combined to give the Network RSL graph shown in Figure 3(b), which shows the percent of network that needs repair for each time period along the horizontal axis (eg 4-year time frames). While the network RSL can be separated into different categories by pavement types, urban vs, rural, roadway classification, district, etc.; eventually they all have to be combined together to give an overall view of the State Interstate and NHS system. In combining the section into the network RSL, the agency needs to determine what time frames to combine the RSL segments (eg time frame grouping can be 1 year, 3, year, 5 year, etc.). These authors suggest using 4-year groupings to match the 4-year STIP planning requirements in MAP-21 (MAP-21 §135(g)).
The RSL network graph gives the overview of the health of the network by presenting the data so that agencies can easily see how long the portions of the pavement will last, as well as see what their future obligations will be. This is needed in developing the risk based asset management programing plan. Also calculated are the Network Remaining Service Life and the Average Network RSL.
RSL. The Network RSL is the summation of each pavement section’s remaining life times the miles in that section and is expressed as lane-mile-years (e.g. this network has 51,269 lane-mile-years). The Average Network RSL is Network RSL divided by the total lane miles of the network (e.g. 51,269 / 3849 = 13.3 years). This number represents the average time between rehabilitation for any given section. By developing the Network RSL graph and calculating the Average RSL, an agency can analyze the impacts of various activities on the network to determine whether the activities will improve the overall network condition or lower it.

The Benefits of Increased Network RSL

Higher RSL networks deliver more value than lower RSL networks because increasing a Network’s RSL and Average RSL means that the average years of service for the entire network is increased. This in turn lowers the networks annual cost because there are fewer pavements to be rehabilitated each year. For example, Figure 4 shows an agency that has a 300 mile highway network with mostly short-life pavements: one-third of the system (100 miles) has a remaining life of 5 years, one-third has a remaining life of 10 years, and the final one-third has a remaining life of 15 years. The Networks’ RSL is 3,000 lane-mile-years (Σ 100 miles x 5 yrs + 100x10 + 100x15 = 3000 lane-mile-years) and the Average RSL is 10 years. As long as the agency continues to use 15-year solutions, it will be rehabilitating 1/3rd of its network every 5 years and in 15 years, the whole system will have gone through one full rehabilitation cycle.

Now assume that the agency, over the next 5 years decides to convert the 100 miles to a 30 year pavement. At the end of the 5 years, the Network RSL will be 4,500 miles and the Average Network will be 15 years (see bottom table of Figure 4). This is a 50% increase in the Average RSL that means, on average, the public will be disrupted once every 15 years rather than once every 10 years as in the first system. It also lowers the annual cost by spreading them over a longer time period, decreases traffic disruptions, and increases safety because of fewer work zones.

### Example of a Hypothetical System
- 300 miles of existing network of short lived (15 year) pavements
  - 1/3rd has an average remaining life of 5 years until work is necessary
  - 1/3rd has 10 years until work is necessary
  - 1/3rd has 15 years until work is necessary
- Convert 100 miles to long life pavements (first 1/3rd) over the next 5 years

<table>
<thead>
<tr>
<th>Miles in Segment of System</th>
<th>Years to Next Fix</th>
<th>RSL of Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>5</td>
<td>100 x 5 yrs = 500 mi-yr</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
<td>1,000 mi-yr</td>
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<tr>
<td>100</td>
<td>15</td>
<td>1,500 mi-yr</td>
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</tbody>
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Network RSL = 3,000 mi-yr
Avg RSL / mile = 3000/300 = 10 yr

<table>
<thead>
<tr>
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<td>1,000 mi-yr</td>
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<tr>
<td>100</td>
<td>30</td>
<td>3,000 mi-yr</td>
</tr>
</tbody>
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Network RSL = 4,500 mi-yr
Avg RSL / mile = 4,500/300 = 15 yr

FIGURE 4 An increased RSL means improved performance because higher RSL networks are delivering more value than lower RSL networks.
One item that is important to note is that the available rehabilitation activities are going to be constrained by costs. As such, the agency cannot just choose solutions to provide the highest Average RSL. They need to look at cost. As such, as agencies will need select rehabilitation activities by looking at both time life extension and at costs, then select the rehabilitation activities by those that provides the greatest increase RSL for every dollar spent (RSL \times \$).

Example of RSL as Performance Measures – Washington State DOT

Washington State DOT has recently initiated using three RSL-based pavement performance measures: (6)

1. Remaining Service Life (RSL)
2. Asset Sustainability Ratio (ASR), which measures how much life is put back into the pavement system versus how much service life is consumed each year
3. Deferred Preservation Liability, which is an estimate of the funding necessary to address the backlog of deferred pavement rehabilitation projects

For RSL, Washington State is using two measures: Average Remaining Service Life, which they monitor to see if it is increasing or decreasing and RSL as a percent of the original life. For example, if the original RSL of a new pavement is 15 years, and the current RSL is 10 years, the pavement has \(10/15=66\%\) of its original life left. WSDOT’s RSL target is between 40% and 60% of the Original Service Life (~half of the original life). This keeps them from spending too much money on rehabilitating roads with adequate service life as well as not depleting the asset by letting a backlog of roads go past due for rehabilitation.

The Asset Sustainability Ratio measures how well pavement replenishment is keeping up with pavement wear and is found by dividing the lane-mile-years replenished each year by lane-mile-years consumed each year. Lane-mile-years replenished is equal to the lane miles of rehabilitated pavement times number of years of added life (eg if 10 miles of pavement is rehabilitated with a 10 year life rehabilitation, 100 lane-mile-years are added back into the system). The Lane-mile-years consumed is the number of lane miles on the network for each year. WSDOT has \(~18,600\) lane miles, which means that each year \(18,600\) lane-mile-years of pavement life are consumed. When the ASR is less than 1.0, fewer lane-mile-years are being put into the network than being consumed. When the ASR is greater than 1.0, more lane-mile-years are being put into the network. WSDOT’s Target ASR is 1.0.

The Deferred Preservation Liability is an estimate of the funding necessary to address the backlog of projects. If funding does not allow for an adequate ASR, some pavement preservation is deferred, incurring a future financial liability. The Deferred Preservation Liability is impacted by both the backlog of projects (more projects) and the additional deterioration of the backlogged projects. That is, as the pavement continues to deteriorate and gets more severe damage, it will require a more costly repair. WSDOT’s Target Deferred Preservation Liability is zero (\$0).

Figure 5 is the Dashboard used to show the condition of WSDOT asphalt and chip seal pavement network, as well as the direction of movement (improving or deteriorating) for the 4th quarter of 2012. As can be seen, while two of the four goals were met, all the performance measures are deteriorating. This is an indication of either not enough money being expended, or the wrong activities are being used, to maintain the system.
Remaining Service Life as an “Asset Management Tool” and a “Statewide Planning Tool”

MAP-21 requires:

- “States shall develop a risk-based asset management plan for the National Highway System to improve or preserve the condition of the assets and the performance of the system” – MAP-21 §119(e)(1)
- the “State asset management plan shall include strategies leading to a program of projects that would make progress toward achievement of the State targets for asset condition and performance of the National Highway System…” – MAP-21 §119(e)(2)
- “The statewide transportation planning process shall provide for the establishment and use of a performance-based approach to transportation decision-making to support the national goals…” – MAP-21 §135(d)(2)

RSL combines these requirements into a risk-based asset management plan and performance-based transportation planning approach all at the same time. It does this by showing the current condition and expected performance of an agency’s pavement assets, as well as where future problems may exist (e.g., risk-based asset management plan). The RSL then provides a basis for a “performance-based transportation plan” because it tells agencies what performance is required “to improve or preserve” the condition of the pavement assets. Finally, the RSL allows agencies to develop and compare different plans and strategies – with different “programs of projects” and limited financial resources – in order to determine what is the best long-term strategy to maintain the system in a “state of good repair” by providing an objective assessment of how the planned activities impact the network’s performance.

The Network’s RSL does this because it defines what is needed from a rehabilitation program. Historically, when selecting rehabilitation strategies for a specific pavement, agencies asked two questions: 1) “What are the feasible alternatives? (feasible means it addresses the existing distresses
and provides a reasonable improvement) and 2) “Is it being applied at the appropriate time?”

However, asking only these two questions is insufficient. A third and equally important question is
“What is the expected life of the selected activity and how does it impact the network?” This last
question compels the agency to assess how potential rehabilitation techniques impact the RSL of the
network and its future activities. It is needed because it is not always best to use a specific activity
even though it may be feasible and applied at the correct time because it will cause future funding and
performance problems for the agency.

For example, Figures 6(a) and (b) show that the agency cannot do rehabilitation activities that
last 10 years because it increases the amount to repair to do in 10 years from 22% to 46%. This will
cause both a funding crises and a decrease in overall network performance (this is shown in Figure
6(b) with the lower the Network RSL and Average RSL, indicating that the program will produce
poor results and should be avoided). Instead DOT’s need to find the best combination of
rehabilitation activities so that the RSL increases without piling work onto a time-frame that already
has a large amount of the repair. This is done by looking for openings in the Network RSL graph that
has little or no rehabilitation activities to be done, and applying rehabilitation alternatives that “fill”
these openings. Figure 6(c) shows that the 4 to 8 year, and the 16 to 28 year time frames are open
because 10% or less of the system is in need of repair during those time frames. The time frame
beyond year 32 is also open because there are no long-life pavements in this system.

As can be imagined, every pavement network will have openings at different times and
therefore in order to fill these openings, agencies will need to use different pavement solutions that
provide different length of lives. Furthermore, as pointed out earlier, what can be done is going to be
constrained by budgets and not all pavements are going to be able to be improved with the best option.
Some pavements are going to have to be preserved and maintained in order to stay in their current
condition, while others are going to need a more in depth rehabilitation. Thus, in selecting the sets of
activities”, planners will need to develop long term asset or pavement management program based on
a concept called “Mix of Fixes.”

Mix of Fixes (Pavement Rehabilitation) Categories

“Mix of Fixes” is a term used to describe rehabilitation alternatives that provide different
length of lives – some with short-term lives, some with medium-term lives, and some with long-term
lives – that can be used to fill the openings in the Network RSL graph.

Short term fixes are usually Preservation Activities that typically address functional issues,
such as ride, early the pavement’s life when it has little deterioration. The intent is to repair isolated
areas of distress and to manage the rate of deterioration. The primary advantage of preservation
activities is that they are relatively inexpensive, and can be applied to many miles of pavements cost
effectively. The life expectancy of preservation techniques is between 2 and 15 years, depending on
the specific activity.

Medium to long term fixes can either be overlays or reconstruction. Overlays are used when
pavement has medium to high levels of distress and preservation is no longer effective. Rather than
just slowing the rate of deterioration, overlays add structure as well as improve a pavement’s
functional condition. Reconstruction is used when the pavement has high levels of distress, when
overlays are no longer effective, or when standards have changed. The advantage of reconstruction is
that it replaces the entire pavement structure so other needs, such as drainage and safety can be
addressed. Depending on the type of overlay or reconstruction activity chosen, a typical service life
can be anywhere from 10 years to over 40 years.
By judiciously programing rehabilitation solutions that fall into openings in the RSL graph and balancing costs, agencies can improve the overall Network Performance by ensuring that there is not too much or too little pavement to repair in any given time frame. Once DOT planners determine how long a given activity needs to perform (e.g., how long a rehabilitation must last), it is the responsibility of the DOT pavement engineers to find pavement strategies and solutions for specific projects to meet that network “time” need. At this point, the engineers will go back to the condition index measurements for each segment of the network that is to be repaired and uses that condition data to help determine the right “fix” to meet the required network “time” need.
Once the appropriate alternates that address the network “time” and the project specific requirements are selected, the alternates are then compared on costs, and specifically by Life Cycle Cost Analysis (LCCA) as specified by MAP 21, §119(e)(4). Life Cycle Cost Analysis is an economic comparison of all competing alternates considering all significant costs (and benefits) over the life of each alternate, expressed in equivalent dollars. Whereas RSL is used at the network level to determine what is needed, the LCCA is applied at the project level to compare the alternates that meet that “time need” to determine which one costs the least.

EXAMPLE

Figure 7 is an example of the long-term impact that pavement rehabilitation selection can have on a network. On the left is the RSL graph for the network that has been used throughout this paper. On the right side are the projected RSL’s in 20 years using two alternate pavement rehabilitation strategies. The first alternate is a typical mill and fill overlay strategy that provides 8 to 15-year fixes before the next rehabilitation activity is needed. The second alternate uses a “Mix of Fixes” approach with 10, 15, 20, 25 and 30-year solutions. In both cases, the same budget is available and spent; and activities are planned out as best as possible in order to maximize the network RSL.

As can be seen in Figure 7, in the Short-term scenario has an Average RSL of 7.3 years and the Mix of Fix Scenario has an Average RSL of 10.3 years. Both are lower than the current Average RSL of 13.3 years, which indicates that there is not enough money going into the system to maintain it (eg the Asset Sustainability Ratio is less than 1.0). However, it can also be seen that the Mix of Fixes scenario is providing greater service because its Average RSL is 3 years higher.

FIGURE 7 Example of Two Alternate Strategies
Short-term (8 to 15-Year Fixes) vs Mix of Fixes (8 to 30-Year Fixes)
Same Budget & Expenditures.
CONCLUSION

Remaining Service Life is the number of years to when the pavement will need rehabilitation. This paper shows on how RSL can be used to meet the three primary provisions in the Moving Ahead for Progress in the 21st Century (MAP-21) relating to a Performance Based Management Program for Pavements. These provisions are:

- §119 National Highway Performance Program – requires the States to develop a risk-based asset management plan to improve or preserve the condition of the assets...
- 135 Statewide and Nonmetropolitan Transportation planning – requires the States to use a performance-based approach to transportation decision-making...
- §150 National Goals and Performance Management Measures – requires the USDOT to develop Performance Measures to show that the “highway infrastructure asset system is in a state of good repair.”

Currently, IRI is being proposed as the National Performance Measure, but there are some concerns with using it. First, IRI only measures the Functional condition (ride) of the pavement. To have a clear understanding of how well a pavement is serving the public, both functional and structural conditions of the pavement need to be taken into account. Second, IRI, as well as structural conditional data such as cracking, rutting, and faulting, only provide a measure of the current condition of the pavement network. They do not provide information on what future conditions will be.

RSL is a better National Measure of the current condition of the pavement network because it adds a “time” element to how well the pavement network is serving the public (a pavement with a higher RSL is serving the public longer and is therefore serving the public better). RSL is also the basis for “risk-based” and “performance based” programs because it provides insight into how the pavement network will perform for the next 10 to 20 years as well as what is required from pavement investment strategies to maintain the system. Additional advantages of RSL are:

- It is a multi-conditional measure and can be developed from any type functional and / or structural data.
- It is flexible and allows State DOT’s to use their current Pavement Management Data and to develop individual condition targets to meet the National Goals
- It can forecast future pavement performance with sufficient accuracy to plan future maintenance and rehabilitation needs
- It can be used to compare different scenarios to determine what are the best investment strategies to ensure sustained performance over any time horizon
- It can be used to show the impact of different funding levels and helps determine the best long-term funding strategy to ensure sustained performance.

REFERENCE

1 HR 4348, Moving Ahead for Progress in the 21st Century Act (MAP-21), An Act to authorize funds for Federal-aid highways, highway safety programs, and transit programs, and for other purposes, 112 Congress, 2nd Session. Enacted October 1, 2012.


6 They Gray Notebook #48: WSDOT’s quarterly performance report on transportation systems, programs, and department management Quarter ending December 31, 2012, Published February 25, 2013