# building OPERATING management

SEPT. 2013 • FACILITIESNET.COM/BOM • $8


Energy management makes gains in retail facilities

## Microsoft gets serious about SMART BUILDINGS

Darrell Smith and his team are using fault detection and diagnostics to **transform facilities management**

## 3 ENERGY-SAVING HVAC OPPORTUNITIES

## HOSPITALS GO BEYOND CODE

## Metrics Steer Investment Decisions

PLUS: Green Building Report • Mass Notification • Elevator Maintenance Contracts

Darrell Smith, director of energy and facilities, Microsoft

# Three Metrics Steer Investment Decisions

The National Park Service combines a facility condition index with an asset priority index and critical systems identification to set funding priorities across varying types of assets

by douglas w. kincaid

## Understanding the Facility Condition Index

The facility condition index (FCI) was developed to provide a benchmark to compare the relative condition of a group of homogeneous facilities. This index is primarily used to support asset management initiatives of federal, state, and local government facilities organizations, but universities, housing and transportation authorities, and primary and secondary school systems also use the index. FCI is defined as follows:

**Facility Condition Index**

*equals*

**Current Maintenance, Repair, and Replacement Deficiencies of Facility**

*divided by*

**Current Replacement Value of the Facility**

To calculate an FCI, a facility manager needs to quantify the cost of current maintenance, repair, and replacement deficiencies of a facility. This cost is typically the outcome of a facility's condition assessment. The CRV is defined as the monetary value the organization places on the facility.

The FCI is a relative indicator of condition and should be tracked over time to maximize its benefit. It is advantageous to define condition ratings based on ranges of the FCI. The book, *Managing the Facilities Portfolio,* published in 1991 by the National Association of College and University Business Officers, where the FCI metric was first published, provided a set of ratings — good (under 0.05), fair (0.5 to 0.10), and poor (over 0.10) — based on evaluating data from various organizations at the time of the publication and reviewing what natural breakpoints might indicate a rating. Today, many organizations are determining an appropriate FCI range for these ratings based on their mission and strategic goals.

*— Douglas W. Kincaid*

If there's a word that describes the portfolio of the National Park Service (NPS), a bureau of the Department of the Interior, that word is "diverse." The portfolio includes national parks, national monuments, battlefields, military parks, historical parks, historic sites, lakeshores, seashores, recreation areas, scenic rivers, trails — plus the White House. The NPS portfolio includes more than 70,000 facilities with a current replacement value (CRV) of more than $150 billion. Another way to get a sense of the portfolio is to say that it includes 401 areas covering more than 84 million acres across the 50 states, the District of Columbia, American Samoa, Guam, Puerto Rico, and the Virgin Islands.

In 2002, the NPS began in earnest to more clearly define its asset management practices and, from that effort, to develop a comprehensive capital asset management program. This program focused on these questions:

- What assets does NPS own?
- What is the current replacement value of those assets?
- What is the current condition of those assets?
- What is required to achieve portfolio performance targets?
- Which assets are mission critical, and where should parks invest their limited resources?

Answering those questions was far from easy with a portfolio that ranges from buildings, monuments, and fortifications, to roads and landscapes, and

even to Cold War-era missile silos. Ultimately, NPS combined three analytical tools to do the job: facility condition index (FCI), asset priority index (API), and critical systems identification. The three tools have enabled NPS to set funding priorities more effectively.

## Understanding the Metrics

FCI is defined as current maintenance, repair, and replacement deficiencies of the facility divided by current replacement value of the facility. The lower the number, the better.

An FCI alone did not provide the clarity of direction NPS needed to optimize management of a portfolio of this size and diversity. It was a challenge for NPS to determine homogeneous facility types to enable valid comparison of condition. The condition of NPS facilities reflected a potentially overwhelming resource requirement for current deficiencies, and the requirements were widely distributed among diverse asset types. Moreover, condition alone did not provide enough insight into how the portfolio could be managed with limited resources and how strategic decisions could be supported.

To see why the FCI alone is an imperfect measure of the true condition of an asset, consider the needs of a building and a utility system. The FCI of a building might be higher than the FCI for a utility system; however, the utility system may be more at risk of failure because of the condition of a lower cost component that is critical to its operation. The FCI cannot account for the condition of its critical components and, therefore, on its own, fails to capture this important distinction.

To overcome these shortcomings, NPS combined two other key approaches with the FCI. The first was the asset priority index (API). API is calculated based on input from a park's major stakeholders. They determine the contribution of each asset in the park's portfolio to the park mission to protect resources, provide visitor experience, and support operations and substitutability. The resulting score, based on a 100-point scale, is intended to reflect the relative importance of each asset. The API helps focus resource allocations on the highest priorities to make smarter, targeted investment decisions.

Even with the combination of FCI and API, the resource requirements for the NPS asset portfolio still greatly exceeded the available funds. In response, NPS added the third element, critical systems identification, for each homogeneous facility type as an evaluation criterion. Guided by the premise that an asset consists of a collection of systems and subsystems, facility management experts identified the critical systems that must be in good working order for an asset to function effectively. For a building, these critical systems include items such as roofing, HVAC, and exterior doors and windows. A building's noncritical systems include items such as floor finishes and interior walls.

Deficiencies were categorized as minor, serious, or critical based on the severity of the impact they would have on the system. An acceptable level of condition exists when all of an asset's critical systems have no critical or serious deferred maintenance; critical systems with minor deferred maintenance and noncritical systems with any priority of deferred maintenance may exist. An unacceptable level of condition exists when some of an asset's critical systems have critical or serious deficiencies.

The combination of the FCI, API and critical systems metrics provided a logical and powerful way of evaluating the NPS portfolio and viewing individual groups of facilities.

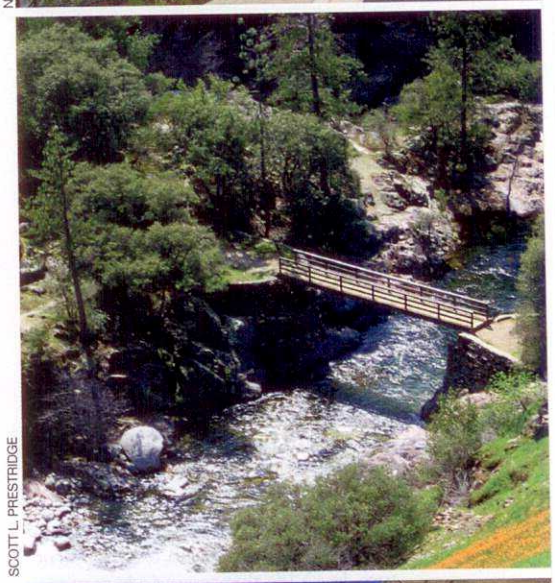
"Being charged with maintaining national treasures is an immense responsibility," says Tim Harvey, chief, park facility management division, NPS. "The National Park Service has never been in a better position to understand the condition of our facilities and to use tools such as the FCI in our strategic decision-making processes."

## FCI: Overcoming Challenges

One of the challenges in using FCI effectively as an asset management tool was making FCIs consistent across NPS asset types. NPS tackled this challenge by developing a standardized approach to calculating current replacement values that did not require extensive cost estimating based on the features of a particular asset. Categories of asset types were developed that were homogeneous in terms of use, function, and basic systems (e.g., visitor centers, maintenance shop, trails). In general, RSMeans was used to develop a unit cost reference and, where appropriate, provided for specific add-ons or dif-

NPS WD URBIN

NPS



SCOTT L. PRESTRIDGE

SCOTT L. PRESTRIDGE

The wide range of types of assets in the National Park Service portfolio made it impossible to use the facility condition index alone as an effective asset management tool. The NPS portfolio includes (from top) the Home of Franklin D. Roosevelt Historic Site, the visitor center at the Fort McHenry National Monument and Historic Shrine, a trail bridge in the Sequoia and Kings Canyon national parks, and the Midwest Regional Office of NPS.

ferentiators. An example of a differentiator might be the number of stories, presence of a finished basement for a housing asset, or the historical nature of the asset or some of the systems. With this approach, current replacement value became the likely cost if the same size and type of asset was constructed using modern materials and methods. It provided a consistent methodology to calculate the denominator of an FCI.

There are two common misconceptions about FCI that are tied to current replacement values. The first is that FCI represents the cost of constructing the exact asset with the materials and methods that currently make up the asset. To build actual cost estimates for NPS's 70,000-plus assets with that level of detail would not have been possible or logical. In actuality, current replacement values are meant to provide a consistent process for generating FCIs that are comparable, but they are not values that should be used at the park level to plan new construction activities.

The second misconception is that FCI cannot be greater than 1.0. Individual cost estimates that are based on condition assessments or on other planning activities are significantly affected by working in an existing structure. For NPS, this scenario is common for historic assets. If an asset requires replacement of several of its systems and components, but the work is taking place within the confines of the existing structure and without the efficiencies of new construction, the unit cost for replacement of the system can be increased significantly from the unit cost associated with new construction. And, even if current replacement values were to provide a detailed constructed cost based on the individual asset's materials, components, and methods, it is not that difficult to generate a numerator (accurate repair and replacement costs) that is greater than the denominator (current replacement value). With a current replacement value based on unit costs, an FCI over 1.0 is even more likely to occur for assets that are in poor condition.

Once the condition data for some of the most prominent categories of asset types was developed and FCI calculated for those assets, it became apparent that the industry-standard scale of good, fair, and poor would categorize average NPS assets as being in poor condition. For this reason, FCI and the good-fair-poor scale did not provide enough granularity. NPS realized that additional criteria were required to optimize asset management investment.

## Challenges of Diverse Portfolio

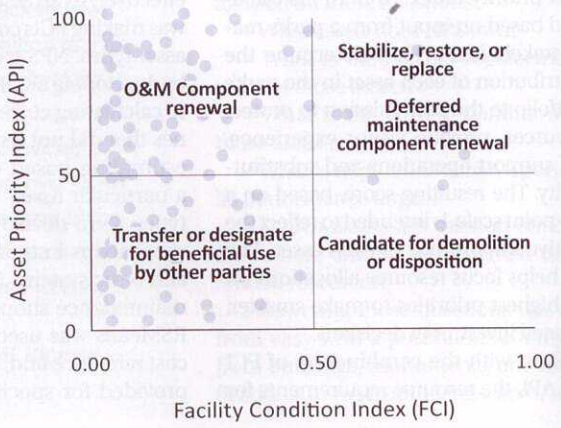
The NPS asset portfolio consists of 31 different asset types, which range from the normal groups of building types to roads, maintained landscapes, archeological sites, towers/missile silos, marinas, fortifications, and monuments. Even within these categories, the types are not considered homogeneous: For example, buildings include types as disparate as visitor centers and lighthouses. Therefore, using FCI to compare conditions between a road, a constructed waterway, and a fortification seemed illogical and of limited value in the decision-making process. The value of using FCI to determine where to focus funding seems especially suspect when one considers comparing the condition of historical structures with cultural significance, such as the Lincoln Memorial, to a trail at Yellowstone National Park. The costs to correct deficiencies as well as the current replacement values are so different that a direct comparison of FCI is not necessarily appropriate.

In the past, NPS addressed asset needs by focusing on the entire portfolio, regardless of importance to the mission or the criticality of a deficiency. This strategy was a mile wide and an inch deep. NPS soon determined that combining FCI with a method of prioritizing assets and then identifying within those assets which systems were critical to keep them operational offered the granularity to make better strategic decisions. Prioritizing assets was determined by the major stakeholders at individual parks. These stakeholders applied criteria to rate and score each asset generally based on its resource preservation, visitor use, park operations, and substitutability qualities. The resulting score, on a scale from 0 to 100, is the API. Under this scale, the assets closer to 100 are considered mission critical; they should be maintained to a higher standard and therefore require the majority of the focus and available funding.

The NPS portfolio continues to expand. In this environment of constrained funding, it was important to focus funding on the systems with the most impact on the protection, condition, and operational aspects of the highest API scoring assets. The roof and windows on a visitor center, for example, protect that asset from further damage and deterioration while interior finishes, although they may enhance the visitor experience, do not keep the visitor center from being operational. From this thinking, NPS developed a list of critical systems for each asset type. The critical systems list for each asset type in the service's portfolio helped

## ESTABLISHING PRIORITIES FOR INVESTMENT

> The National Park Service looks at multiple metrics to determine where to invest preventive maintenance funding. Assets falling into the top left quadrant should receive the bulk of the preventive maintenance funding.



## TRACKING PROGRESS

> Trends for the facility condition index for some of the major asset types in the National Park Service portfolio.

### FCI Trends by Asset Type FY03-FY11

| Asset Type | FY03 | FY04 | FY05 | FY06 | FY07 | FY08 | FY09 | FY10 | FY11 | Trend |
|---|---|---|---|---|---|---|---|---|---|---|
| Buildings | 0.156 | **0.100** | 0.168 | **0.203** | 0.179 | 0.177 | 0.198 | 0.186 | 0.185 | |
| Housing | **0.217** | **0.126** | 0.162 | 0.173 | 0.152 | 0.151 | 0.158 | 0.182 | 0.188 | |
| Paved Roads | 0.385 | **0.439** | 0.439 | **0.227** | 0.232 | 0.258 | 0.246 | 0.239 | 0.248 | |
| Trails | 0.169 | **0.364** | 0.269 | 0.194 | 0.183 | 0.184 | 0.185 | 0.165 | **0.157** | |
| Campgrounds | 0.174 | 0.146 | 0.161 | 0.188 | **0.296** | 0.263 | 0.223 | **0.124** | 0.126 | |
| Unpaved Roads | **0.265** | 0.122 | 0.174 | 0.174 | 0.144 | 0.122 | 0.123 | **0.108** | 0.125 | |
| Water Systems | **0.172** | **0.076** | 0.119 | 0.157 | 0.157 | 0.157 | 0.152 | 0.131 | 0.127 | |
| Wastewater Systems | 0.227 | **0.170** | 0.173 | 0.198 | 0.232 | **0.236** | 0.236 | 0.215 | 0.220 | |

*Numbers in red indicate lowest scores. Numbers in bold indicate highest scores.*

transform data into information to support decisions by focusing investment dollars on systems critical to ongoing operation and functional integrity.

These three evaluation criteria (FCI, API, and critical systems) were applicable to decisions involving every aspect of asset management, including operations and maintenance decisions. Preventive maintenance tasks were being assigned to critical equipment and systems in the NPS inventory, but rather than applying the funding to all assets, systems, and equipment, a more strategic approach was employed: applying the most resources to the highest priority assets in the best condition to gain an optimal return on investment. (See "Establishing Priorities for Investment" on facing page.)

NPS incorporated this approach into how NPS facility managers strategically plan and execute work. Harvey reviewed past spending trends across NPS and recognized that the mindset of NPS facility managers was to try to fix or maintain all assets. From a strategic perspective, this mindset was neither resulting in an effective use of available funding nor possible to achieve. Only when the combination of FCI, API, and critical systems criteria was adopted did things change. This approach has transformed NPS facility managers' evaluation process into one where strategic decisions are supported by data and information rather than being made as a reaction to a particular need.

Using API and critical systems along with FCI provides a valuable tool in identifying the assets with real issues that can be solved. Such a tool is particularly important because NPS is facing a backlog of approximately $11 billion and must preserve assets of cultural or historical significance. Although the task to maintain 70,000 assets for perpetuity is still a daunting one, with this tool and the combination of asset management practices, it is achievable.

This method — combining FCI with API and system criticality metrics in decision-making processes — has gained acceptance over time and increased the visibility and validity of the NPS asset management program. The NPS culture has also changed: from reactive to strategic, data-driven management of assets. NPS facility managers now regularly discuss ways to improve the use of data in decision-making. This significant cultural change transcends NPS facilities management. Now, NPS managers outside of facilities departments, as well as managers in other agencies working with NPS, are gaining an appreciation for the program's strategic approach and the powerful combination of metrics used to support everyday decisions. ■

*Douglas W. Kincaid (doug@ameinc.biz ) is president of Applied Management Engineering (AME), Inc., of Virginia Beach, Va. The firm was the principal author of the book* Managing the Facilities Portfolio, *where the FCI metric was first published in 1991, and the ratings that appeared in that book were based on data from evaluating AME clients.*

*Tim Harvey, chief, and Mary Hudson, asset management project manager, both of the park facility management division of the National Park Service, and Scott L. Prestridge, PE, CCE/A, Booz Allen Hamilton, also contributed to this article.*

*Email comments and questions to edward.sullivan@tradepress.com.*

## Critical Systems Identification: Preventive Maintenance

**A key to critical systems identification is prioritizing deficiencies based on the impact they would have on the systems. The following terms define the levels of priority for deferred maintenance:**

- **MINOR DEFICIENCY (LOW PRIORITY):** condition with a long-term impact beyond five years or a reduced life expectancy of affected materials or related equipment/features.
- **SERIOUS DEFICIENCY (HIGH PRIORITY):** deterioration, which if not corrected within two to five years, will result in the failure of the equipment/feature or the asset of which it is a part, or deterioration that will create a threat to the health or safety of the user.
- **CRITICAL DEFICIENCY (HIGH PRIORITY):** advanced deterioration that has already resulted in the failure of the equipment/feature, or advanced deterioration that if not corrected within one year will result in the failure of the equipment/feature, or advanced deterioration that has created a threat to health or safety of the user, or a failure to meet a legislated requirement.

*— Douglas W. Kincaid*