When we try to pick out anything by itself, we find it hitched to everything else in the Universe. *John Muir* (Wood, 2008)

**Principle:** High-performing maintenance operations organizations insure quality experiences through well-managed spaces and places.

If our first duty as professionals is to provide the people we serve with the means to achieve fulfillment through recreation and leisure, then take a moment to recall your own “best” (and “worst”) recreation or leisure experience, and explain why it was so.

More than likely, some aspect of your environment played an important role: the well-lit, secure parking lot (or the uneasy walk through broken glass and rusting fences); the cheering crowd (or the cursing of a drunken fan); the video arcade’s pulsating invitation (or the game console’s broken controller). Did the sun brighten the day, or burn the participants; did the trees provide shade, or obstruct people’s sight lines; was the water feature a calming influence or an attractive nuisance; were the paths and walkways level and accessible, or cracked and impassable?

In pursuit of recreation and leisure, whether in actual or virtual environments, we need accommodating spaces and also the properly functioning “toys” with which to “play.” The quality of those spaces and “play”-ces directly impacts the quality of our experiences, and it is our duty to provide that quality by adhering to—if not exceeding—established management of maintenance operations standards.

Standards may be defined as *basic rules or a set of criteria used for testing or judging* (Sawyer, 2005). In turn, standards are derived from principles: statements of time-tested wisdom that are modified to reflect changes or anticipate trends. The more a manager can see the “big picture,” the more completely principles can be evaluated for their usefulness and the more accurately standards can be developed and met.

Seeing the big picture, however, requires managers to handle large amounts of information coming from many sources simultaneously. Accomplishing this difficult task was almost impossible in the past, but changes in how volumes of information are collected, stored, and accessed have produced a new way to organize and analyze it: a big-picture perspective called the *systems approach*.

Acknowledging the trend toward a systems approach to maintenance operations management, this chapter introduces principles that locate where immediate or potential challenges fit within the big picture. That recognition enables managers to identify the ultimate reasons why challenges arise, understand how they are linked within a system of forces (see Exhibit 13.1), and design specific, customized solutions. Typically, these customized solutions satisfy accreditation standards through the development, consistent use, and periodic review of management plans, policies, programs, and procedures, as well as inspection[s] and assignment schedules and records.

### The Components of Managing Maintenance Operations

The components of every-day managing maintenance operations are well known. Typical facility, parks, and event-related maintenance and/or operations textbooks (e.g., Edginton, Hudson, Lankford, & Larsen, 2008; Hurd, Mulvaney, Rossman & McKinney, 2007; Sawyer, 2005; Warren, Rea & Payne, 2007) prescribe some combination of the following list, most of which are chapters in this book:

- facility design, planning, and management considerations, and related procedures;
- financing, budgeting, revenue management, and financial practices;
- staffing and human resource management;
- programming and scheduling;
- promotion, marketing, and public relations;
- risk management; and safety, security and legal concerns;
- inclusion, accommodation, cooperation, and partnerships;
Exhibit 13.1
Systems Approach to Management

The two general forces of the natural world: Entropy and Inertia...

...show their power in the five “spheres”...

...whose interactions are arranged into a system...

Exhibit 13.1: Systems Approach to Management

- maintenance, including preventative maintenance and personnel assignment;
- equipment, property, and supplies, including fleet management, depreciation, and replacement;
- compliance, accountability, and evaluation; and
- most relevant to this chapter, information systems and technology.

Based on these authors’ years of practical experience, the conclusion can be reached that an organization built of these components generally runs fairly well. But what if “fairly well” no longer is good enough? What separates ordinary performance from higher performance—or excellence? If the identical who, what, where, when, and how components are present in sufficient amounts, why do the results sometimes differ? The answer is that the components listed above often are examined as separate questions, instead of parts working together as a larger system to answer the ultimate question: Why?

Management of Maintenance Operations as a System

Because of the very diverse nature of maintenance operations management, its many challenges, and its local variations, this chapter does not attempt to present detailed information about specific circumstances. Instead, management of maintenance operations is described as a system made up of natural and human forces. By understanding how the system’s components affect each other, managers can discover the underlying reasons why things happen the way they do, and then design effective and efficient solutions customized to their own unique challenges. curing the disease, rather than only treating the symptoms.

Principle. Although particular maintenance or operations problems may seem local or unique, being able to see them as part of a larger system helps create the best solutions.

Trend: A Shortage of Research

Certainly the development of management-related theories in many fields has progressed since the classics developed during the World War II era (e.g., Deming, 1950; Lewin, 1943; Maslow, 1943), and someone, somewhere is publishing a new book on managing people or organizations nearly every week (see Hersey & Blanchard, 2008 for an overview of theories and styles). In contrast, surprisingly little academic research has
been conducted on maintenance or operations topics within recreation and leisure, a trend noted by Beaman (2000) which continues through the present day.

An examination of more than 200 article titles published within the past ten years among six leisure-related professional journals reveals that exactly two researcher teams (Fletcher & Fletcher, 2003; Wirsching, Leung, & Attarian, 2003) have addressed management from a maintenance perspective, while another two (Farrell & Marion, 2001–2002; Krannich, Eisenhauer, Field, & Luloff, 1999) explicitly discussed management in an operations context.

Nonetheless, many other articles review important management topics such as playground safety (e.g., the Law Review column published in Parks & Recreation magazine), legal case studies (e.g., the Ordinances column featured in Landscape Architect magazine), and management topics in general (e.g., the Manager’s Toolbox column appearing in Parks and Recreation Business magazine). Besides, haven’t maintenance operations managers gotten along pretty well without “theory” up until this point? Or have they?

From a maintenance standpoint, stories ranging from embarrassing oversights to tragic failures appear with disappointing regularity (Sawyer, 2005), and the resulting lessons are not always learned or critically analyzed. In terms of operations functions, their scope in service-oriented organizations may be broad enough to consume entire budgets (80 percent personnel, 20 percent utilities, equipment, and supplies), and mismanagement of those functions has brought many an organization to its knees.

Sources of Maintenance Operations Management Information

Given this substantial impact, where can a conscientious manager of maintenance operations turn to find advice and guidance? At the moment, the great majority of this information is published in trade magazines (e.g., Landscape Superintendent and Maintenance Professional, Parks & Rec Business, Parks & Recreation, and Recreation Management) and journals (e.g., the NIRSA Recreational Sports Journal), or is presented in “best practices” seminars and workshops ranging from aquatics to zoos, sponsored by practitioner or entrepreneurial organizations (e.g., National Park and Recreation Association, or REI Corporation).

To be sure, these are reputable sources; experience is a master teacher. But simply put, it is not possible to cover, in-depth, the seemingly limitless challenges confronting each individual manager of maintenance operations; one recreation director’s playground inspection checklist does not, at first glance, seem to apply in any way to a parks supervisor’s equipment maintenance schedule. This is exactly why a systems approach is essential. Viewing problems from a systems approach allows what at first appears to be a unique issue to be recognized as a variation of a more general type for which a range of solutions already has proven effective, or can be improvised. A systems approach illuminates the paths connecting incidents to a common source.

Coping with Entropy and Inertia

In Greek mythology, Sisyphus was sentenced for eternity to push a boulder up a hill, even as the boulder resisted by trying to roll back down the hill (see Exhibit 13.2). Systems are built around a core idea, and then use principles and models to explain or solve specific problems. The most central statement that can be made about managing maintenance operations is this: to a greater or lesser degree, humans’ pursuit of recreation and leisure almost always is at odds with the natural forces of Planet Earth.

Like poor Sisyphus, in the process of creating, maintaining, and operating spaces and places, either we’re trying to move something that doesn’t want to budge, or we’re struggling to stop something that wants to keep moving. These forces can be generalized into two related categories—entropy, and inertia—acting as the center of the maintenance operations system, which attempts to manage those natural forces and their effects.
**Principle.** Every component managed through maintenance operations is wearing down or tiring out, and the ability to conceptualize that process as a system will determine an organization’s level of performance.

**Entropy.** Moving things or putting them into motion—and the reverse—forms the Universe’s two most generalized forces: entropy and inertia. **Entropy is the tendency for all forms of energy to dissipate:** to “stop” or “come to rest,” or to “evolve toward a state of inert uniformity” (American Heritage Dictionary, 2008). Engines and motors stop running without a fuel or power source, as do staff without food or sleep.

**Inertia.** Inertia is the tendency for objects in motion to remain in motion, and objects standing still to remain in their places (Webster’s, 1996). Inertia is related to entropy in that entropy is the process of inertia’s motion slowing down until it stops. Sisyphus’s rock wants to stay at the bottom of the hill (inertia), and will roll down the hill as long as gravity pulls it (entropy).

However, the people we serve enjoy waves and wind, so if there are no waves or wind, we create wave-pools and skate parks, and wind tunnels to simulate sky-diving. People desire mountains, and we build climbing walls when mountains are not available. People want cricket pitches and soccer fields and tennis courts, so we grade the land and plant sod and landscaping, and lay asphalt pads and install fences and lighting.

But then the forces of entropy and inertia go to work. The water in the wave-pools wants to be calm, so machinery needs to constantly re-create the waves, the skate parks require repairs to chipped and scarred surfaces, and the wind-tunnel turbines require electricity. The climbing walls must be inspected to ensure that gravity hasn’t compromised its structure, asphalt needs to be re-sealed to prevent its disintegration, and fences must be protected from rusting. And staff grows weary from the never-ending work.

**The Five “Spheres”**

The idea of entropy and inertia as the core of a system is made more practical by breaking it into smaller bits for analysis of root causes and implementation of customized solutions, particularly in light of the many aspects of managing maintenance operations. Some of the root causes involve the normal action of the forces of nature. Conversely, people constitute their own potential force: actions great and small result from their decisions. One useful approach (Uhlik, 2006; Uhlik, 2007) is to divide the world into the physical or natural environment, and the human or cultural environment (see Exhibit 13.3a).

**Human Relations to the Natural Environment**

The physical/natural environment is defined as forces and processes, and their effects, occurring in the “natural world” independently of human influence. The sun shines and the winds blow; plants grow and animals nest; rain falls and rivers flow; mountains rise and hillsides slump. These events happen without human intervention. When they occur in humans’ recreation and leisure spaces, however, the spaces are impacted by these forces of nature.

The human/cultural environment is defined as forces and processes, and their effects, initiated by humans or resulting from their presence within actual or virtual environments: skydiving, planting and cutting grass fields, building “spraygrounds” and retention basins, and constructing recreation and leisure facilities.

Entropy and inertia may be the most generalized forces, but they are more familiar to people as the four or five natural, “elemental” forces imagined by Greek and Hindu philosophers (Larson, 1969; Waterfield, 1996). Alone or in many combinations, this system of forces produces any and all of the maintenance and operations problems in the world, and in managers’ back-yards. Recognizing the typical results of these combinations allow managers to predict what could happen and be proactive, or explain why what happened did happen and react appropriately.

Drawing on the ancient elemental forces produces a more detailed system made-up of five “spheres” (see Exhibit 13.3b) named according to their Greek root words: atmosphere, biosphere, hydrosphere, lithosphere (the natural environment), and a new term: anthroposphere (the human environment). The four spheres of the natural environment are examined first, while the anthroposphere will be discussed in the Maintenance and Operations section. It is important to remember that these five spheres interact with each other within the system, and recognizing these interactions enhances maintenance operations managers’ abilities to achieve high performance.

The atmosphere is defined as that portion of the inorganic environment extending outward and away from a surface, and consists of the following attributes:

- “air” (gasses);
- temperature;
- humidity;
- pressure;
- radiation (e.g., sunshine); and
- wind (circulation).

Although the force or energy of the atmosphere may carry other substances, such as spores, rain, and dust, these substances retain the elemental association
with their respective spheres (bio-, hydro-, and litho-). The fact that each of the four spheres is capable of “carrying” any or all of the others reinforces the systems approach, which makes these links more obvious.

The biosphere is defined as that portion of the organic environment exclusive of human beings, including:
- plants;
- animals;
- insects;
- molds and fungi; and
- bacteria and viruses.

The hydrosphere is defined as that portion of the environment comprised of non-gaseous fluids, usually water (H₂O). Note that at interfaces (discussed below), the hydrosphere can exist as transitional forms, such as ice or steam. Similarly, its force or energy (like the atmosphere’s) can carry other substances, as in quicksand or so-called red tides. More “pure” forms of the hydrosphere are:
- precipitation falling through the atmosphere (e.g. rain, snow);
- surface water (exposed on the lithosphere, e.g. rivers, ponds); and
- ground water (enclosed within the lithosphere, e.g. aquifers).

The lithosphere is defined as that portion of the inert environment composed of solids extending inward from their surfaces, and composed of one or more of the 117 elements (from actinium to zinc) of the Periodic Table from which all other substances are created (Scerri, 2006).
- “The ground” extends from a solid’s surface to its core; and
- Gravity is a function of a solid object’s mass.

The solids that compose the lithosphere are many and varied, and this chapter also will include transitional forms concocted by humans, such as concrete and asphalt slabs or pads, brick walls, etc.

Each of the spheres further can be divided on the basis of whether they occur “outside” or “inside” (see Exhibit 13.3c).

The external environment, or outside, is defined as the aspects of the spheres as they exist outside of an envelope, in “the world” so to speak. The term envelope will be explained below.

In contrast, the internal environment, or inside, is defined as the aspects of the spheres as they exist inside an envelope, inside a recreation center, for example.

A third way of looking at phenomena and objects is whether they are “natural” (relatively untouched by humans), or artificial (created by humans). Each of these has its own characteristics and capacities, and their associated risks and benefits, such as environmental impact, and initial cost.
Natural objects are those portions of the physical environment existing in a form resembling, to some degree, their original state, e.g., a tree, or objects made from it, such as wooden beams.

Artificial objects and environments are created by humans from materials that either do not exist in nature, or are greatly modified, e.g., plastic “wood,” or graphite fibers used in the manufacturing of sports equipment.

Geographic Information Systems

Entropy and inertia, and the five spheres, have been explained here in “geographic” terms, and the link between these geographic components and the information technology central to the systems approach is geographic information systems (GIS), also referred to as geographic information science (Longley, Goodchild, Maguire & Rhind, 2005). Every force and associated phenomena has an actual or virtual location: a space or place, and every recreation and leisure space or place requires maintenance. What GIS creates is a way for managers to assign a location to every maintenance task, and attach to that location to almost any other pieces of relevant information relating to the maintenance of that location.

Principle. Geography is everywhere; all physical phenomena and many abstract ones are not randomly spaced or placed, and not only can, but should, be distinguished from one another (Longley, et al., 2005).

Essentially, GIS classifies all spaces and places roughly according to the four dimensions of geometry:

<table>
<thead>
<tr>
<th>Dimension Name</th>
<th>GIS Term</th>
<th>Number of Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Point/vertices</td>
<td>0-D</td>
</tr>
<tr>
<td>Line</td>
<td>Line</td>
<td>1-D (length)</td>
</tr>
<tr>
<td>Area</td>
<td>Polygon</td>
<td>2-D (length and width)</td>
</tr>
<tr>
<td>Volume</td>
<td>Raster/vector</td>
<td>3-D (length, width, and other properties)</td>
</tr>
<tr>
<td>Space/time</td>
<td>Modeling</td>
<td>4-D (motion through space and/or time within a given time span)</td>
</tr>
</tbody>
</table>

Based on the classifications, above, five “Ms” are enabled (Longley, et al., 2005):

- measurement;
- mapping;
- modeling;
- monitoring; and
- management.

A key GIS concept is a georeference, which allows each item of interest (record) to be “tagged” or identified by its geographic characteristics. A georeference is:

- unique: no other feature is exactly like it, within the context being examined;
- shared: every person examining the feature agrees about the feature’s defining characteristics;
- persistent: the feature is permanent or has longevity throughout the passing of time (Longley, et al., 2005).

Typical georeferencing data include latitude, longitude, elevation, and “sphere” association. Once all GIS data is collected and georeferenced, it can be displayed in tabular, or more commonly, mapped formats. Several software packages have been developed for those purposes, most notably the ArcGIS series of integrated software applications created by the Environmental Systems Research Institute, Inc. (ESRI).

Geographic information systems emerged in the 1960s (Longley, et al., 2005) as computers, and their ability to handle large amounts of raw data, became increasingly affordable and available. Originally, GIS’s main function was to manage the collection, storage, and analysis of spatially (geographically)-associated information for the federal and state governments, and large businesses.

Prior to the advent of GIS, maps and mapped information was hand-drawn on translucent sheets of vellum, which then could be layered on each other and viewed on a light-table. Now that powerful computers and sophisticated software are commonly available, and that large databases have been assembled by upper-level government agencies and businesses, GIS systems have evolved into GIScience (Longley, et al., 2005), providing individuals and agencies with powerful decision-making capabilities based on sophisticated analyses.

For example, in preparation for the 1980 U.S. Census, many county-level agencies received federal funding to digitize their road maps, which then were integrated to form a large database encompassing most of the United States. The digitizing of census tracts and blocks soon followed, creating the foundation for many other governmental and business data-collecting uses, including demographically-based funding and market analysis.

Geographic Positioning Systems

As important as systems data is to management of maintenance operations, the focus should remain on
place: the actual facilities. Thus, any data always must
be associated with a particular location. An important
development enhancing this georeferencing process is
the Geographic Positioning System (GPS), consisting
of a network of geosynchronous satellites orbiting the
earth that transmit and receive radiotelemetric signals.
By means of the triangulation concept, an instrument
called a GPS transceiver interprets signals exchanged
with several satellites orbiting overhead nearest to the
operator’s physical location, generating an electronic
display of georeference coordinates.

For example, if a parks agency is retrofitting its
facilities to comply with the Americans with Disability
Act Amendments Act (U.S. Department of Labor,
2009) accessibility standards, curb-cuts and restroom
locations first can be mapped using GPS. Then, their
conditions and requirements are described numerically,
allowing them to be prioritized, assigned, and tracked
according to a schedule developed within a GIS.

Within the systems approach, management plans,
policies, programs, and procedures, and the inspection
and assignment schedules and records on which they
are based and evaluated are not complete and reli-
able until all data are interconnected among all their
aspects.

Steve Lohr (2009) defines smart infrastructure as
being “more efficient and environmentally friendlier
systems for managing, among other things, commuter
traffic, food distribution, electric grids and waterways,”
made possible by the technological developments in all
of the “systems” described above. The combination of
cheap sensors, a dense, fast communications network,
and sophisticated computer software and hardware is
enabling maintenance operations managers to make
better decisions more quickly, based on more complete
and current information.

It is no coincidence that a variety of vendors offer
software that is compatible with other platforms (e.g.
GIS with Computerized Maintenance Management
Systems: CMMS) or with Computer Assisted Drafting
(CAD) software, and some feature open-source coded
software enabling in-house staff to customize the appli-
cations. The integration of hand-held GPS devices and
GIS software also is currently available. A partial list of
GIS web sites is available in the Resource Section. (See
Chapter 14, Information Technology Management.)

Facilities, Areas, and
Envelopes

As a system, entropy, inertia, the five spheres, and their
components together form the environmental context
that influences recreation and leisure spaces and play-
ces: commonly known as facilities and areas. However,
although the word facility brings to mind a building
of some kind, a recreation center is not the same as
a stadium. Similarly, the meaning of area could be as
variable as a forest, a meadow, or a sports field. Because
moment-to-moment conditions are location-specific,
the systems approach encourages more precise defini-
tion of the terms “facilities” and “areas.”

Principle. One of maintenance operations managers’
basic duties is to design and adjust their facilities’ level
of development to the ability of those facilities to sustain
that level of development.

Many communities still classify facilities based
on level of development. Developed sites are character-
ized by facilities accommodating high-density use that
requires a high degree of maintenance and continuous
site supervision and management and are categorized
as follows:

• buildings. Buildings that serve the public,
  including: community centers, fitness cen-
ters, and nature centers/interpretive facili-
ties. Buildings that serve park and recreation
  employees, including: administrative build-
 ings, maintenance facilities, utility structures,
  and employee residences;
• special facilities. Golf courses, marinas, zoologi-
cal exhibits, botanical gardens, historical prop-
erties, etc., represent special facilities that often
  require an admission or user fee;
• day-use areas. Aquatic facilities, picnic areas,
  athletic facilities, and playgrounds are exam-
  ples of typical recreation day-use areas and
  may represent the majority of park and recre-
  ation developed sites;
• overnight areas. These include campgrounds,
  lodges, and group camps;
• support facilities. Food service, restrooms, rental
  structures for canoes, bicycles, etc., represent
  support facilities used by the public to enhance
  convenience and enjoyment of the area. The
  helpful concept introduced above is develop-
  ment, explained as the intensity (numbers and
  frequency) with which humans visit and utilize
  a leisure or recreation site. Thinking of devel-
  opment as intensity allows for identification
  of three additional conditions: undeveloped,
  underdeveloped, and overdeveloped (see
  Exhibit 13.4).

Viewed from a systems perspective, an alternate
way to classify these venues is according to how people
have transformed the natural environment to suit their
cultural needs (as discussed in the Five Spheres sec-
tion, above). This scheme makes distinctions among
facilities, areas, structures, buildings, and envelopes, which then allows the previous idea of “development” to include humans’ intended relationship to the natural environment (see Exhibit 13.5). These relationships are managed on a day-to-day basis through decisions and actions that sustain the facilities, rather than wear them out.

**Principle.** As more of the four forces are modified to achieve desired facility-related outcomes, the degree of maintenance operations management increases.

Grading a natural area to create a field may eliminate tripping hazards caused by uneven ground (lithosphere) and plant roots (biosphere), but then requires seasonal rolling and pest control. Adding a structural component by laying an asphalt or concrete pad over the graded area—or installing artificial turf—further protects participants from the lithosphere (getting dirty) and also the hydrosphere (puddles, or saturation), but then requires periodic cleaning or sealing and re-striping. Enclosing the field with screens or walls mitigates the wind, and adding a pavilion overhead protects against the sun and rain (atmosphere and hydrosphere), but then requires HVAC and perhaps artificial lighting. Often, creating the inside-outside divide mentioned earlier can double the amount of work, as well as introducing a whole new set of maintenance and operations functions (see below).

**Facilities.** According to its original meaning, a facility must “facilitate” the achieving of goals or expectations: that is, “to make easy or less difficult; to free from difficulty or impediment; to lessen the labor of” (Webster’s, 1996). In recreation and leisure therefore, facility is an all-inclusive term that refers not only to buildings but also to areas and everything in between. The sport of field hockey, for example, is facilitated by having an actual field on which to play, but the field is not a building.

**Areas.** An area is a facility defined as any portion of external geographic space (the natural environment) intentionally delimited for a defined use; it is exposed to the influence of all four physical forces. Imagine standing at the edge of a meadow located in a National Wilderness Area. Literally, it is an area as defined here, largely untouched.
by human activity, but contained within boundaries created by human intentions—to preserve it for a defined use in this case as untouched true wilderness: nature in all its glory and fury.

**Structures.** Structures occupy areas, but consist of supplies, materials, and/or equipment placed or constructed on or around areas according to the requirements associated with a particular leisure or recreation pastime or activity. They also may be “buildings,” but not necessarily. A tennis court is a structure that is not a building, so is a jungle-gym or play-structure.

**Buildings.** Typically, a building is a *well-constructed, permanent space enclosed within an “envelope.”* A building can be considered a structure, but it is not an area.

**Envelopes.** An envelope is an *artificial structure that completely separates the external environment from the internal environment enclosed within the envelope, and attempts to mitigate the influence of external physical forces.* It may be temporary or permanent, mobile or stable, compact or massive, ranging from a mountaineering tent to a multi-use recreation center. In both metaphorical and literal senses, an envelope represents the anthrosphere’s essence. It fulfills people’s desire to achieve complete physical separation from the natural environment, and results in the substitution of artificial systems for their natural counterparts.

Within a systems approach, then, facilities exist on a continuum ranging from “pure” areas to “pure” envelopes—with various types of structures in-between—according to the degree to which they enhance recreation and leisure by shielding or protecting people from the four spheres of the natural environment (see Exhibit 13.5). Thus, each can be assigned a numerical value by type—along with a specific GPS location—which allows them to be integrated into GIS (See Roanoke maintenance plan in the Compendium 13-1).

**Principle.** Breaching an envelope, like cutting your skin, creates conditions for letting the inside out, and the outside in.

The envelope’s atmosphere is completely controlled for temperature, humidity, purity, and sometimes even scent. The presence of living things is highly controlled; most creatures are considered unwanted intruders, and even plants may be artificial rather than living. The hydrosphere is confined to pipes, fixtures, and features. The lithosphere is carefully engineered and constructed to shield its inhabitants from the forces of the external environment, even so far as to include earthquakes, floods, and tornados. All of these attributes, of course, become matters for maintenance operations management.

Immediately it is clear that maintenance operations management requirements increase substantially from area to envelope. What once was a turf field (an area) needing occasional watering, mowing, and relining now (as a field house) requires an up-front capital investment, monthly utility expenses, an expanded and site-dedicated staff, and increased security and insurance. Further, constructing an envelope results in the need to manage two systems simultaneously: the four forces as they exist in the external environment, and those same four forces as they occur internally within the envelope’s artificial environment.

**Maintenance and ops**

Misspelling? Yes. Mispronunciation? No. This *is* the way many recreation and leisure professionals and even the people they serve recognize the two terms: inseparable, with one always following the other. Yet, like a pair of identical twins, maintenance and operations are both individual *and* closely related. Further, the distinctions that can be made between the two are just as important as the similarities.

**Principle.** Without maintenance, nothing gets done. Without operations, no one knows what to do, or who will do it.

The photocopier is broken, but no one bothered to call the 800-number when the warning message appeared in the menu window. The recreation center’s doors are locked, so the front-line staff members—who have arrived on time—are stranded outside the building. These typical vignettes illustrate the principle, above; performing preventative maintenance on the photocopier allows the operations staff to do its job, just as operations staff remembering to schedule someone in maintenance to unlock the doors assures staff and patrons that the building will be open as advertised.

Despite this importance, very little research has been conducted into “how” maintenance and operations work together as an integrated *system.* Conversely, the simplicity by which the public understands “maintenance and ops” often has been summed in two words: grass and garbage. As Fletcher and Fletcher (2003) discovered,

34 percent of visitor satisfaction variance was predicted by ratings in just two categories of items: park maintenance and park personnel. Park managers who concentrate their efforts on these two manageable and demonstrably important features of the park experience—by assuring maintenance and cleanliness of the park and by training employees and their behav-

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Exhibit 13.5
The Facilities Continuum

**AREA**

- *Natural Area*  
  (all four forces unmodified)

- *Area graded flat and seeded with grass to form a field*  
  (biosphere and lithosphere modified)

- *Concrete pad creates a court*  
  (lithosphere modified)

- *Fencing and windcreens added*  
  (atmosphere modified)

- *Roof added creates a Field House*  
  (atmosphere further modified)

- *Solid walls added*  
  (all four forces modified)

**ENVELOPE**
ior—should produce measurable and documentable increases in park visitor satisfaction (p. 21).

The general public is not aware that manicured turf and litter-free facilities, including restrooms, result from well-managed maintenance operations, a conceptually based, coordinated sequence of decisions and actions called the systems approach.

“Stuff” and Staff

*Maintenance is defined as actions performed to ensure that components related to the physical/natural spheres or forces continue to function at expected levels of efficiency and effectiveness.* Maintenance functions and aspects consist of:

- spaces and surfaces that require maintenance;
- materials and substances needed to accomplish maintenance objectives;
- supplies, consumed in process of applying materials and substances; and
- standard or specialized equipment and systems, consisting of longer-lived reusable items or “networks.”

*Operations is defined as decisions made to ensure that human/cultural systems achieve desired levels of efficiency and effectiveness.* Operations functions consist of:

- staffing: hours of operation, recruitment, selection, training and development;
- finance: budget, and accounting;
- safety: protection of patrons and staff;
- security: protection of facilities;
- communications: information/technology;
- logistics: moving “stuff” (supplies, trash, deliveries), and the means for moving the “stuff.”

It should be no surprise that these two definitions are similar in form and structure, given their close association. However, comparing and contrasting several of the definitions’ key words clearly reveals their different emphases.

Actions Versus Decisions

This comparison describes the essence of maintenance and operations: maintenance is “doing” (and the stuff to do it with) and operations is “deciding” what needs to be done. Simply, actions are *procedures undertaken to produce intended results*. Actions are implemented decisions, with decisions ideally being made before actions are taken. Conversely, a decision will not be fulfilled until a corresponding action is performed, so a decision is the *choice to act*. If managers want to reduce lighting costs, they determine the revised schedule and assign someone to re-set the timer; when a staff member re-sets the timer, the savings begin to accrue.

Principle. The four natural forces, and their sphere’s components and phenomena, are measurable and predictable: humans’ capacities are much less so.

Function Versus Achievement

Equipment and supplies are manufactured to perform at prescribed levels, often determined by test-based standards. A floor detergent diluted according to instructions will clean a specified number of square feet. A steel girder is rated to support a specified amount of weight. A swimming pool pump will filter a specified number of gallons per specified time-frame to achieve specified water clarity. An important corollary concept is “original state” or “acceptable condition”: an established, recognized quantity or quality. Standards are an essential part of both function and achievement.

In contrast, the range of human performance is much more variable, and possesses great potential. Whereas a machine's optimal functioning and absolute limits can be known, people’s performance often is relative to the context in which it occurs. Certainly, staff performance standards can be set and evaluated; but one satisfying role maintenance operations managers play is to set high standards and then provide the training and development that empower staff to actually achieve their potential.

Expectation Versus Desirability

When a standard has been set based on previous testing, the resultant *rating* becomes an *expectation* for performance level. Thus, the swimming pool pump mentioned in the previous paragraph is expected to pump at its rating, but neither more nor less. An operator might want the pump to work more quickly, but does so at the risk of breaking the pump. Staff also can be expected to perform their duties at some given level, but managers desire staff behavior that exceeds expectations. A second management role is to inspire the desire to exceed expectations and reward staff for doing so.

Efficiency Versus Effectiveness

Efficiency results from investing the fewest “resources” toward accomplishing a task. Effectiveness is the degree to which the task is *fully* accomplished. For example, if a one-gallon tank of gas is needed at the bottom of a ravine—to refuel a chainsaw—the gas tank could be thrown through the air down to the waiting operator. The only investment is the minimal energy needed to toss the tank; gravity does the rest, and quickly, too. The risk, of course, is substantial. Conversely, a staff member could slowly and carefully walk down the side of the ravine to safely deliver the gas, but would invest much more time while wasting the time of the waiting chain.
saw operator. An optimal solution might be to slide the gas tank along a rope strung between the top and bottom of the ravine, keeping control of the tank while allowing gravity to do its work. A third management duty, therefore, is to recognize that, in the quest for desired achievement, efficiency must balance effectiveness, and vice versa.

The Systems Approach: Analysis Before Action

Earlier in this chapter, it was stated that the variable and unique circumstances faced by individual managers makes it difficult, if not presumptuous, to offer specific solutions to particular problems; providing a systems approach, however, would give managers the flexibility necessary to devise customized answers. To fulfill that promise, the system's structure was revealed as being comprised of:

- the universal imbalance of energy expressed as entropy and inertia, which managers attempt to balance;
- the five spheres within which entropy and inertia display their forces: four natural, and all that is "human";
- an understanding that the spheres operate both outside and inside: facilities ranging from areas to envelopes;
- an understanding that the spheres' forces often act together, overlapping at two or more interfaces; and
- operations and maintenance functions expressed as decisions and actions.

Now it is time to explain how the systems approach enables recreation and leisure professionals to manage well, to create the high-performing maintenance operations that insure quality experiences through well-managed spaces and plays described in this chapter’s first principle.

Each situation faced by a manager, whether common or unique, is an incident (or potential incident) representing an imbalance of energy (forces), involving one or more spheres (interfaces), requiring decisions and actions that account for the relevant maintenance and operations functions and aspects.

To illustrate, take a look around you: right now, wherever you happen to be reading this chapter. Examine your immediate environment. If you’re having a good day, everything surrounding you appears to be balanced. If you’re within an envelope, the structure is stable, nothing is leaking in or out, the power is on, and all human and mechanical systems are humming along with efficiency and effectiveness. Fabulous, yes? Well, yes and no.

What seems to be comfortable and calm actually is but a momentary balance: the illusion of stasis. Almost invisibly, imperceptibly, entropy and inertia are at work. So, let's make a list analyzing current conditions for maintenance and operations functions. Maintenance functions include:

- spaces and surfaces: How’s the air in there (temperature, humidity, freshness, circulation, etc.)? Do you have enough (or too much) lighting, and is it artificial or natural (or both)? Any plants to water or dust (any spiders nesting in the corners)? Is the fire suppression sprinkler operational? What about the flooring, the walls, and the ceilings? (Note how these questions involve the atmosphere, biosphere, hydrosphere, and lithosphere, respectively.)
- materials and substances: Do you know the properties of the paint used for the walls, the composition of the carpeting, the dilution of the window washing liquid, or the fire resistance of the ceiling tiles?
- supplies: Do you have paintbrushes and drop cloths, spare collection bags for the vacuum cleaner, replacement squeegee blades for the window wipers, and replacement ceiling tiles in storage?
- standard or specialized equipment: Are the air handlers rated for the recommended amount of air circulated? Do you need an ionizer to control dust? Are the thermostats working properly? Are you using live traps to capture wayward critters? Is the water pressure in pipes being measured?

Operations functions include:

- staffing: Have you scheduled anyone to check the air filter, oil the blower, test the thermostat, vacuum the floor, wash the walls (and windows, inside and out), and change the light bulbs?
- finance: Have you budgeted for the people you’ve scheduled, the materials, supplies, and equipment they’ll need to accomplish their tasks? Do you have a “rainy day” account for unexpected repairs or replacements?
- safety: Do you conduct regular safety audits and training sessions? Do you have an evacuation plan? How long ago did you conduct a mock emergency drill?
- security: Are the air exchanges protected from tampering? Are materials and supplies carefully stored and inventoried? When was the
last time you met with your security chief, or the local police liaison?
- **communications**: (information/technology)
  How many methods exist by which your staff can contact you and each other? What about the people you serve? Have you planned for any upgrades?
- **logistics**: moving “stuff” (supplies, trash, and deliveries): Are you utilizing a “just-in-time” ordering and delivery system? Are you providing “green” transportation alternatives for your staff? Do you own and dispatch your fleet?

Analyzing the maintenance operations environment using a systems approach provides a framework of common questions creating individual customized lists on which schedules and evaluation forms can be based. However, it is not likely that any two managers will generate identical items. Within an envelope for example, the atmosphere may be the concern; at an aquatics center, the hydrosphere; in a natural area, the biosphere, etc.

**Principle.** Wherever one of the spheres is abundant, its force will be the dominant opponent.

Communities located along Lake Erie’s southern and eastern shorelines experience 300 days of partial to full clouds, abundant rain in spring and fall, substantial snow in the winter, and violent thunderstorms in the summer. Rivers flood during all seasons, unprotected soils erode regularly, and basements fill with water. Numerous puddles and standing water provide prime mosquito breeding sites during the summer, and road salt applied to melt winter ice creates pavement potholes from frost-heaving conditions, as the temperature fluctuates between below 0 degrees Fahrenheit in the winter and the upper 90s in the summer. Tornadoes are a possibility in all but the dead of winter.

Conversely, communities located in California’s San Francisco South Bay area enjoy 300 days of full sunshine, but pray for enough precipitation during the rainy season, and often are subjected to drought conditions, water rationing, and wildfires. The roads get dirty and a multitude of cars raises dust and contributes to ozone alerts. Termites feast on houses’ wooden frames, and summertime temperatures sometimes reach or exceed 100 degrees Fahrenheit. Earthquakes are an ever-present possibility.

Catastrophic forces exert themselves in the spheres: tornadoes and windstorms, hurricanes and typhoons, earthquakes and volcanic eruptions, floods and tsunamis, infestations and epidemics, tragic accidents and terrorism. Each of these calamities has resulted in the development of codes, regulations, policies, and procedures intended to lessen or minimize the effects of nature’s fury and humans’ negligence and treachery.

The interface between maintenance and operations is most evident in the decisions and activities that result from either proactively planning for the consequences of the spheres’ overlapping forces, or in reacting to them. Increasingly, these decisions and actions are driven by analyses enabled by technology: the systems approach.

**Interfaces and Critical Incidents**

An interface is defined as the **dimensional context in which two or more spheres or forces overlap or interact.** The intensity of that interaction is related to entropy and inertia. When energy is added to the system (entropy is lowered), these elements become forces (inertia in motion). The effects of each elemental force on the other four occur at the interfaces.

Although all five spheres act as a system, note that the anthrosphere is placed in the middle of Exhibit 13.6, overlapping the four natural spheres in equal measure. Symbolically and historically, humans have put themselves in the center of all things, but the arrangement of spheres in the exhibit shows that maintenance operations (as an anthropic activity) is built on managing the four natural spheres for the benefit of the fifth. Further, while the four natural spheres can exist independently of human involvement, the diagram also emphasizes that humans absolutely are dependent on the other four. It is because of this dependence that maintenance operations management is necessary.

The individual numerals arrayed symmetrically across Exhibit 13.6 indicate the number of spheres that create the interface at that location. As mentioned, each of the four natural spheres can exist independently of the others, but in practice they seldom do. As a result, the forces associated with those spheres potentially interact in a myriad of ways, producing a wide range of consequences. The manager who can conceptualize this plethora of possibilities, and who plans accordingly, will not often be caught by surprise.

**Principle.** As the number of overlapping spheres (interface level) increases, the number and complexity of maintenance and operations issues also increases.

A park area surrounding a beautiful lake formed by glacial deposits damming an ancient river experiences the weather for most of the year as pleasant and calm, and entropy rules the day. Imagine a powerful storm develops. Water from the heavy rain begins to fill the lake, and a strong wind creates waves that begin to erode the shore. At the storm’s peak, the wind-driven waves breach the glacial dam, sending a torrent of water
cascading downhill, uprooting trees and moving tons of earth.

The dam did not fail solely due to the amount of additional rainwater, nor was it only the sand and gravel comprising the glacial till that caused the dam to fail. It was the combination of the high water (hydrosphere) and the wind-raised (atmosphere) waves that made the dam's soil (lithosphere), and the trees downstream (biosphere), vulnerable to attack.

The “normal” low entropy state was only temporary, as the storm’s energy converted “resting” inertia into “energized” inertia, which spent that energy by rearranging the park. The next morning, after the storm’s energy had dissipated, calm returns as high-state entropy, temporary though it was, is restored. Exhibit 13.7 represents a generalized chart providing managers with examples of forces combining at interfaces in the external environment.

Understanding the typical outcomes occurring when any two or more spheres and external forces interface is made simpler by constructing a table, as above. Each cell represents the interface of two spheres, and the addition of a third dimension or axis can be accomplished by converting the cells into cubes. GIS, of course, accomplishes this automatically, providing that appropriate data, including GPS coordinates, has been collected and input.

**Principle.** Every external natural force or process has an equivalent internal force.

Returning to the glacial lake vignette—but bringing it inside an envelope—imagine managing an indoor environment.
aquatics center. One afternoon, a large group of raucous high-school students converges on the hot tub. Before the lifeguards can react, all of the kids have jumped into the hot tub. Their combined body mass displaces an equivalent measure of water, raising its level. Immediately they begin splashing and sloshing, and the pool deck suddenly is covered with an inch of water. At that moment, a passerby slips in the water and is injured; a lawsuit soon follows. Exhibit 13.8, below, represents a generalized chart providing managers with examples of how forces combine at interfaces within the internal environment.

**Legal Considerations**

As described in the previous scenario, human interactions with forces occurring at the interfaces are not always positive, and as a result, many local, state, and...
federal regulations have been developed that affect the operation of recreation and leisure organizations. As public concerns about the environment, public safety, employment conditions, and human resources have increased, the number, type, and scope of laws, policies, rules, and regulations with which the recreation and park organization must comply have expanded at a corresponding rate. Therefore, it is essential that someone in the organization be charged with the responsibility of reviewing and becoming familiar with all applicable regulations and their impact on the organization.

In many organizations, the human resource or safety personnel assume that responsibility, but whoever takes-on this role should be proactive in developing compliance policies and procedures, and in minimizing their impact. At minimum, a record-keeping system must be established to ensure that employees who need specialized training in areas such as pesticide application, confined space, or respiratory protection actually receive the training, and that it is recorded in their personnel file and in special compliance files for each applicable regulation. The systems approach enables incident record keeping to be integrated into the larger organization database, allowing in-depth analysis of contributing factors.

It also is important to keep participants and employees informed about significant safety and health issues that may affect them. Both the employer and the employees have a responsibility to ensure that programs, areas, and facilities are as safe as possible for visitors and staff, including minimizing health risks. In addition, employees are obligated to work safely, to wear appropriate protective equipment when required, and to quickly report accidents and hazardous conditions. Employers are obligated to maintain a safe working environment, provide proper tools and equipment, train employees, and maintain records about occupational injuries and illnesses.

The principal agency charged with promoting and enforcing workplace safety is the Occupational Safety and Health Administration (OSHA), created through the Occupational Safety and Health Act of 1970. Its mission is “to insure safe and healthy working conditions for working men and women,” and during the past 38 years, the department has promulgated standards expressed as approximately 50 “Parts” (OSHA, 2008).

With regard to facilities and equipment, the Consumer Products Safety Commission (CPSC) was created in 1972 through the Consumer Product Safety Act to protect “against unreasonable risks of injuries associated with consumer products,” protect consumers against unreasonable risk of injury by developing voluntary and mandatory standards, ban dangerous consumer products, issue recalls of products already on the market, and research potential hazards associated with consumer products. CPSC learns about unsafe products in several ways. The agency maintains a consumer hotline and Internet site through which consumers may report concerns about unsafe products or injuries associated with products. The agency also operates the National Electronic Injury Surveillance System.

In 2008, the United States Congress passed the Consumer Product Safety Improvement Act, which took effect in February, 2009. The sections most applicable to recreation agencies relate to children’s safety:

- products containing lead, and lead paint;
- mandatory third-party testing for certain children’s products;
- tracking labels for children’s products;
- standards and consumer registration of durable nursery products;
- labeling requirement for advertising toys and games;
- mandatory toy safety standards;
- study of preventative injuries and deaths in minority children related to consumer products;
- prohibition on the sale of certain products containing specified phthalates (contained in plastics like PVC).

Also relevant sections are:

- All‑terrain vehicle standards;
- Study on use of formaldehyde in manufacturing of textile and apparel articles;

Regarding Section 107 more generally, the National Playground Safety Institute (NPSI) has ranked the following causes of playground injuries:

1. improper protective surfacing;
2. inadequate fall zone;
3. protrusion and entanglement hazards;
4. entrapment in openings;
5. insufficient equipment spacing;
6. trip hazards;
7. lack of supervision;
8. age‑inappropriate activities;
9. lack of maintenance;
10. pinch, crush shearing, and sharp‑edge hazards;
11. platforms without guardrails;
12. equipment not recommended for public playgrounds.

Although “lack of maintenance” appears later in the list, each of the 12 causes clearly falls within
the purview of maintenance operations management (NPSI, 1999/2000).

Facilities requiring special attention include swimming pools, playground equipment, and the vehicle-pedestrian circulation interface. In response to incidents relating to Item 4, above, the Virginia Graeme Baker Pool and Spa Act (VGB) mandates that all public pools must be equipped with certified drain covers or grates that meet the required standards and safety measures. The American Society for Testing and Materials (ASTM) has set forth playground safety standards.

One outcome of the VGB was a Consumer Products Safety Commission (CPSC) directive, which stated that pools that operate year-round must comply by December 19, 2008: all public pools must be equipped with certified drain covers or grates that meet the required ASME/ANSI A112.19.8-2007 standards and safety measures to prevent entrapment and evisceration. The implementation of this act created a hardship for the majority of operators in all sectors in that no manufacturer existed from which operators could purchase complaint equipment.

Within the decision-to-action framework previously discussed, then, several common concepts apply to each of these types of maintenance. The first is planned versus unplanned maintenance. Many types of maintenance, e.g., housekeeping, routine and preventive maintenance, program support, and scheduled improvements, can be planned ahead of time. For these types, the maintenance manager can develop a schedule before the work is started. A computerized management system automates this task.

However, many types of maintenance cannot be planned ahead of time, e.g., emergency repairs and correcting vandalism. When these types of problems occur, the maintenance manager must deviate from the planned schedule and find a way to work emergency repairs into the daily routine. One proactive measure that mitigates unplanned maintenance is the previous establishment of a “rainy day fund” to cover unforeseen incidents. Inaction in this regard could cause significant hardship.

Proaction, Reaction, and Inaction

Proaction is the decision to act before an incident happens, to intentionally shape the context in which it occurs. Proaction requires the collection and analysis of data, sometimes in large quantities, for which the systems approach is well suited. Preventative maintenance and succession planning are two examples. If an HVAC blower motor is rated for 90,000 hours, a prudent manager might schedule its replacement at 80,000 hours—before it breaks down—storing the older motor as a spare. Similarly, if a maintenance worker is approaching 25 years of work, the search for a replacement should begin before the retirement to allow continuity and proper orientation.

Among other proactive measures are preventative security measures, such as lock and key security, fencing, fire protection, signage and illumination; allocating a portion of operating income to the aforementioned “rainy day fund” to pay for emergencies; and preparing for the unexpected, a step-wise process which includes:

- identifying potential threats in consultation with safety and security authorities;
- creating an emergency operations plan containing guidelines and emergency contact information;
- developing and rehearsing facility evacuation plans—identifying safe paths and zones; and
- establishing mail-handling precautions and protocols to identify suspicious letters or packages.

These activities, and those below, fall within a broad category known as crisis management, and the systems approach governing it is known as the National Incident Management System (NIMS). Created as

Reaction involves decisions and actions made in response to an incident, to influence the outcome. An important distinction should be made here between events that are unforeseen or unpredictable, and those that are inevitable and therefore predictable. Water safety instructor certification is an example. Although drownings are not “scheduled,” they are likely, and life guards are trained to respond. In concept, the systems approach, by taking into account the potential consequences of all possible interfaces, encourages both advance planning and devising responses to each of those consequences. Fire codes are an example of proaction: the recognition that the interface between certain design and construction techniques (anthrosphere) and materials (biosphere/wood products) may result in combustion. Regulating the techniques and materials changes the context for fire. Fire drills rehearse people’s reactions to the occurrence of a fire—an effort to influence the fire’s outcome by saving lives and property.

Like reaction, inaction has two aspects. The first involves failure to collect or ignoring information, while the second is a tactic for delaying action until the decision-making context becomes more favorable. Fighting a wildfire can be more effective and safer by waiting for the winds to subside or change direction, or to bring a rainstorm. Similarly, interviewing for replacement staff to fill a soon-to-be vacated position can proceed proactively, but the actual hiring decision can be postponed until budgets improve.

**Maintenance Operations Managers’ Minimum Obligations**

Accreditation standards such as those listed in the Compendium promote following basic maintenance operations management and principles and procedures as they relate to recreation and leisure facilities (areas through envelopes). A responsible way to look at these principles is from the perspective of operators’ minimum obligations, (Sawyer, 2005) which include:

- keep premises in safe repair;
- inspect regularly;
- remove or warn of hazards;
- anticipate foreseeable uses/activities; and
- require safe conduct of normal operations.

**Facility Security and Safety**

Providing a secure and safe environment begins at the design stage, and afterward requires constant management of the facility, equipment, patrons, and staff. On many user attitude and opinion surveys, the lack of a sense of security is one of the most frequently listed reasons for why people do not use parks and recreation facilities. The responsibility for developing security measures for the premises rightly belongs to management and staff; while maintenance personnel install and keep security equipment in good condition, and perform systematic inspections.

Several national and international agencies are involved with establishing and disseminating standards that form the basis for staff training as well as security and safety equipment/supply purchases. Among them are the American National Standards Institute or (ANSI), the American Society for Testing Materials (ASTM), the International Organization for Standardization (ISO), the Consumer Product Safety Commission (CPSC), and Underwriters Laboratories (UL). Prudent managers will do well to stay current with updated standards, and even may wish to influence the process by participating in their development.

Although the type of facility and use received will greatly influence specific security functions and responsibilities, each facility should have a security plan, which includes inspection checklists for opening, closing, operating, and monitoring procedures. Items on the checklists for other safety and security functions include:

- automatic sprinklers;
- fire alarms;
- fire and security doors;
- downspouts and drains;
- electrical cabinets and panels;
- fire extinguishers;
- flammable liquids and chemicals;
- heating and air conditioning systems;
- housekeeping problems; and
- personal protective equipment.

Of course, preventative security should be a first priority, involving:

- lock and key security;
- fencing and other physical barriers;
- fire protection;
- signs and symbols;
- envisioning and training for the unexpected; and
- illumination; and
- Crime Prevention Through Environmental Design (CPTED).

CPTED was developed by the National Crime Prevention Institute (NCPI), and is defined as “The proper design and effective use of the built environment can
lead to a reduction in the fear and incidence of crime, and improvement of the quality of life” (NCPI, Inc., 2008).

Although safety for children, such as on playgrounds, often is separated from that of adults, conceptually, they are similar and may be classified as being related to the following topics:

- surfacing;
- entrapment;
- entanglement,
- sharp points, corners, and edges;
- crush and shear points; and
- trip hazards.

Similarly, a safety program that applies to children’s facilities will protect adults as well, and consists of the following elements:

- safety policy statement;
- safety audit;
- inspection and maintenance program;
- facility incident reference file;
- staff training program;
- signage and user education; and
- accessibility.

Trend: Creating Critical Incident Databases

Despite all good-faith efforts to prevent and minimize risk, unexpected and unfortunate events inevitably will occur. A longstanding frustration among maintenance operations managers is related to the inability to centralize the reporting of the seemingly innumerable mishaps occurring at recreation and leisure facilities of all types. Implementing the systems approach now permits the accurate recording and analysis of critical incidents leading to identifying and promoting proactive preventive measures.

Critical incidents are defined as “any event or situation that threatens people, and/or their homes, businesses or community [including] any situation requiring swift decisive action involving multiple components in response to and occurring outside of the normal course of routine business activities” (Jones, Kowalk & Miller, 2000, 4). The most recent edition of the Standardized Emergency Management Systems (SEMS) Guidelines (California Office of Emergency Services, 2006) combines results reported by the SEMS Maintenance System in 2001 with the California Implementation Guidelines for

Exhibit 13.9
A Model for Designing an Incident Management System
the National Incident Management System (NIMS) released in 2006. Agencies adopting NIMS follow standardized processes, protocol and procedures that use a common language and set of assumptions for “analyzing outdoor incident data, to identify incident trends for organisations and the outdoors sector, and to inform current accepted practice” (Outdoor New Zealand, 2008).

A model for designing an incident management system follows the basic program planning model (Edginton, et al., 2004) as depicted in Exhibit 13.9. The process need not begin with an incident (Step 1); proactive managers can initiate Step 2 prior to the occurrence of an incident. After all, an ounce of prevention is worth a pound of cure.

**Trend: Universal Design**

Nowhere is the systems approach more apparent than in the concept of Universal Design (UD), an architectural philosophy with wide-reaching implications for maintenance operations managers whose agencies are, of course, embedded within and dedicated to the betterment of the communities they serve. Ronald Mace is credited with creating the term to describe “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaption or specialized design . . . UD features in a product or environment are integrated into the design so that they foster social integration and do not stand out” (Burgstahler & Cory, 2008, p. 6). The seven UD principles are:

- equitable use;
- flexibility in use;
- simple and intuitive use;
- perceptible information;
- tolerance for error;
- low physical effort; and
- size and space for approach and use (Burgstahler & Cory, 2008, pp. 7–8).

Immediately, it is clear that UD not only is mindful of the large forces of entropy and inertia, but also is sensitive to the requirements desired by maintenance operations staff and the people they serve. Its influence ranges from functional design, through accessibility, to sustainability.

**Principle.** Operations managers should insure that facility designers are designing for people, and that maintenance functions are designed in consultation with maintenance personnel (Sawyer, 2005).

The people for whom facilities are designed may include a number greater than is apparent at first glance. They are:

- clients: the people who “ordered” or control/own the facility;
- users: the people who are attracted (or hoped to be attracted) to your the facilities, programs, and events;
- affected persons: these may be the immediate neighbors, or those near enough to hear the sounds or see the sights (or lights) associated with the facilities, programs, and events;
- others: this category includes people who may benefit indirectly from the facility’s operation, such as hotel owners who provide hospitality for out-of-town participants drawn to a tournament (Sawyer, 2005).

**Functional design.** Whether creating an organization “from the ground up” or having inherited a well-established existing agency, inevitably managers will encounter what generally can be categorized as facilities-related “design” issues. Most prevalent among all of them is neglecting to involve maintenance operations managers or staff when considering matters of functional design, such as:

- access to the site itself;
- circulation within the site;
- parking;
- water supply and sewage disposal;
- electrical service and other utilities as required;
- telephone/communication services;
- structures to be constructed;
- environmental concerns and climatic conditions;
- easements, zoning requirements, and other legal restrictions;
- historical significance;
- pre-existing uses;
- security concerns and nuisance potentials;
- natural features, natural barriers, and visibility; and
- economic impact and supporting demographics (Sawyer, 2005).

**The R-continuum.** A useful way to conceptualize the scope of design-related matters is by their location on the “R-continuum,” arranged by cost, complexity, or both:

- redecorate: the facility is structurally sound, but requires cosmetic/stylistic change(s);
- repair: although the facility is basically sound, minor failures need correcting;
- retrofit: the facility is structurally sound, but requires the installation of previously-omitted features;
• renovate: updating an existing facility to current standards and materials; to make new;
• remodel: a process intermediate between redecoration and renovation, usually involving modification of the facility’s spaces;
• restore: the facility is returned to original condition, including authentic materials and trade techniques;
• raze: demolishing the existing facility without replacing it, whether it was structurally sound or not;
• replace: demolishing the existing facility to make room to build a new facility on the same site;
• relocate: transporting an existing facility to another site;
• reconstruction: duplicating a previously razed facility, often on the same site, based on authentic plans and techniques (Burden, 2002);
• brand-new: constructing a state-of-the-art facility on a “virgin” site.

Design Styles and Management of Maintenance Operations
Throughout history, facilities ranging from areas (landscapes) to envelopes (structures and buildings) have reflected the cultures of the people who produced them, resulting in five general design styles, each of which presents unique maintenance challenges and operational considerations. Being aware of these characteristics informs both the design process and the management of maintenance operations after completion:

• romantic: the “original” style, intimately involved with nature and using natural materials, including structures built by indigenous peoples such as log cabins, adobes, sod houses, yurts, igloos, sweat houses, etc. Materials used include(d) animal skins, lumbered products and vegetation, and soils and rocks, which limit(ed) the scale and size, and degree of manufacture. Romantic-style structures often are susceptible to the natural forces of the four spheres, requiring extensive maintenance and limiting operations.
• classical (and also neoclassical): principally referring to more massive Egyptian, Greek, and Roman structures (although castles and cathedrals may be included). Typically built of stone and requiring more sophisticated levels of engineering and manufacture, this style is more resistant to natural forces, but the materials present their own challenges, particularly surfaces, which may stain or react adversely to certain chemicals, or exhibit difficult to clean architectural details.
• Asian: although this style is at least partially a cultural perspective, it also represents a combination of Romanticism’s use of natural materials with the grandeur associated with the classical style, such as the great palaces and walls of the Chinese dynasties. Thus, it is more resilient to and in harmony with natural forces in all the spheres, but retains some of the detail-related constraints.
• modern: constructed mainly of artificial or highly engineered or manufactured materials with unproven resilience, this style represents a direct challenge to the natural forces while also often failing to rise to that challenge. Leaks and premature material failures cause maintenance headaches and operation disruptions.
• postmodern: originally a philosophical movement rejecting the existence of one “Truth” and resisting attempts by powerful people to force their Truth on others, in architecture it became a reaction to modernism’s “function-over-form” version of Truth. Instead, this style often sacrifices performance/function for form, creating difficult maintenance problems and operation inefficiencies such as circulation impediments (anthropospheric as well as atmospheric), oddly-shaped inefficient spaces, and obstructed sight-lines. In addition, postmodern structures’ non-traditional shapes tend to cost more to design and build.

Building Codes
Ensuring compliance with building codes is generally the jurisdiction of the local governmental entity (county, city, village, township, etc.). Building codes, which encompass building processes and layout, as well as mechanical, electrical, and plumbing systems, have their greatest effect at the time of construction but also may affect certain levels of building maintenance.

The typical building code may mandate types of materials used in construction, parking spaces needed, installation of fire sprinkling systems, use of burglar and/or fire alarms, number and types of entry doors and hardware, and the number and type of toilets, etc. Many local governments require approval of construction drawings or plans and specifications, and mandate inspections and approvals by fire and building authorities before issuing an occupancy permit. Some building code requirements also affect maintenance operations (for example, a requirement that the inspector’s test valve on the building sprinkling system be activated at least once each year). Also, certain areas of the country have building codes related to earthquakes, floods, and hurricanes.
Further, local zoning and development codes regulate development, including building setback requirements, landscape standards, and density/use parameters.

**Accessibility**

The Architectural Barriers Act of 1968 (Access Board, 2009) requires that any building or facility using federal funds must be accessible to and by people with physical handicaps. Subsequently, this act was augmented by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 (ADA). Most state and local laws complement the federal ADA, requiring all public facilities to be accessible to all people.

ADA stipulations related to new or remodeled facilities and recreation areas include the following categories:

- barrier-free entries and exits;
- ease of access to seating areas, including wheelchairs;
- barrier-free access to service areas, including toilets, concessions, telephone, first-aid areas, etc.;
- exits near vehicle parking and traffic patterns;
- designated parking spots for users with physical disabilities; and
- accessible drinking fountains, fire alarms, fire extinguishers, and thermostats.

In 2004, the United States Access Board (Access Board, 2005) published specific accessibility guidelines for play areas, addressing key accessibility concerns, including:

- definitions of ground level and elevated play components;
- criteria for determining the number of required accessible components;
- criteria and design specifications for providing ramps and transfer systems;
- technical requirements for play components; and
- accessible surfacing.

While past accommodation efforts often were more associated with retrofitting facilities, recent legislation impacting maintenance operations management involves not only assuring on-going compliance within spaces and places but also with particular regard to staff hiring and development. On January 1, 2009, the Americans with Disabilities Act Amendments Act (ADAAA) Public Law 110-325 became effective. Its intent is:

- to overturn a series of Supreme Court decisions that interpreted the Americans with Disabilities Act of 1990 in a way that made it difficult to prove that an impairment is a ‘disability.’ The ADAAA makes significant changes to the ADA’s original definition of ‘disability’ that broadens the scope of coverage under both the ADA and Section 503 of the Rehabilitation Act (U.S. Department of Labor, 2009).

While retaining the essential meaning of “disability” as being “an impairment that substantially limits one or more major life activities, a record of such an impairment, or being regarded as having such an impairment,” the ADAAA:

- broadens the definition of disability by modifying key terms of that definition;
- specifying that disability includes any impairment that is episodic or in remission if it would substantially limit a major life activity when active;
- prohibiting consideration of the ameliorative effects of “mitigating measures” when assessing whether an impairment substantially limits a person’s major life activities, with one exception;
- adds a new provision restricting employers’ use of qualification standards, tests, or other selection criteria that are based on uncorrected vision standards;
- clarifies that an individual who satisfies only the “regarded as” prong of the definition of disability is not entitled to “reasonable accommodation”; and
- modifies the language of the ADA’s General Rule that prohibited discrimination against “a qualified individual with a disability because of the disability of such individual” to say that discrimination is prohibited against “a qualified individual on the basis of disability” (U.S Department of Labor, 2009).

In much the same way that accessibility reflects an ethical philosophy of inclusion, and the acknowledgement of basic human rights, sustainability represents an expression the systems approach’s philosophy of interconnectedness, and recognition of, perhaps, the basic rights afforded the entire planet that maintenance operations professionals are ethically obligated to manage well.

**Sustainability and Sustainable Practices**

The effort to balance people’s recreational and leisure desires with the ability of Planet Earth to remain “healthy” is called sustainability. Every recreation or
leisure facility impacts its environment. The extent of this impact varies from minimal, such as in a protected wilderness area, to substantial, such as results from constructing a large sports complex. Further, the impacts may vary from immediate to long-term or cumulative, and from local to global. For example, the day-to-day effect of baseball fans’ driving automobiles eventually causes wear-and-tear on roads leading to the complex (as well as producing toxic tailpipe emissions), while the use of exotic imported wood for paneling luxury loges contributes to the destruction of tropical rainforests. It is with regard to sustainability that John Muir’s quote, appearing at the beginning of this chapter, has its first application.

In many ways, maintenance operations management is sustainability, but closer examination reveals it to be a particular type of sustainability. This chapter already has discussed the concepts of development as a way to classify how “tough” or resilient facilities are, spheres and forces whose energy tangles at interfaces, and entropy: nature’s attempt to achieve the lowest level of energy investment—an eternal calm undisturbed by human activity.

In comparison, sustainability as practiced by maintenance operations managers is described more accurately as functional sustainability: attempting to make permanent what actually is only a temporary balance among the spheres’ forces so that agencies can satisfy people’s recreation and leisure needs and wants in economically viable ways. However, the energy existing in the system of spheres and interfaces is a continuing threat to functional sustainability, and so must be managed.

The great irony of sustainability, then, is that even the minimal use of a facility (in effect, investing/expending energy) for recreation and leisure also tends to degrade it. Further, once the balance is upset, the interaction of the spheres’ forces accelerates the pace of degradation. This process raises a critical question: To what degree should a given condition be sustained? What if a maintenance operations manager, many millennia ago, prevented the Colorado River from carving the Grand Canyon?

Principle. Functional sustainability and entropy fundamentally are at odds. A maintenance operations manager’s responsibility is to conserve, reserve, and preserve resources by imitating nature’s energy investment as closely as possible, even as nature attempts to reach a state of complete entropy.

The impacts of recreation activities may vary from immediate to long-term or cumulative. A cross-country hiker traversing a wilderness area introduces energy into the system by creating a path from vegetation crushed underfoot. Bright sunlight (more energy) parches the damaged plants. Later hikers are curious to explore the new path and decide to follow it themselves (more energy), killing additional vegetation. Then the rain comes (more energy) and washes-out the soil beneath the crushed plants. Ruts soon follow. Does a manager ban cross-county hiking at the outset? Does the hiker have a “right” to wander at will? Likely a maintenance team eventually will expend further energy repairing the ruts.

Thompson and Sorvig (2007) describe sustainability in terms of two basic rights: being able to satisfy people’s current needs, while (secondly) not infringing on the ability of people living in the future to do the same. From these two rights are derived 10 principles. The spheres are added in parentheses, below, to show the interconnection among the sustainability principles and the natural forces:

1. keep healthy sites healthy;
2. heal injured sites;
3. favor living, flexible materials (biosphere);
4. respect the waters of life (hydrosphere);
5. pave less (lithosphere);
6. consider the origin and fate of materials;
7. know the cost of energy over time;
8. celebrate light, and respect the darkness (atmosphere);
9. quietly defend silence (atmosphere);
10. maintain and sustain.

One way to think about sustainability is in economic terms (Carter, 1999). The assets (facilities) currently managed by an agency are like a certificate of deposit; the best scenario involves living off the interest, while leaving the principal untouched. A difficulty with this arrangement is that, while the principal’s face value remains the same, inflation in effect diminishes the principal’s actual value as time passes, and also reduces the buying power of the interest payments. Inflation is finance’s version of entropy.

If entropy seems inevitable, the following strategies empower managers’ “sustain-ability”: conservation, reservation, and preservation. The shared root word “serve” indicates that assets are to be used, in some fashion, to satisfy desired needs or wants.

Gasoline, used by every agency in some amount, provides a good example. As a limited resource, it can be conserved every day by efficiency and effectiveness:

- using fuel-efficient engines;
- maintaining the engines to achieve peak performance;
- using the engines under proper conditions and loads; and
- selecting transportation routes based on shortest distances or optimal speeds.
Nonetheless, at some point the fuel tank will be empty. To assure that a supply of gasoline will be available for refueling, bulk gasoline can be stored in reserve by the agency, refiners, or by the federal government, for example. To preserve a reliable supply of gasoline for the nation, to replenish its reserves, government representatives can enter into political and economic agreements with supplier countries. Conservation, reservation, and preservation can be applied to any aspect of the system to achieve functional sustainability.

The systems approach illuminates the interrelation among the five “hitched to everything else” (Wood, 2008), and suggests that striving for sustainability in one of the spheres will impact some aspects of the others. Consider the following observation made by Steve Carlyon, director of parks for La Crosse, Wisconsin:

We view each play-structure installation as an opportunity to rethink every aspect of the park environment and bring it in line with the sustainability goals of our department and our city. We’ll look at the lighting in the park, the concrete or paved walkways, how our landscape design can make better use of our water resources, how we can reduce fuel consumption during mowing, the types of fertilizers we use, and even the construction of green buildings and structures. None of this is particularly unique, but we are taking a more holistic approach to sustainability. We’re rethinking everything (Pinioniemi, 2009).

This conception of Earth as a living whole has its roots in pre-history (Szerszynski, 2005), but was brought into modern awareness during the 1970s environmental movement in the form of Gaia (Lovelock, 1979): the idea is that if Mother Earth is to sustain all life, humans need to recognize all life as a system, and must nurture Mother Earth in turn.

The iconic phrase “think globally and act locally,” although perhaps overused, has never been more appropriate as a sustainability mission statement for maintenance operations managers. However, the success of sustainable practices depends on applying three tactics (Carter, 1999). The first is intervention, which is both proactive and reactive, followed by integration, and involvement.

Examining and analyzing the interfaces formed by overlapping spheres identifies both existing conditions and probable incidents. Take the path-to-ruts scenario described above. Prior to the hiker’s excursion, all four of the natural spheres present in the wilderness area were balanced and entropy had been satisfied for the moment. After using the systems approach to assess the area’s development capacity, the probability that ruts would occur becomes a foreseeable outcome, and an appropriate range of interventions is planned, including forbidding access altogether, making preparations to repair the ruts when they occur, or even passively allowing the ruts to grow to form the next Grand Canyon—“letting nature take its course.”

If the decision is to conserve the wilderness area by limiting access before the ruts occur, integration is the next step. At minimum, selective promotion (to attract fewer, environmentally conscious hikers), signage, diligent inspection, prompt repairing of damage and enforcement efforts will need to be coordinated. Further, full integration requires the inclusion of other activities occurring adjacent to or outside of the area’s boundary, leading to the third tactic: involvement.

Sustainability is an individually chosen ethical position that eventually must be adopted freely among all stakeholders to be most effective. Internally, managers cultivate active involvement in this process by modeling the sustainability principles listed above while encouraging and rewarding agency staff for following suit. Involving the greater community is more complicated, however, and usually requires creating symbiosis—give-and-take relationships which benefit all parties.

In the wilderness area scenario described above, has the limited access policy disenfranchised nearby residents who formerly may have had unrestricted use of the land? Is the agency viewed as a parasite making money on the area from rich tourists at the expense of local residents? Is that money “leaking” from the local economy in the hands of outside vendors, or is it being re-circulated among stakeholders?

Ultimately, intervention, integration, and involvement manifest themselves in agencies through their maintenance functions:

- **spaces and surfaces**: To balance aesthetics and function, how large should spaces be? Larger spaces require more building materials and, typically, more energy. Will the spaces take advantage of site characteristics, such as available natural lighting, or geothermal heating/cooling? Is rough-cut cedar an appropriate wall surface, or does it present maintenance problems?

- **materials and substances**: Have projects been designed to use the minimum amount of materials, and can the remnants be recycled or reused? Are staff familiar with the environmental impacts of various substances, such as the lead content in old paint, and the types of volatiles emitted from newer paints and stains?

- **supplies**: Are cleaning supplies environmentally friendly in both use and disposal? Does the staff of the cafeteria use recyclable packaging, plates, and utensils? Does the motor pool recycle its used oil?
• standard or specialized equipment and systems: Are lawn mowers and trimmers fuel-efficient (or even electric)? Has management systems software, especially GIS, been purchased, and are old computers being properly recycled or donated?

They also manifest themselves through their operations functions:

• staffing: Have the most qualified staff been recruited? Are they being cross-trained and developed as valued human beings? Are staff encouraged to be creative and innovative, and rewarded for useful ideas? Do all staff share a sustainability ethic?
• finance: Have all operations been assessed for efficiency and effectiveness. Has financial software been integrated with other management systems?
• safety: Do all staff share an ethic of prevention, and are they empowered to shut down an area or activity if they perceive unsafe conditions? Are all staff trained as first responders?
• security: Has the most recent surveillance technology been installed, and the staff oriented toward its proper use?
• communications: Has the most recent technology been purchased, and has redundancy been built-in? Is it as close to paperless as possible?
• logistics: Has logistics software been installed, and linked to GIS and other appropriate management systems?

Principle. “Sustainability” for agencies centers around the concept of biomimetics (including xeriscapes, rain gardens, reforestation, urban forestry, and integrated pest management), recycling, as well as adopting and accommodating alternative energy sources and modes of transportation exemplified by smart infrastructures (Lohr, 2009) and complete streets (www.completestreets.org).

Biomimetics

One approach to sustainability is biomimicry, more technically known as biomimetics, which asks the fundamental question, “What would nature do?” when considering sustainable solutions to problems (Kuck, 2009). Biomimetic research, such as that appearing in the Bioinspiration & Biomimetics Journal (published since 2006), is devoted to the “study and distillation of principles and functions found in biological systems that have been developed through evolution, and application of this knowledge to produce novel and exciting basic technologies and new approaches to solving scientific problems” (Bioinspiration & Biomimetics, 2009). In other words, over time, nature has evolved methods to manage the particular forces processes present within nearly every environment. Maintenance operations managers can achieve similar balances by imitating nature’s “systems approach.” Recycling is a perfect example.

Recycling

In general terms, recycling is defined as the collecting of “products that have reached the end of their useful lives and then transforming them into highly valuable secondary raw materials that can be fed back into the manufacturing process” (Bureau of International Recycling, 2009).

As resource depletion and waste management become increasingly pressing concerns, recycling has been established as a credible, economically viable solution. Its critical philosophical distinction, with legal implications, is the view of end-of-life materials as renewable resources rather than as disposable “waste.”

This change in perception results in products being proactively designed to be recyclable, rather than having their reuse inhibited by expensive materials-separation processes.

Through entropy, nature recycles continuously as mountains are eroded to fill in valleys, and organic matter is transformed into soils. Materials created by humans, however, typically must be separated into several categories, such as paper, ferrous metals, non-ferrous metals, textiles, construction and demolition, electronics, tires, paints and petroleum derivatives, and plastics. An agency’s recycling plan, then, must account for scope (how many categories of materials) and intensity (how thorough will collections be and what amounts will be collected in relation to the agency’s capacity to process them).

The United States hosts 80 percent of the world’s recycling industries (Bureau of International Recycling, 2009), many of which support the Institute of Scrap Recycling Industries, an affiliate of the worldwide Bureau of International Recycling (U.S. Institute of Scrap Recycling Industries, 2009). Among the institute’s functions is the promulgation of the Recycling Industry Operating Standards. Agencies that have not already created recycling programs, or whose programs may be underperforming, should consider the following sequence:

• adopt a recycling ethic as an agency-wide value;
• identify the types of materials used within all agency functions;
• design both proactive and reactive policies and procedures (logistics) for collecting, storing, and transporting materials;
• integrate those plans with other local, regional, and state agencies;
• evaluate those plans for effectiveness; and
• modify the plans to accommodate changes in the human and natural environments.

LEED-ing the Way

These rights and principles, above, have been incorporated into and popularized by the Leadership in Energy and Environmental Design (LEED) program developed and promoted by the U.S. Green Building Council (USGBC). Founded in 1993, USGBC “is a nonprofit organization composed of leaders from across the building industry working to advance buildings that are environmentally responsible, profitable, and healthy places to live and work” (USGBC, 2008).

LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas:
• sustainable site development;
• water savings;
• energy efficiency;
• materials selection; and
• indoor environmental quality (Katz, 2008).

LEED certifications for areas and facilities are available in eight categories:
• new construction;
• existing buildings;
• commercial interiors;
• core and shell;
• retail;
• schools;
• health care; and
• homes

Note: In 2009, a new “neighborhood developments” category passed the first review stage.

After applying for certification, a building is evaluated by independent analysts, and is awarded a certified, silver, gold, or platinum ranking according to the number of points earned. “More than 1,500 buildings have received LEED certification since the program was introduced in 2000, and more than 11,000 are seeking it” (Katz, 2008). Further, as the general public becomes more aware of the standards, even maintenance operations managers who are not seeking LEED certification are acknowledging its image value by installing energy-saving devices and equipment, increasing the use of natural lighting, purchasing recycled and non-polluting materials, and installing low-flow water fixtures and toilets (Katz, 2008).


Energy Management

Principle. Energy management makes dollars and sense, and takes dollars and sense.

During 2008, extraordinary speculation in the oil futures market resulted in significantly higher fuel prices across the world, affecting all sectors of the global economy. The most immediate direct maintenance operations impact was on the cost of both diesel fuel and gasoline. The indirect costs were reflected in price increases for any products that were manufactured from petroleum, required petroleum energy in their production, or had to be shipped to their eventual points of sale.

Prior to 2008, environmentalists and scientists increasingly cited evidence of a worldwide rise of the Earth’s ocean temperatures, a trend referred to as global warming (e.g., Al Gore’s movie, book, and lectures entitled An Inconvenient Truth, 2006). In combination, these influences appear to have triggered a “tipping point” (Gladwell, 2002) resulting in a purposeful focus on energy management as part of a broader effort for organizations and individuals to become environmentally responsible by embracing energy efficiency.

Cumulative analyses of maintenance operations functions have proven true the premise stating that after personnel costs (approximately 80 percent), an organization’s next highest expense is energy. Heating and cooling is lost through envelope leaks or conduction; while equipment and systems require prescribed amounts of power, but may underperform because of improper maintenance or scheduling. As Sawyer (2005) noted, “Over the life of the facility, energy costs will exceed the initial cost of all the energy systems” (p. 170).

Since energy actually is about money, a prudent approach is to manage energy the same way money would be managed. In the past, planning and design included funding for purchasing energy-related equipment and (sometimes) supplies, but less thought was given to paying for their continuing use, the assumption being that income streams would be adjusted as energy costs became apparent. Further, omitting potential energy costs gave the appearance of a smaller total cost, making the project appear more affordable.

This situation often led to facility balance sheets posting unanticipated early operating losses, followed by “sticker shock,” as facility patrons were faced with unwelcome, credibility-crushing fee increases. Just as with incident management, an ideal solution to this
dilemma is found by following the generalized planning cycle (Edginton, et al., 2004). First, energy management is a philosophy (Step 1), the conscious choice to be proactive and honest about the true costs associated with operating a facility, coupled with a decision to fulfill the fiduciary duty to the people being served, and also one’s responsibility as a steward of the Earth’s environment.

Second, the needs identification involves investigating and measuring the factors affecting energy consumption, such as (from Sawyer, 2005):

- day-to-day weather conditions, and a region’s climate overall;
- design, composition, quality, and condition of a facility’s envelope (a critical interface);
- presence (or absence), placement, and quality of insulation;
- number and size of windows, doors, and other openings, as well as use of artificial lighting;
- efficiency of facility mechanical systems, and level of equipment and systems maintenance;
- efficiency of circulation systems (e.g., HVAC, water), components, and their operation; and
- patterns of building occupancy and use, including internal activities such as heating water, and using appliances.

Third, part of planning and design includes creating an energy expenses “bank account” as part of the initial planning, perhaps included as part of the capital budget. Just as financial investors recommend that individuals or households maintain liquid savings equal to the amount of money necessary to live for three-months, the energy account would be funded based on a (preferably maximum) energy-use projection. Any energy cost overages would be covered by withdrawing from the fund, and any savings would be deposited for use on the inevitable “rainy day.”

Fourth, implementation of the plan requires that an energy policy and procedures manual (see Compendium 13-2) be written, approved, and widely distributed, accounting measures created, and monitoring devices and procedures installed and tested. If implementation includes the installation of new equipment, or retrofitting/renovating the old, those objectives should be fully funded and scheduled to minimize interruptions to daily operations.

Fifth, measurements are taken, and data supporting the systems approach are collected and analyzed from among the following sources (from Sawyer, 2005):

- actual metered energy usage;
- logged facility system performance inputs (e.g., supply air temperature and boiler efficiency);
- logged weather conditions;
- solicited patron comfort comments;
- recorded changes in occupancy and use patterns;
- recorded changes as sequenced energy management initiatives are implemented; and
- logged scheduled and unscheduled equipment and systems maintenance.

Finally, decisions are made to modify any portions of the cycle that is underperforming, and to investigate further unanswered questions or puzzling results. Of course, each of these five steps is taken only after insuring that they reflect the first step: the underlying energy management philosophy. For example, a review of electricity bills indicates a usage level higher than predicted; sensor data indicate that automatic motion detector switches are working properly, but building lights remain on at night in low-activity spaces. Further investigation reveals that evening staff feel much safer keeping the lights on, even in mostly untraveled hallways, so they keep the light switches “on,” overriding the automatic sensors If your philosophy is “safety first,” than an upward budget adjustment is necessary to cover the cost of additional illumination.

Trees and Rooftop Vegetation

LEED principles carry over into the landscape, where reforestation movements and urban forestry programs have emerged in many areas of the United States. Among the major proponents of these efforts is the Arbor Day Foundation. In addition to aesthetic benefits, the Arbor Day Foundation (2009) lists the following advantages of planting trees:

- as trees grow they remove CO₂ from the atmosphere, storing the carbon and releasing oxygen;
- shade provided by trees reduces summer air conditioning needs;
- trees reduce the “heat-island” effect in urban areas; and
- trees around homes and in cities slow cold winter winds, reducing the need for winter heating.

A second tactic involves establishing rooftop gardens or vegetative areas referred to as “green rooftops” (Landscape Communications Inc., 2008). For example, in 2007, New York City established PlaNYC, a long-term sustainability plan. Following this protocol, “Building owners in New York City who install green rooftops can now receive a significant tax credit. Green roofs installed on at least 50 percent of available rooftop space in New York City qualify for a one-year property tax
credit of up to $100,000” (Landscape Communications Inc., 2008). (See Compendium 13-3 for Virginia Beach Sustainability Assessment Plan.)

Maintenance operations managers who adopt these, and similar initiatives can “LEED” by example, enhancing their role as responsible agencies while saving money at the same time.

Alternative Modes of Transportation

The ever-increasing costs associated with petroleum-based transportation methods, combined with the expansion of trail and differentiated traffic access efforts, such as bike and car-pooling lanes, have increased the adoption of alternative transportation options. This integration of all modes of transportation in populated areas is termed “complete streets,” which are “designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists, and transit riders of all ages and abilities must be able to safely move along and across a complete street” (Complete the Streets, 2009).

While recreation and park agencies often have been in the forefront of these initiatives within their properties, the completion of external and interagency networks has resulted in the demand for dedicated parking areas, monitored by staff, for two-wheeled personal transport at event sites, trailheads, and stopping/rest areas. Further, the slow transition to electric-powered vehicles gained significant momentum from the worldwide restructuring of automobile manufacturing in 2009, which eventually will increase the demand for recharging stations. Recreation and leisure facilities will be expected to offer and maintain such amenities.

The Sustainable Tourism Criteria Initiative

Many parks and recreation agencies have been, or are becoming, more active in tourism. For example, National Parks such as Yosemite and Grand Canyon draw millions of out-of-state visitors every year (Barna & Gaumer, 2005), and local agencies often promote their communities by marketing historic sites or nature-based recreational opportunities. Taking note of the wear-and-tear visitors impose on destinations and surrounding communities, 24 tourism-affiliated organizations created a partnership in 2008 to “create and adopt sustainable tourism criteria” (STC Partnership, 2008).

Sustainable tourism is defined as “tourism that is economically viable, but does not destroy the resources on which the future of tourism will depend, notably the physical environment, and the social fabric of the host community” (Swarbrooke, 1999). Sustainable tourism is founded on four principles:

- effective sustainability planning;
- maximizing social and economic benefits to the local community;
- reduction of negative impacts to cultural heritage; and
- reduction of negative impacts to environmental heritage (STC Partnership, 2008).

The complexity inherent in these four principles suggests that the development of sustainable maintenance operations programs and plans would be greatly aided by making use of the many “systems” introduced in this chapter, such as Geographic Information Systems and Computerized Maintenance Management Systems.

When generalized, Crossley, Jamieson and Brayley’s (2007) model of commercial recreation provides a framework for understanding the interplay among sustainability’s various aspects. Conceptually, a manager’s operating environment is divided among three categories or sectors, which can exist at scales ranging from local (micro) to global (macro):

- attractions: a pocket park to Disneyland;
- amenities: a bed and breakfast to a J.W. Marriott resort;
- transportation: a rickshaw to an ocean-liner.

In practice, these three sectors are the equivalent of the spheres mentioned throughout this chapter, overlapping at interfaces creating increasing levels of complexity. An agency’s facilities, recreation centers and parks, for example, are its attractions, to which a given number of participants must be drawn to support agency financing. Each facility has its own relatively unique set of maintenance operations requirements and level of development: its capacity to accommodate numbers of visitors and their intensity of use.

For instance, how can a wilderness area visitor “become one with nature” (emotional sustenance) in the presence of 100 others also hoping to experience solitude, and what of the waste products produced by that number of people? A manager can conserve the asset’s spiritual and physical capacity by adjusting the number of visitors.

Attractions typically are supported by hospitality-associated amenities, which may be free-standing commercial operations such as hotel or restaurant franchises, or integrated into an agency’s structure in the form of campgrounds, concession stands, or park lodges. Although maintenance operation management functions are similar to those of attractions, develop-
ment may or may not be within an agency’s control, especially in the commercial sector.

The controversies over conflicting land use at the Gettysburg National Military Park come to mind. In several instances, the battleground’s sustainability was threatened by degraded visual aesthetics surrounding the site’s boundaries, including a tall viewing tower and numerous fast-food restaurants. National Park Service managers went to court to reserve the park’s perimeter.

Entrepreneurially minded managers realize that, although local residents are an important, if not crucial, source of program participants, agency finances are enhanced by drawing visitors from regions situated beyond the attractions’ local area. Travel, and methods of transport, constitutes the third sector.

For example, a commercial airline transports people to the airport located nearest an agency’s attraction, and the agency will provide a shuttle-bus to collect the travelers and bring them to the attraction’s site or nearby hotel. But what of the environmental impact of the gallons and gallons of petroleum products consumed by the planes and the shuttle-bus, and the necessity of road construction and maintenance? Looking toward the future, managers can meet with community business and political representatives to develop long-range plans to preserve petroleum and infrastructure-related resources.

Although involving all stakeholders in longer-range planning is necessary to achieve global sustainability, the second half of “think globally and act locally” shifts the maintenance operations management focus to the individual agency level, where local planning decisions and actions accumulate to influence the globe.

Developing a Maintenance Program and Plan

Efficient and effective maintenance operations are critical to the success of an organization’s mission, for several major reasons, such as enhanced recreation experience, increased economic efficiency, reduced liability, and improved public image and environmental stewardship. But because our senses constantly are bombarded with information, we tend to focus on those few bits that we think are the most important at the time, often at the expense of many others. In other words, people see only what they expect or want to see. In maintenance operations management, this can be a problem, especially when trying to “cover all bases” or to be proactive by taking preventative measures before things go wrong.

Guidelines

Within the systems approach described in this chapter, every action is preceded by a well-reasoned decision. To insure that the best decisions are reached, guidelines provide a structure and context:

1. Organize well: The organizational structure must be tailored to the needs and requirements of the individual organization.
2. Establish maintenance goals, objectives, and standards: These are statements of the purposes and end results for the maintenance operation, and should be clear, realistic, and achievable.
3. Use time, personnel, equipment, and materials efficiently and effectively: Every effort should be made to marshal resources to satisfactorily resolve every legitimate request for maintenance work.
4. Develop work schedules based on established policies and priorities: Although elimination of value judgments is impossible, the decision-making process can be made easier by developing policies and criteria regarding maintenance priorities.
5. Emphasize preventive maintenance: Although establishing a preventive maintenance program requires considerable planning, a preventive approach to maintenance enables tasks to be scheduled at convenient times, rather than in response to breakdowns.
6. Make sure adequate resources to get the job done are available: An organization needs to commit to providing enough funding, personnel, equipment, and materials to get the job done.
7. Incorporate environmental stewardship into the maintenance program: The effect of decisions and actions on the environment and its ability to be preserved and protected for future generations should be carefully considered in all aspects of park and recreation maintenance.
8. Assume responsibility for visitor and employee safety: The maintenance department has a primary responsibility for providing areas and facilities that are safe.
9. Ensure compliance with federal, state, and local laws and regulations: Maintenance personnel are responsible for ensuring compliance with all applicable federal, state, and local laws, regulations, codes, and procedures.
10. Make maintenance a primary consideration during design and construction: Many long-term maintenance problems and difficulties can be reduced, if not eliminated, by considering
maintenance during the design and construction phases of a facility or site development project.

**Identifying and Assessing Maintenance Requirements**

Two common concepts apply to previously described maintenance functions (e.g., housekeeping, preventative maintenance). The first is *planned versus unplanned* maintenance. Because of their recurring nature, many types of maintenance can be planned ahead of time. For these types, the maintenance manager can develop a schedule before the work is started. Especially relevant here is recognizing that the costs of neglecting planned maintenance nearly are identical to those resulting from unplanned maintenance (below), including:

- down time,
- emergency repair, and
- less efficient machinery (Sawyer, 2005).

Conversely, some maintenance cannot be planned ahead of time, e.g., emergency repairs and correcting vandalism. When these types of problems occur, the maintenance manager must deviate from the planned schedule and find a way to work emergency repairs into the daily routine. In addition, unplanned incidents disrupt more than the normal routine; also they carry financial implications, sometimes substantial. Not only might staff overtime pay be involved, but supplies and equipment costs as well. Planning for the unplanned, then, requires an operating surplus as well as carrying adequate insurance.

A second important concept recognizes that “original state” or “acceptable condition” are known quantities—that is, standards are an essential part of each type of maintenance. Regardless of type, both planned and unplanned maintenance are devoted to upholding the original state or acceptable condition standards.

Given these initial maintenance concepts, programs are developed to structure the maintenance actions derived from operational decisions. Because each park and recreation organization has unique problems and concerns, a maintenance program is valid and will function only when attentive to individual conditions, such as:

- needs (active vs. passive, natural vs. constructed, structured vs. unstructured areas, facilities and activities);
- conditions (weather, geography, visitor characteristics);
- resources (funding, equipment, natural resources);
- priorities (athletics, resource preservation, interpretation);
- circumstances (budget, political realities, public attitudes); and
- capabilities (staff size and level of ability).

Note that the second item, above, *conditions*, directly refers to the four natural spheres described in the Five Spheres section presented above. Utilizing this framework, and its overarching link to entropy and inertia, permits the customization of forms and schedules to fit each individual agency’s unique conditions.

**Computerized Maintenance Management Systems**

Given the pace of innovation in computer technology and software capability, it was inevitable that maintenance operations management tasks would invite computerization. Like the transition from paper-based systems in other fields and domains, the decision to migrate to a Computerized Maintenance Management System (CMMS) depends on several factors:

- is adoption compatible with the organization’s philosophy, vision, and mission?
- will CMMS actually benefit the patrons?
- are staff ready to embrace the migration?
- can the organization’s workload incorporate an orderly migration?
- can the budget absorb the initial cost, and the ongoing expenses?

Two additional factors influence the type and sophistication of CMMS selected: organization size and complexity. A small department overseeing few facilities may not need CMMS, whereas a large organization responsible for many facilities may not be successful without CMMS. For example, an informal survey of CMMS adoption among public agencies in Ohio revealed behaviors ranging from no use, through developing a proprietary in-house system, to purchasing software from commercial vendors (personal communication, Charlotte Walker, Executive Director of Ohio Parks and Recreation Association, August, 2008).

The number and variety of vendors and software packages makes selection a daunting task. Not only do multiple vendors offer roughly comparable packages, software is available for more specific applications, such as predictive maintenance, preventative maintenance, fleet management, equipment maintenance, and even K-16 school management. A partial list of general CMMS vendor websites is available in the Resources section, below. Barriers to successful CMMS implementation include:
Fleet Maintenance and Management

To achieve the maximum life from vehicles and equipment, a fleet maintenance program incorporates both preventive maintenance and a regular repair process, toward achieving three goals:

- prevent safety hazards: Regular preventive maintenance, including safety checks, will ensure that vehicles and equipment are safe for operators and participants;
- prevent or reduce costly down time: Regular preventive maintenance will allow mechanics to spot problems that can be corrected before they become serious;
- reduce operating costs: Good preventive maintenance prolongs equipment life. Well-maintained equipment operates more efficiently and costs less to operate.

Typical preventive fleet management program tasks include:

- lubricating;
- changing oil;
- washing;
- checking fluid levels;
- checking tire pressure;
- checking equipment safety features;
- keeping proper adjustments and tuning;
- replacing filters and other expendable items;
- checking brakes and emission control systems;
- checking for rust and repainting as necessary; and
- performing periodic electronic diagnostic tests.

In most park and recreation maintenance operations, responsibility for performing preventive vehicle and equipment maintenance is shared by equipment operators and mechanical staff. Specific responsibilities must be clearly defined, and may be governed by collective bargaining agreements. Generally, equipment operators are asked to perform routine daily tasks such as washing, greasing, and checking oil levels, tire pressure, belts, and hoses. More complex preventive tasks, such as changing oil, tune-ups, and replacing brake linings, usually are the responsibility of the mechanical staff.

Record-keeping is an essential element in the preventive vehicle and equipment maintenance program. Inspection results, preventive maintenance standards, inventory information, and vehicle and equipment histories are examples of types of information collected and maintained for each vehicle and major piece of equipment. Fleet Management and Maintenance Systems (FMMS) such as collectiveFleet v5.2 (collectiveData, 2008) are particularly suited for these tasks. (See Compendium 13-4 for vehicle maintenance examples.)

Creating a Maintenance Plan with a Systems Approach

Whether using pen-and-paper or computer software, maintenance plans typically are a mix of timelines, scripts, and checklists: forms or schedules of some kind. How the forms and schedules are developed and designed is governed by each agency’s philosophy, vision, mission, goals, objectives, and intended outcomes. The systems approach described in this chapter provides the framework within which a customized maintenance plan can be built by considering the following criteria:

Entropy and inertia: Is the plan to stop something from moving, or to try to get something to move, and is it upsetting or creating a balance? If stopping inertia, how will the energy be absorbed of deflected; if energizing inertia, how will the energy be generated? If the balance is being upset, how will it be restored, or established at a new level?

For example, plans to build a recreation center addition raise the possibility of having to cut into a wooded hillside. At the moment, the terrain is in balance, as the tree’s ecosystem stabilizes the hill; “resting” inertia is high so entropy is low. Removing the vegetation and earth, however, energizes the system, disrupting the balance. Now the remaining hill wants to slump, and it will take more energy (perhaps in the form of a retaining wall backed by substantial drainage elements) to restore balance, or the slumping danger may become an ongoing maintenance concern.

The Five Spheres: Which of the four natural forces are present, in what combinations, and at what energy levels? How does this combination interface with the anthrosphere (patrons and staff)?

Continuing with the example above, the existing trees (biosphere) anchor the hill (lithosphere) and provide shelter from the rainwater (hydrosphere). The planners (anthrosphere) suggest cutting the hill. This scenario is rated at Interface Level 4, indicating that four
Forces are involved: a potentially powerful mix. Will debris from the remaining trees compromise the roof? Will the rainwater be sufficiently diverted or absorbed, protecting both the hillside and the new addition's foundation? Will the remaining trees be toppled by strong winds, now that their root systems have been disturbed?

Facility location along the Area–Envelope continuum: Areas are external and are exposed to all the natural forces, whereas envelopes create an interior environment wherein the forces may be expressed artificially. In the present case, the recreation center addition is an envelope, but the external forces are at a level high enough to threaten it, exclusive of the many internal maintenance requirements discussed previously in this chapter.

Having determined the operating context using the systems approach, the development of a comprehensive, systematic, written or computerized maintenance plan becomes one of the best means of ensuring that facility maintenance operations are functioning at maximum efficiency and effectiveness. It communicates operational expectations throughout the organization, and provides data to assist in planning, problem solving, and decision making. Further, it allows deployment of human, physical, and financial resources to their best advantage, and evaluating departmental performance.

A properly designed maintenance plan will assist maintenance operations management in many ways, two of which deserve particular mention, scheduling and decision making. First, scheduling provides a systematic approach to accomplishing the maintenance program and improves the use of personnel by allowing a manager to:

- identify recurring and non-recurring work load;
- monitor work functions by collecting data about time spent on each task;
- avoid over committing personnel;
- justify full-time or seasonal personnel needs;
- ensure that the correct number individuals is assigned to each task;
- provide a detailed accounting of all overtime spent weekly or monthly; and
- preview future schedules.

With regard to the second, decision-making, developing a maintenance plan derived from systems data analysis can help managers to:

- focus attention on particular areas;
- establish priority lists for projects and improvements;
- provide information to handle complaints or lawsuits;
- develop frequency and quality standards for recurring tasks;
- estimate the impact of additional land and facilities;
- provide budget rationale and justify time-sensitive budget adjustments; and
- compare maintenance activities from moment to moment, as well as from year to year.

Facilities and Equipment Depreciation and Replacement

Sound fiscal management policies require the development of a system for replacing facilities, equipment, and other capital items. As a general rule, funds for replacement of equipment and facilities in most park and recreation organizations are relatively scarce, resulting in facilities and especially maintenance equipment being used long after their specified life span. Among the consequences of over-extending components are:

- compromising the safety of the operator and the recreation user;
- increasing operating costs because equipment is not operating at optimum efficiency;
- increasing repair costs because equipment is old and worn; and
- possibly diminishing the quality of maintenance when using worn-out equipment as it may be substandard.

Budgeting for replacement of expensive facilities and equipment is generally handled by including replacement items in the regular operating budget, or by developing a separate “replacement” fund (sometimes called a sinking fund) in which a certain percentage of the operating funds are allocated specifically for replacement purposes. The difficulty with including major facility and equipment replacements in the regular operating budget is that replacement decisions must be made well in advance, and emergency breakdowns are not easily accommodated.

In recent years, the replacement fund, concept has become more widely used. Under this method, each facility or piece of maintenance equipment is depreciated (that is the replacement costs are spread equally over the useful life of the facility or equipment) and an equivalent amount of money is set aside each year for the replacement of that piece of equipment.

For example, the maintenance department undertakes a renovation project for which a dump truck, backhoe, power saw, and brush chipper are necessary. Each piece of equipment is then “rented” at a predetermined operating rate for the duration of the project. The rate is set according to the established useful life of the
particular piece of equipment, and is transferred into the replacement fund. At the end of the useful life of the truck, tractor, power saw, or brush chipper, this fund (if properly administered) contains sufficient money to purchase a new piece of equipment. The money for the replacement fund comes from the organization’s operating budget, but is set aside to be used for equipment replacement only. Unspent monies left in the replacement fund at the end of the year are carried over rather than placed into the next year’s budget.

The replacement fund concept permits maintenance operations managers the flexibility to replace equipment that has reached the end of its useful life span, while not being forced to purchase new equipment just because funds for its replacement are budgeted. It is necessary, however, to develop realistic depreciation schedules that indicate when a piece of equipment should be replaced. (See Chapter 19, Financial Management and Chapter 20, Budgeting.)

Managing Property and Equipment

Managing property and equipment begins with developing a detailed inventory of all resources and facilities for which maintenance operations managers are responsible. Each component must be quantified (for example, number of ball fields, acres of turf mowed, linear feet of fencing maintained, square footage of building space, etc.) and described precisely. The number of categories and classes will vary by agency, but should be numerous enough to allow meaningful divisions among components.

Formerly, compiling aerial photos, maps, site plans, and blueprints was helpful for identifying components (and may yet be), but location and description are two functions for which systems-based applications such as GIS particularly are suited. Further, once the data have been stored electronically, it becomes available to other systems: CMMS, for example. In whatever form, however, base data must be retained and updated continually as improvements and changes are made to existing resources and facilities.

Being able to locate job sites and equipment easily allows agency staff to complete assignments quickly while expending the least amount of resources. The equipment needed depends upon the job, while the equipment available depends upon the size of the organization and its financial resources. For example, nearly every park and recreation organization will have a vacuum cleaner for cleaning carpeted floors, but not all organizations can afford a tree spade. Some specialized equipment may be shared between organizations, and it also may be cost-effective to rent specialized equipment, such as an air compressor, if it is to be used only a few times each year.

When purchasing equipment, it generally is most cost effective to consider its life-cycle costs, which factor in maintenance, repairs, and replacement. It is almost always more economical to purchase high-quality, rugged, industrial-grade equipment with a long life span than to purchase lighter equipment that will require continuous repair. When purchasing, seek the advice of the mechanics who must maintain the equipment, and of the people who will be operating it. Their experienced counsel will probably save future headaches and pay off financially in the long run.

Other questions to ask are: Will the machine do the job for which it is being purchased? Are parts and service available? Is it dangerous to operate? Can inexperienced workers operate it? Will it be a safety hazard to visitors, spectators, or participants?

After equipment has been selected, organizations must incorporate care and preventive maintenance into the equipment maintenance program. The maintenance manuals, provided by the manufacturer, are key for all equipment maintenance programs and should be kept in a permanent repair file. Both the operator and mechanic should read and be familiar with all operating and maintenance manuals.

Only experienced personnel should operate specialized equipment such as stump grinders, brush chippers, crawler tractors, concrete mixers, power saws, and front-end loaders. Employees should not be allowed to operate these types of equipment until they understand associated capabilities, operating techniques, and basic care and maintenance. Keeping equipment secured and instituting a sign-out system gives maintenance operations managers better control.

Whether repairs can be accomplished in-house depends on the capabilities of the mechanics, and the resources available. Many small organizations have repair work performed by commercial garages, while larger organizations maintain their own garage facilities as part of a maintenance service center. Although the capital invested to adequately equip and operate a garage is substantial, such an arrangement generally pays off in economy and convenience when an agency owns a large fleet of maintenance equipment.

If an in-house garage is to operate efficiently, a policy must be established to deal with repair priorities. When several pieces of equipment break down simultaneously, it may not be possible to make all necessary repairs immediately. To establish a policy on repair priorities, consider the following:

• time required to complete the repair;
• effect on park users if repair is delayed;
• economic consequences of putting off the repair; and
• available alternatives, such as another piece of equipment or having the repair done commercially.

Such judgments are not easily made. However, if guidelines for determining priorities are established and understood by equipment operators and supervisory personnel before the equipment repairs are needed, chances of a service disruption are lessened.

**Trend: A Systems Approach**

As computers and Internet technologies transform and revolutionize maintenance operations management, inertia and entropy exert their influence on the pace of change. Rogers’s (1995) model of innovation diffusion describes how ideas become trends by following developmental stages similar to the Program Life Cycle (Edginton, et al., 2004):

- innovator;
- early adopter;
- early majority;
- late majority;
- laggard.

*Innovators* actually (or virtually) create movement by investing resources into new methods or approaches, such as systems-thinking, while entropy in the forms of tight budgets, scarce time, or low interest levels causes innovation to lag.

Most recreation and leisure professionals already are familiar with registration systems such as RecTrac (Vermont Systems, 2008) and RecDesk (RecDesk LLC, 2008). As described throughout this chapter, these systems have been joined by CMMS, Fleet Management and Maintenance Systems (FMMS), Standardized Emergency Management Systems (SEMS), GIS, and NIMS, to list a few.

While not every recreation and leisure agency requires sophisticated systems-driven software applications (indeed, many smaller agencies continue to operate successfully utilizing time-tested pencil and paper methods), thinking in terms of systems helps managers clarify goals and objectives, and makes measuring outcomes easier: actually or virtually.

With or without using the systems approach, a well-formulated maintenance operations management plan can be developed by adhering to the following sequence:

1. Involve staff, and other stakeholders.
2. Establish maintenance goals and objectives.
3. Inventory resources.
4. Establish measurable quantitative and qualitative standards and outcomes.
5. Identify maintenance tasks.
6. Describe those tasks.
7. Determine task frequencies and priorities.
8. Determine the amount of time needed to accomplish task once.
9. Project personnel needs.
10. Organize tasks by appropriate time span (e.g., by month or by week).
11. Analyze available personnel.
12. Identify projects and improvements.
13. Implement the plan.
14. Evaluate the plan.

Nevertheless, while the procedure outlined above may be thorough, it may not be comprehensive. It is important to understand that although no single maintenance operations management plan applies to every facility or organization in an identical way, any given plan is valid and will function effectively *only* when it is developed from more general principles that then are reflected in local needs, conditions, resources, priorities, circumstances, objectives, and capabilities.

The structure provided by the systems approach requires comprehensiveness, in addition to thoroughness and precision. The resulting framework allows maintenance operations managers to anticipate challenges and to make proactive, informed decisions, insuring that the people they serve receive quality experiences delivered by high-performance agencies.

In his journal, the noted naturalist John Muir expressed an expanded version of the quote appearing at the Introduction to this chapter: “When we try to pick out anything by itself we find that it is bound fast by a thousand invisible cords that cannot be broken, to everything in the universe” (Wood, 2008).

These “thousand of invisible cords” are the often unaccounted for interfaces among forces and spheres revealed through the systems approach.
Resources


Krannich, R. S., Eisenhauer, B. W., Field, D. R., Pratt, C., & Luloff, A. E. (1999). Implications of the National Park Service recreation fee demonstration pro-


**Internet Resources**

**GIS vendor sites:**
- www.esri.com
- www.cartegraph.com (GIS with CMMS)
- www.magellanGPS.com

**CMMS vendor sites:**
- www.arsenault.biz
- www.capterra.com
- www.cogz.com
- www.cworks.com
- www.eaglecmms.com
- www.eMaint.com
- www.KeepTraK.com
- www.mpulsesoftware.com
- www.plant-maintenance.com
- www.pdmsolutions.com
- www.schooldude.com
- www.wbdg.org

**Maintenance operations management information sites:**
- Professional grounds management society (PGMS): www.pgms.org
- American public works association (APWA): www.apwa.net
- Landscape superintendent & maintenance professional magazine: www.landscapeonline.com

**Other**

Questions regarding the playground accessibility requirements and interpretation should be addressed to the United States Access Board as follows:

United States Access Board
1331 F Street, NW, Suite 1000
Washington, DC 20004-1111
Phone (voice): (202) 272-0080 toll free: (800) 872-2253
Phone (TTY): (202) 272-0082 toll free: (800) 993-2822
Fax: (202) 272-0081
E-mail: info@access-board.gov
Web: www.access-board.gov
Authors, Consultants, and Contributors

After earning degrees in geology, geography, and sport administration, Kim S. Uhlik has taught Maintenance and Operation of Facilities and Areas and Recreation Management courses for several years. As a practitioner, he has programmed, maintained, and repaired a variety of recreation and sports “play”-ces, particularly tennis courts. He designed, built, and landscaped his own home, thereby gaining first-hand experience and in-depth insight into the integration of concepts and techniques. Kim’s research seeks to discover and develop a partnership-based philosophy and practice that promotes responsible entrepreneurship, stakeholder empowerment, proactive stewardship, sustainable development, and innovative pedagogy through the transformation of students, teachers, clients, and practitioners that leads to life satisfaction and fulfillment for all. He has published articles related to both partnership and pedagogy, and his community-centered class projects—involving recreation organization development, park design, and high risk drinking abatement—have garnered positive publicity for students and higher education alike.

Mary Bates is a native Californian and raised her four daughters in the Bay Area. She began her life-long passion of working and volunteering in the leisure field more than 30 years ago. She has worked for private, public, commercial and non-profit organizations. Ms. Bates’ community and professional involvement includes the American Red Cross Bay Area Chapter, the Maintenance Superintendent Association, the Rotary Club of Foster City, Hillbarn Theatre, California Parks and Recreation Society, the National Parks and Recreation Association and is a graduate of the San Mateo Leadership Program and San Francisco State University. While employed with the cities of South San Francisco, Foster City, Palo Alto, and San Jose, she developed collaborative relationships with community groups and city departments, managed multi-divisional budgets and Capital Improvement Projects, oversaw contract administration, created and implemented various programs and services, led city-wide facility, parks and recreation operations, and implemented the strategic planning process. Ms. Bates currently resides in the City of San Carlos and for the past four years is employed with the City of South San Francisco as the Superintendent of Parks and Facilities.

Previous Author
Alan Ewert of Indiana University and Steve Plumb of the Elmherst IL Park District were authors of the first and second editions and also contributed to this chapter.

Contributors to the Compendium
Debbie McLaughlin, Parks and Recreation Director, City of Miamisburg.
Victor C. Garber, CPRP, Superintendent of Operations, Roanoke Parks and Recreation Department.
Julie Anne McQuary, Parks Project Coordinator, Olympia Parks, Arts and Recreation.

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