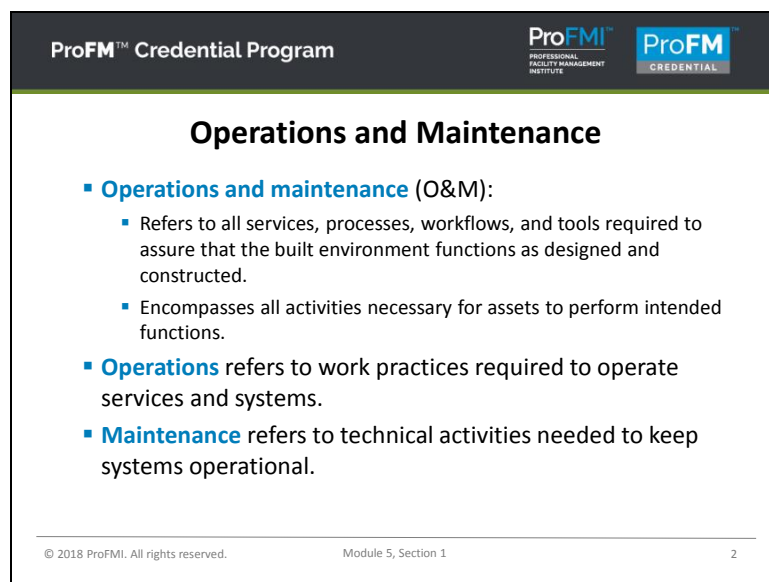
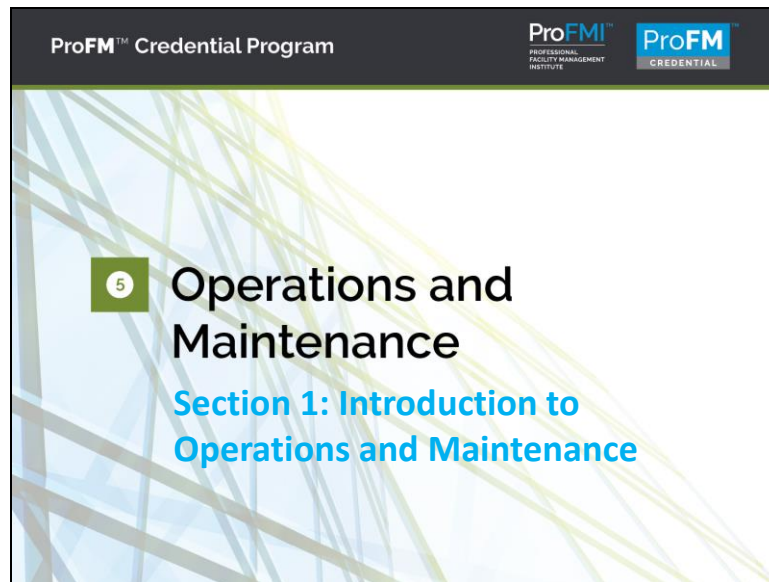

Module 5: Operations and Maintenance

Section 1: Introduction to Operations and Maintenance



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General Aspects of O&M

- Technical services** • Activities related to building site and structure, building systems and components, and managing building system performance
- Occupant services** • How FM team keeps occupants content, safe, and productive
- Work management** • Methods of coordinating daily, reactive, preventive, and replacement/repair FM tasks
- Utility management** • Techniques to control use of energy and water
- Space management** • Techniques used to estimate and plan space, software used to plan space efficiency while preserving optimal working conditions

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Challenges for O&M

- Key challenges:**
 - Funding
 - Customer satisfaction
 - Consistency
- Site-dependent challenges:**
 - Standards
 - Certifications and training
 - Common measurement
 - Insourcing versus outsourcing
 - Work order management

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O&M Goals

- Ensuring that all working environments are safe for occupants
- Preserving value of building
- Maximizing efficiency and usability of building
- Maintaining or increasing occupant satisfaction
- Maximizing equipment and building efficiency to minimize cost and carbon footprint


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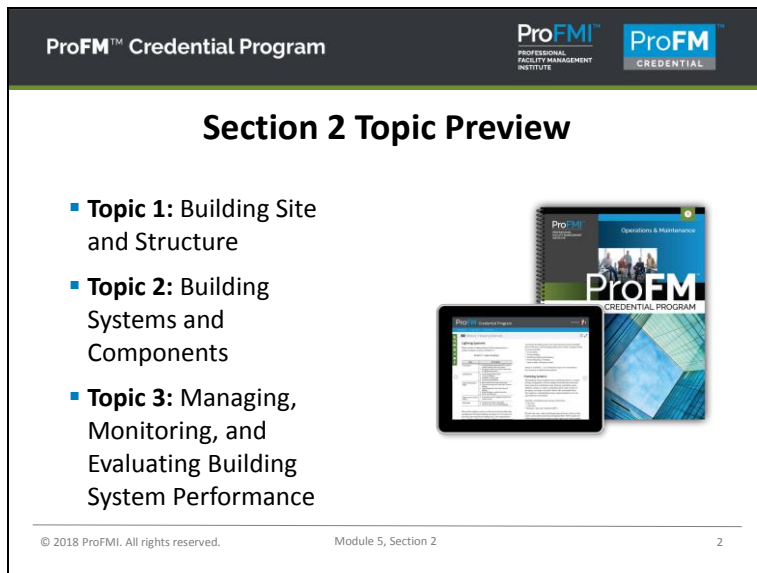
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Questions?



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Section 2: Technical Services



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Technical Services and Occupant Services

Technical Services	Occupant Services
<ul style="list-style-type: none"> ▪ Building site ▪ Building structure ▪ Roofing systems ▪ Building envelope ▪ Building control systems (HVAC, lighting, plumbing, electrical, conveying, communication, IT infrastructure) ▪ Waste management ▪ Interior systems 	<ul style="list-style-type: none"> ▪ Food (and beverage) services ▪ Custodial services ▪ Fleet management ▪ Mail and copying/printing ▪ Records management ▪ Telecommunications ▪ Security ▪ Conference room scheduling ▪ Audiovisual equipment services

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Building Site and Components

Topography	Ingress and egress	Landscaping	Storm water drainage systems
Paving, curbing, and gutters	Parking lots/structures	Utilities	Stairs and ramps
Loading areas	Signage and lighting	Fire safety	Ponds and reservoirs

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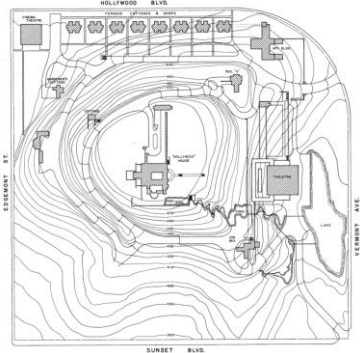
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Topography

Topography is the study of the physical contours of the land and elements in their current state.

Survey the complete topography of a site, including:

- Surface volume.
- Contour of the land.
- Elevation changes.
- Erosion.



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Ingress and Egress

- Ingress and egress are routes to enter and exit a site.
- Property owners may grant limited access to their property via an **easement**.



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Landscaping

- General requirements for landscaping include:
 - Service standards.
 - Key personnel.
 - Equipment.
 - Reporting.
 - Licensing, accreditation, and registration.
 - Conformance with laws.
 - Timing.
- Scope of work is a detailed forecast of quantity and category of work required.

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Discussion Question

What landscaping tasks are you responsible for managing for your organization?

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Storm Water Drainage Systems

When assessing water drainage systems, look for:

- Remaining surface water.
- Water detention basins.
- Pooling.
- Ponding.
- Clogging.



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Paving, Curbing, and Gutters

- Paving includes areas for both foot traffic and vehicles.
- Curbing and gutters are critical components of paving systems.

Deficiencies to look for:

Paving	Curbing	Gutters
<ul style="list-style-type: none">• Raveling• Potholes• Sinkholes• Rutting• Corrugation• Cracks• Alligatoring• Stripping	<ul style="list-style-type: none">• Cracks• Crumbling• Missing pieces• Chipped paint	<ul style="list-style-type: none">• Cracks• Crumbling• Missing pieces• Clogging• Buried grates

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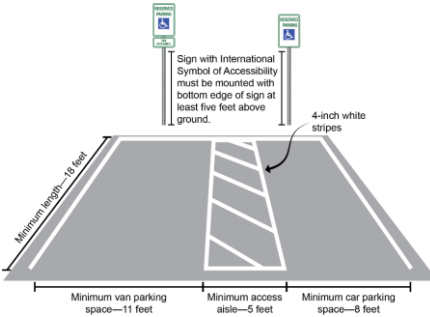
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Parking Lots/Structures

- Ensure that all zoning and legal requirements are met.
- Watch for upkeep items such as:
 - Litter.
 - Excessive oil spots.
 - Overflowing trash cans.
 - Distinct odors.
 - Standing water.
 - Lighting.
 - Blocked drains.
 - Leaks (structures only).
 - Shrubs encroaching on parking spaces.



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Utilities

Most utilities cannot be inspected visually.

When possible, look for these visual cues indicating issues:

- Physical deterioration
- Distress
- Lack of compliance with codes
- Leakage



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Stairs and Ramps

When assessing, focus on:

- Operational efficiency.
- Safety of stairs, ramps, and handrails.
- Compliance with accessibility requirements.
- Wear.
- Cracks.
- Crumbling.
- Missing pieces.



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Loading Areas

When assessing, focus on:

- Platforms.
- Walls.
- Doors.
- Bumpers.
- Guards.
- Safety markings or guides.



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Signage and Lighting

When assessing, focus on:

Signage	Lighting
<ul style="list-style-type: none">• Consistency• Visibility (not covered by shrubs or bushes)• Wear• Damage• Rust	<ul style="list-style-type: none">• Bulbs• Power• Damage• Base

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Fire Safety

- Fire lanes
 - Must be clearly marked, maintained, and kept free from any obstructions.
- Fire hydrants
 - Number must comply with code, and they must be kept free from obstructions.
- Fire system backups
 - Used to augment fire service water supply; must be unobstructed and clearly marked.



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Ponds and Reservoirs

When assessing, focus on:

- Natural versus human-made.
- Waterproofing system present.
- Filtration system present.
- Pedestrian protection in place.
- Flooding around body of water.
- Ground saturation around body of water.



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Structural Types

Concrete	Steel	Wood
Frame systems	Frame systems	Frame systems
Slab floor construction	Joists and truss floor construction	Joists and truss floor construction

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Concrete

During structural review, be concerned with:

Frame Systems	Slab Floor Construction
<ul style="list-style-type: none"> Warping or bowing Deformations Misalignments Exposed rebar Spalling (fragmenting of concrete surface) Discoloration Chipping Cracking 	<ul style="list-style-type: none"> Joint discoloration Cracks Chips Spalling

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Steel

During structural review, be concerned with:

Frame Systems	Joists and Truss Floor Construction
<ul style="list-style-type: none"> Misalignment Bowing Corrosion Rust 	<ul style="list-style-type: none"> Deteriorated welds Buckling Bowing Corrosion Rust Missing or loose bolt connections

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Wood

During structural review, be concerned with:


Frame Systems	Wood Joists and Truss Floor Construction
<ul style="list-style-type: none">• Termite damage• Dry rot• Delamination• Splitting• Cracking• Water damage	<ul style="list-style-type: none">• Dry rot• Water damage• Rodent damage• Splitting• Cracking

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Discussion Question

Which type of construction is best for areas that are prone to earthquakes or high winds, and why?

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Below-Grade Elements

During structural review, be concerned with following:

Floor slabs

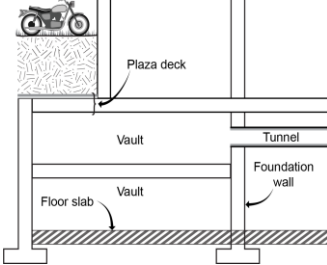
- Pooled water, leaking, cracking, chipping

Foundations

- Settlement, pooled water, water stains, discoloration



Plazas, tunnels, vaults

- Obtrusions, leaking, distress points, crumbling, weathering (freezing, thawing)



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Roof Types

Low-slope roofs

- Pitch usually ranges from flat (0/12) to 4/12.
- Three types:
 - Built-up roofs (BUR)
 - Modified bitumen
 - Single-ply

Steep-slope roofs

- Two types:
 - Shingles and tiles
 - Metal

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Inspecting Roofs

Be sure to check the following components when evaluating a roof:

- Roof deck
- Base flashing
- Counter flashing
- Coping
- Parapet
- Gravel stops
- Gutters, downspouts, drains
- Equipment penetrations and supports
- Expansion joints
- Projections and fixtures
- Insulation

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Building Envelope

- Includes physical components that separate external environment from internal environment.
- Must take climate into consideration.
- Includes exterior walls and fenestrations.



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Exterior Walls

Typically composed of:

- Masonry.
- Stone.
- Concrete.
- Exterior insulation and finish system.
- Curtain walls.
- Siding.

When examining, look for:

- Thermal performance
- Shrinkage or expansion
- Water penetration
- Material/finish durability
- Pitting

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Fenestrations

- **Fenestrations** are openings in building such as doors and windows or skylights.
- They should have tight integration with adjacent wall system components.



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Site Sustainability

Key features that impact sustainability:

- Grounds management
- Hardscape (parking lots/structures, stairs and ramps, loading areas)
- Landscape
- Fleet management
- Storm water runoff
- Light pollution

Common Landscape Sustainability Focus Areas


- Turf maintenance
- Mulching
- Composting
- Fertilization
- Irrigation

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Discussion Question

What are some methods that can be employed to increase the sustainability of irrigation practices?

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Building System

- A **building system** is a coordinated set of components that are expected to achieve clearly predefined performance criteria.
- Facility managers need to know enough about building systems and components to be able to:
 - Identify deficiencies.
 - Establish a plan.
 - Ensure completion to desired standards.

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Building Control Systems


Pneumatic Systems	Electro-Pneumatic Computerized Systems	Direct Digital Control (DDC)
<ul style="list-style-type: none"> • Use air pressure to signal other equipment. • Limited remote monitoring capabilities. • Thermostats and controllers must be continually maintained as they drift out of calibration. • No electricity powering thermostats. 	<ul style="list-style-type: none"> • Convert pneumatic signal to electrical. • Data can be reviewed by computer. • Computer-controlled stop and start. 	<ul style="list-style-type: none"> • Includes computer terminal, controller, software, server, router, points, and sensors. • Can process information and make decisions based on predetermined criteria to take corrective action immediately. • Graphic interface. • Communicates device position.

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HVAC Systems

- Energy source is usually electricity, solid fuels, gas, or oil.
- Conducting medium is usually gas, steam, or water.
- Cooling and heating source equipment use same energy source to heat or cool conducting medium.
- Air is modified by heating and cooling units.



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Heating System Types

System	Description	Advantages	Disadvantages
Radiators	<ul style="list-style-type: none"> • Heat air by convection. • Space around them must be kept clear. 	<ul style="list-style-type: none"> • Low maintenance • Adequate temperature control 	<ul style="list-style-type: none"> • Inefficient • Slow thermal response
Convection	<ul style="list-style-type: none"> • Diffusion to transfer heat. • Enclosed heating element. 	<ul style="list-style-type: none"> • Warms up quickly • High output • Safe 	<ul style="list-style-type: none"> • Requires regular maintenance • Needs local power supply
Underfloor systems	<ul style="list-style-type: none"> • Used in large public spaces. 	<ul style="list-style-type: none"> • Invisible • Even temperature 	<ul style="list-style-type: none"> • Slow response time • Prone to leaks
Warm air units	<ul style="list-style-type: none"> • Use fire box with ducts. • System or fan used to ensure circulation. 	<ul style="list-style-type: none"> • Easy maintenance access • Even heat distribution 	<ul style="list-style-type: none"> • Noisy • High energy use • Amount of floor space required
Boilers	<ul style="list-style-type: none"> • Forced or atmospheric. • Heat water through combustion system. 	<ul style="list-style-type: none"> • Clean • Don't produce dust 	<ul style="list-style-type: none"> • Space required • Special maintenance skill set

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Ventilation System Types

System	Description	Advantages	Disadvantages
Forced ventilation: overhead	<ul style="list-style-type: none"> Air supplied through ducted diffusers. Exhaust air drawn through unducted grills. 	<ul style="list-style-type: none"> Eliminates need for unnecessary return air ducting. No external noise. 	<ul style="list-style-type: none"> Some fresh air gets sucked into return system. Fan noise.
Forced ventilation: underfloor	<ul style="list-style-type: none"> Natural flow of air using thermal air movement. Raised floor where supply ducts run. 	<ul style="list-style-type: none"> Easy access. Cabling can be run through floor system. No external noise. 	<ul style="list-style-type: none"> Fan noise.
Natural ventilation	<ul style="list-style-type: none"> Relies on wind pressure and cross-ventilation. Stack effect. 	<ul style="list-style-type: none"> Significant energy-saving benefits. Fan noise. 	<ul style="list-style-type: none"> Requires open floor plan. Greater variance of temperature throughout day. External noise.

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Air-Conditioning Systems

System	Description	Advantages	Disadvantages
Split	<ul style="list-style-type: none"> Condenser and compressor are in one location, metering device and evaporator in another. Also called ductless system. 	<ul style="list-style-type: none"> Zoned temperature control. Most can be controlled remotely. Low maintenance costs. Can be subsidized by solar power. 	<ul style="list-style-type: none"> Not as practical for large or tall buildings. Noise where compressor and condenser are located.
Packaged	<ul style="list-style-type: none"> All components encased in single outdoor unit. Located on ground or roof. 	<ul style="list-style-type: none"> Available in multiple capacities. Single or multiple zone. 	<ul style="list-style-type: none"> Higher maintenance costs due to leaking, corrosion, and rust.
Centralized (chiller)	<ul style="list-style-type: none"> Uses steam to produce chilled water. Plant room houses compressor, condenser, throttling valve, evaporator. 	<ul style="list-style-type: none"> Serves multiple locations from one base. Control of comfort conditions. Load-management potential. 	<ul style="list-style-type: none"> Extensive ductwork required for air distribution. Expensive to install. Complex to operate and maintain.

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Electrical System Components

Switchgear	<ul style="list-style-type: none"> • Controls power to facility. • Typically consists of switches or circuit breakers.
Panelboards	<ul style="list-style-type: none"> • Control and protect branch circuits. • Usually housed in cabinet; contain breakers.
Switches and controls	<ul style="list-style-type: none"> • Direct flow of power. • Safety switches in areas where emergency cutoff may be needed.
Transformers	<ul style="list-style-type: none"> • Don't create energy, convert/transform energy to another level. • Usually located outside facility.
Service outlets	<ul style="list-style-type: none"> • Receptacles or outlets; can be two- or three-pronged. • Grounding to earth is used as precautionary measure.
Fuses	<ul style="list-style-type: none"> • Current-limiting or non-current-limiting types. • Found in panelboards, circuit breakers, switches, and transformers.

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Types of Lighting


Type	Description
Fluorescent	<ul style="list-style-type: none"> ▪ Compact fluorescent lamps in integral ballasts with screw bases. ▪ Fluorescent tube and circline lamps for lighting large areas.
Incandescent	<ul style="list-style-type: none"> ▪ Least energy-efficient type. ▪ Turns on instantly. ▪ Available in many sizes. ▪ Provides warm lighting.
Light-emitting diode (LED)	<ul style="list-style-type: none"> ▪ More durable than other types. ▪ Uses less energy, lasts longer than most other forms of lighting. ▪ Emits lighting in specific direction. ▪ Emits very little heat.
High-pressure sodium (HPS)	<ul style="list-style-type: none"> ▪ Commonly used for lighting industrial and outdoor areas.
Metal halite	<ul style="list-style-type: none"> ▪ Produces intense white light. ▪ Used for wide area overhead lighting.

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 **Discussion Question**

What percentage of energy does fluorescent lighting use compared to incandescent lighting?

- a) 10 to 15 percent
- b) 25 to 30 percent
- c) 40 to 50 percent
- d) 45 to 55 percent

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Plumbing Systems

- Three lines:
 - Hot water
 - Cold water
 - Drainage, waste, and ventilation (DWV)
- Any deficiencies should be addressed promptly, as they are likely to impact other systems.



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Conveying Systems

- Conveying system uptime impacts occupant satisfaction.
- Elevators are one of most expensive components of facility.
- Specialized skills are needed to maintain conveying systems.

Traction	Hydraulic
<ul style="list-style-type: none"> • Geared used in low- or mid-rise buildings; gearless used in mid- to high-rise buildings • Travels faster than hydraulic elevators • Uses a counter-weight 	<ul style="list-style-type: none"> • Electric drive • Cheaper to install • More expensive to maintain • Used for six stories or less • Moderate car speed

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Communication and Cabling Systems

Cable Type	Advantages	Disadvantages
Shielded twisted pair	<ul style="list-style-type: none"> • Eliminates electrical interference • Higher transmission rate than unshielded 	<ul style="list-style-type: none"> • More expensive than unshielded
Unshielded twisted pair	<ul style="list-style-type: none"> • Low installation cost 	<ul style="list-style-type: none"> • Electrical interference
Coaxial	<ul style="list-style-type: none"> • Runs longer distances • Bandwidth • Not impacted by radio interference 	<ul style="list-style-type: none"> • Cost of termination, splicing
Fiber-optic	<ul style="list-style-type: none"> • Speed • Bandwidth • Two kilometers without repeaters • Smaller and lighter • Not impacted by radio interference • Safe to use in dangerous environments 	<ul style="list-style-type: none"> • Need for termination equipment at both ends

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Networks

Options	Description	Advantages	Disadvantages
Wireless networks	<ul style="list-style-type: none"> Allow occupants to work without being connected to cable or fiber-optic network. 	<ul style="list-style-type: none"> Increased efficiency. Easier, cheaper to install. Reach areas that cables cannot. 	<ul style="list-style-type: none"> Increased vulnerability to security attacks. Slow connection speed. Black spots/voids.
Cellular networks	<ul style="list-style-type: none"> Used for voice and data transmission. 	<ul style="list-style-type: none"> Available where LANs and WLANs do not reach. Offer access to other tools, such as email. 	<ul style="list-style-type: none"> Expensive data packages. Gaps in coverage.
Personal area networks	<ul style="list-style-type: none"> Short-range wireless network for close devices. 	<ul style="list-style-type: none"> Free up desk space. Unclutter cords/cables. Cost-effective. 	<ul style="list-style-type: none"> Slow data transmission rates. Short distances.
Virtual private networks	<ul style="list-style-type: none"> Create secure network by using data encryption. 	<ul style="list-style-type: none"> Remote/secure access to corporate intranet. Available from internet. 	<ul style="list-style-type: none"> Complex internal setup. Network specialist needed. User cannot roam.

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Data Center Design Requirements

Space

- Location in building
- Square footage
- Floor system

Mechanical

- Power requirements using PUE
- HVAC
- Humidification and dehumidification
- Air pressure
- Electrical infrastructure
- Uninterrupted power supply

Security

- Physical locks
- Access control system
- Intrusion detection system

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Data Center Classifications

Tier	Description	Requirements
1	Basic site infrastructure	<ul style="list-style-type: none">• Nonredundant capacity components• Single, nonredundant path to computer equipment
2	Redundant capacity components site infrastructure	<ul style="list-style-type: none">• Redundant capacity components• Single, nonredundant path to computer equipment
3	Concurrently maintainable site infrastructure	<ul style="list-style-type: none">• Redundant capacity components• Multiple independent paths• One path to service computer equipment at all times• Dual-powered
4	Fault-tolerant site infrastructure	<ul style="list-style-type: none">• Multiple, independent, physically isolated systems, each with its own redundant capacity• Multiple independent paths servicing computer equipment at same time• Dual-powered

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Waste Management and Removal Systems

- Must align with organization’s sustainability initiatives.
- Execution depends on type and volume of waste that must be removed from facility.

Most preferred

Prevent

Minimize

Reuse

Recycle

Dispose

Least preferred

Sustainability

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Interior Systems


Systems	Common Types	Common Deficiencies
Walls	<ul style="list-style-type: none"> • Veneer plasters • Gypsum board • Gypsum fiber 	<ul style="list-style-type: none"> • Mold • Water spots/damage • Crumbling/rot
Floors	<ul style="list-style-type: none"> • Wood frame • Concrete • Pre-stressed concrete 	<ul style="list-style-type: none"> • Uneven/sloping • Cracks • Water damage • Odor
Stairs	<ul style="list-style-type: none"> • Prefabricated 	<ul style="list-style-type: none"> • Uneven wear • Cracks • Splitting/rotting • Loose connections • Cupping
Interior doors	<ul style="list-style-type: none"> • Hollow core • Solid core • Fiberglass 	<ul style="list-style-type: none"> • Do not latch when closed • Do not fully close

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Furnishings, Fixtures, and Equipment

- May be purchased or rented.
- Must be tracked and managed to:
 - Ensure appropriate availability.
 - Avoid overages.
 - Reduce waste.



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Acquisition and Installation of Building Systems

```

    graph TD
      CP[Capital planning] --> AI((Acquire & install building systems))
      PM[Project management] --> AI
      FM[Financial management] --> AI
      P[Procurement] --> AI
    
```

- A thorough analysis is required before starting a new acquisition initiative.
- Once a need is determined, establish the selection criteria and select a provider for the system installation.

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Facilities Audits

```

    graph LR
      S1[Step 1: Designing the facility audit] --> S2[Step 2: Conducting the facility audit]
      S2 --> S3[Step 3: Preparing the facility audit report]
    
```

<ul style="list-style-type: none"> ▪ Establish audit parameters. ▪ Decide on team of auditors. ▪ Arrange inspection. ▪ List required information. 	<ul style="list-style-type: none"> ▪ Prepare forms. ▪ Perform audit. 	<ul style="list-style-type: none"> ▪ Review audit forms. ▪ Design report. ▪ Create report.
---	--	---

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Measuring Building Performance

Four most significant indicators of building performance:

- Carbon
- Energy
- Water
- Waste

Term	Definition
Baseline	Measurement taken at starting point to use for comparison.
Benchmark	Reference point or metric against which process, performance, and/or quality can be measured.
Key performance indicator (KPI)	Measure that provides essential information about performance.
Target	Desired level of future performance.

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Discussion Question

What is the effect of the International Organization for Standardization developing standards for measurements for carbon, energy, water, and waste?

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Key Building Performance Metrics

Select metrics based on:

- Ease of collection.
- Usefulness of information.
- Quality of data.

```

    graph TD
      A[Document the purpose/goal of data collection] --> B[Identify the data needs]
      B --> C[Identify the data source(s)]
      C --> D[Determine how the data will be collected]
      D --> E[Collect the data]
      E --> F[Analyze and interpret the data]
      F --> G[Take action]
    
```

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Performance Benchmarking

- **Property costs:** Lease, service charges
- **Maintenance costs:** Corrective, preventive/scheduled, emergency
- **Cleaning:** Janitorial costs, cleaning frequencies
- **Utilities:** Consumption, costs
- **End-user productivity:** Employee engagement, customer satisfaction, financial performance, service level, quantitative

```

    graph TD
      1[1. Plan] --> 2[2. Gather cost and performance data]
      2 --> 3[3. Analyze the data]
      3 --> 4[4. Interpret the data]
      4 --> 5[5. Report and take action]
      5 --> 1
    
```


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Technology and Tools Targeting Increased Efficiency

Facility managers may encounter some of these technologies:

- Building management system (BMS)
- Building control system (BCS)
- Energy management system (EMS)
- Direct digital control (DDC)
- Application programming interface (API)



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Intelligent Buildings

<p>Key traits:</p> <ul style="list-style-type: none"> ▪ Integration of disparate building systems ▪ Use of shared network ▪ Common user interface ▪ Merged IT and building management systems 	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #444; color: white;"> <th style="padding: 5px;">Advantages</th> <th style="padding: 5px;">Challenges</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px; vertical-align: top;"> <ul style="list-style-type: none"> • Increased employee productivity. • Reduced operating expenses. • Flexible space options. • Energy metering. • Facility management tools accessible via web/self-service. </td> <td style="padding: 5px; vertical-align: top;"> <ul style="list-style-type: none"> • Must be planned in advance of cabling. • Building and business systems may interfere with each other. • Technology continues to change. • New systems must either merge with existing systems or take other systems forward. </td> </tr> </tbody> </table>	Advantages	Challenges	<ul style="list-style-type: none"> • Increased employee productivity. • Reduced operating expenses. • Flexible space options. • Energy metering. • Facility management tools accessible via web/self-service. 	<ul style="list-style-type: none"> • Must be planned in advance of cabling. • Building and business systems may interfere with each other. • Technology continues to change. • New systems must either merge with existing systems or take other systems forward. 	
Advantages	Challenges					
<ul style="list-style-type: none"> • Increased employee productivity. • Reduced operating expenses. • Flexible space options. • Energy metering. • Facility management tools accessible via web/self-service. 	<ul style="list-style-type: none"> • Must be planned in advance of cabling. • Building and business systems may interfere with each other. • Technology continues to change. • New systems must either merge with existing systems or take other systems forward. 					

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Computer-Aided Facility Management (CAFM)

- CAFM systems allow different software programs to work together.
- CAFM software is a tool to track, manage, and report on specific business areas.

CAFM System Benefits
<ul style="list-style-type: none">▪ Detailed information to assist with planning of space requirements, location of equipment, environmental constraints, and construction costs▪ Valuation of fixed assets▪ Precise cost allocation and accounting▪ Real-time reporting capabilities and benchmarking▪ Access to a decision-making tool▪ Capability to perform analysis


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Questions?



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Section 3: Occupant Services

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Maintenance
Section 3: Occupant Services

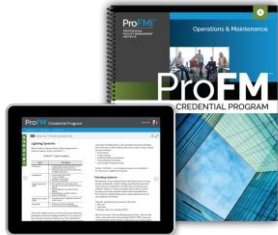
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Section 3 Topic Preview

- **Topic 1:** Determining the Need for Occupant Services
- **Topic 2:** Occupant Services Overview
- **Topic 3:** Monitoring and Evaluating Occupant Services



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Occupant Services Examples

- Food
- Custodial
- Mail services
- Telecommunications
- Security



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FM Role in Occupant Services

- Identifying need or want
- Determining alignment with organization's strategy
- Setting service levels and standards for performance
- Determining reporting requirements
- Administering allocation of services
- Monitoring, inspecting, and evaluating services



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Knowing the Occupants

- Facility managers must understand:
 - How occupants are using the space.
 - Typical work styles of occupants.
 - What percentage of time is the space completely, partially, or minimally occupied.
- Use surveys to learn more about occupants and their needs. There are two types:
 - Traditional surveys
 - Net Promoter Score surveys



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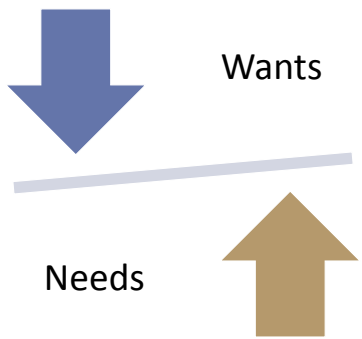
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Determining What Services to Offer

- Differentiate between needs and wants.
- Needs** are items required by occupants to perform job tasks.
- Wants** are items occupants would like to have but are not required to perform their jobs.



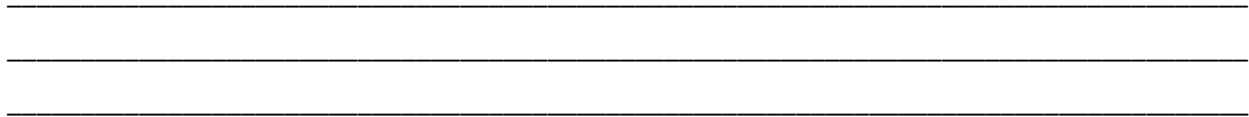
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Service Levels and Standards

- Service standards are used to:
 - Set expectations.
 - Ensure consistency in level of service provided to occupants.
 - Establish baseline to measure against and monitor performance.
- Service level agreements (SLAs) are used to:
 - Ensure that occupant’s voice is heard.
 - Establish reasonable service delivery expectations.
 - Eliminate ambiguity.
 - Provide single point of reference.
 - Ensure that success (or failure) can be measured.

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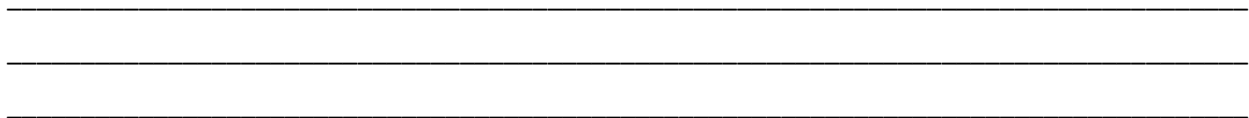


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Outsourcing

Advantages	Disadvantages
<ul style="list-style-type: none"> ▪ Global reach for required talent ▪ Allows FM to focus on core competencies ▪ Adds specific expertise ▪ Ramp up and down for seasonal work 	<ul style="list-style-type: none"> ▪ Lack of control over quality of work ▪ Can be expensive ▪ Lack of knowledge of organization’s culture and norms ▪ Missed opportunity to connect with other departments

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Insourcing

Advantages	Disadvantages
<ul style="list-style-type: none">• Control over quality of work• Control of who is working on what projects• Stretch opportunities for employees• Builds internal organizational knowledge• Builds relationships with other departments	<ul style="list-style-type: none">• Requires additional head count• Does not allow for seasonal scaling of workforce• Requires additional resources for supervision• Additional training costs on specialty skills• Limited workforce to select from

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Discussion Question

What types of occupant services have you insourced or outsourced at your facility? What positive or negative experiences did you have as a result of your decision to insource or outsource?

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Food and Beverage Services

- Five categories of food services offerings: coffee service, fast food/ takeout, full-service cafeteria, table service, and party/banquet service.
- Capital investment for food services is high, so decisions must be carefully considered.
- Facility managers must keep up to date on laws and regulations regarding food service and ensure that they comply with them.



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Custodial Services

- High visibility service.
- Frequency, cleaning method, and quality standards must be specified.
- Cleaning audit checklist can be used to monitor specification compliance.



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Fleet Management

- Facility managers may be responsible for staff service vehicles, employee shuttle buses, or executive sedans.
- Fleet management principles:
 - Central control and dispatching
 - Planned maintenance
 - Differences in liability for leased and owned vehicles
 - Controlled on-site parking areas for fleet vehicles when not in use
 - Only licensed/registered drivers

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Mail and Copying/Printing Services

- Ergonomics is important.
- Workflow should match that of postal equipment.
- Flexible mail-sorting areas/layouts.
- Copy services may be centralized and/or decentralized.
- Key sustainable behaviors:
 - Emailing whenever possible
 - No unnecessary copying
 - Turning off machines when not in use



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Records Management

- Review, retention, archiving, and disposing of records.
- File management system is required to ensure efficient retrieval of documents.

Type	Duration (in Years)
Accident reports	8
Accounts payable records	6
Bank statements	6
Credit files	6
Employee records	6 (after termination)
Financial statements	Permanent
General ledger	Permanent
Inventory	6
Patents	17
Taxes	6
Travel and expense reports	6

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Telecommunications

- Requires managing both cabled infrastructure and wireless technology requirements.
- Local, long-distance, and cell service contracts may all need to be negotiated separately.



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Conference Room Scheduling

- May involve setup of room or configuration for specific meeting needs.
- FM team must ensure that room scheduling policy is being followed and troubleshoot any booking errors.
- Audiovisual support may be offered along with conference room scheduling.



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Additional Services

- Additional services such as child care, health and fitness, and concierge services may fall under the purview of a facility manager.
- These services may be used as a method to attract and retain talent.




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 **Discussion Question**

What types of occupant services does your facility provide as a means to attract and retain talent?

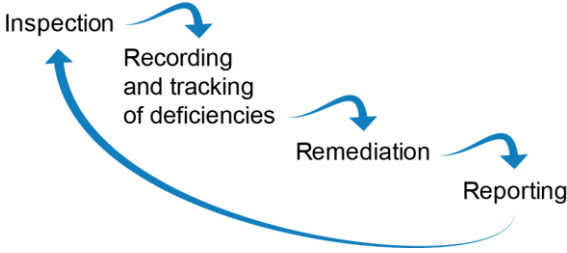
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Quality Control Plan



```
graph LR; Inspection --> Recording[Recording and tracking of deficiencies]; Recording --> Remediation; Remediation --> Reporting; Reporting --> Inspection;
```

An occupant services quality control plan is a tool to ensure that all services are being performed to agreed-upon standards.

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Inspection

- Accomplished most efficiently when facility manager creates set of facility- and equipment-specific checklists or guidelines.
- Should be conducted by individuals at multiple levels of the organization.



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Recording and Tracking of Deficiencies

- Deficiencies during inspection must be recorded and corrective actions must be documented and submitted.
- Information to gather:
 - Date/time
 - Location
 - Who is completing documentation
 - Description of discrepancy
 - Severity
 - Supporting images



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Remediation

- Facility manager must review deficiencies and work to determine corrective action.
- When applicable, deficiencies may be entered into CMMS.
- While fixing deficiency, examine situation to determine cause.



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Reporting

- Using information provided manually or from CMMS, track deficiency trends.
- Use those trends to determine:
 - Ability of FM to address deficiencies in timely manner.
 - How preventive maintenance impacts occupant services deficiencies.
 - Need for changes to existing occupant services.
 - Need for new/additional occupant services.



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Workflow for Occupant Services

Priority	Task
Level 1	Emergency
Level 2	Critical (within 12 hours)
Level 3	Standard (within 48 hours)
Level 4	Maintenance (preventive/predictive)
Level 5	Projects

Priority levels and expectations are unique to each organization.

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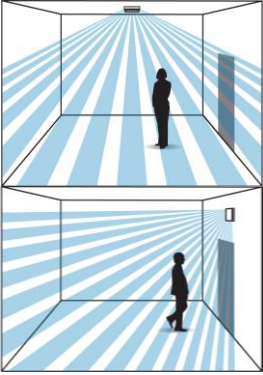
Technology and Tools Targeting Increased Efficiency

Lighting management systems

- Centralized control points managed by calendaring, occupancy sensors, external factors.
- Combining local and centralized control points to double energy efficiency.

Occupancy sensors

- Infrared sensors count people entering building.
- Space/desk sensors track use of desks, offices, or rooms.
- Facial/people recognition sensors count people in given space.



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Handling Occupant Complaints

Complaint-handling tips:

- Don't let complaints linger.
- Have a policy that addresses your philosophy on complaints.
- Examine complaints without assumptions.
- Use prioritization criteria.
- Communicate clearly with occupants while resolving.

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Discussion Question

What additional methods or tips for handling occupant complaints have you found to be effective?

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Evaluating Occupant Services

- Each occupant service has key points where deficiency can occur.
- Occupant satisfaction is result of difference between expectations and perception.
- Satisfaction surveys can be used to gauge occupant satisfaction.
- Use data to work smarter and provide better services.

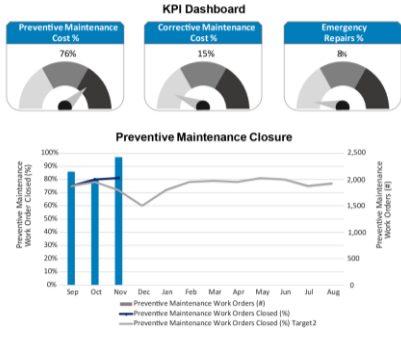
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Key Performance Indicators (KPIs)

- KPIs are measures that demonstrate that particular goal has been met.
- KPIs should be monitored regularly.
- Reporting can be presented via many ways, including:
 - Scorecards.
 - Dashboards
 - Reports.



KPI Dashboard

Metric	Value
Preventive Maintenance Cost %	76%
Corrective Maintenance Cost %	15%
Emergency Repairs %	8%

Preventive Maintenance Closure

Month	Preventive Maintenance Work Orders Closed (%)	Preventive Maintenance Work Orders Closed (N)
Sep	~85%	~1,800
Oct	~80%	~1,800
Nov	~90%	~2,000
Dec	~70%	~1,500
Jan	~75%	~1,600
Feb	~75%	~1,600
Mar	~75%	~1,600
Apr	~75%	~1,600
May	~75%	~1,600
Jun	~75%	~1,600
Jul	~75%	~1,600
Aug	~75%	~1,600

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Benchmarking Occupant Services

- Benchmarking can be conducted with the internal or external organization and can be performed on an international, national, or local level.
- The more similar the organizations, services, and metrics are, the greater the correlation.
- Determine the benchmarking goal and strategy up front.




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Questions?



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Section 4: Work Management

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Section 4: Work Management

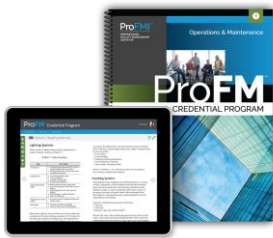
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Section 4 Topic Preview

- **Topic 1:** Work Requests
- **Topic 2:** Maintaining Systems and Equipment



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Work Management

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Work Orders

- A **work reception center (WRC)** is typically the single point where all facility work requests are received, prioritized, tasked, coordinated, and evaluated.
- A **work order** is a formal record of the effort required to maintain a facility in an optimal operating condition.

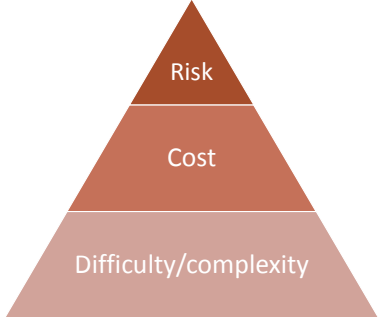
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Prioritizing Work

- Requests normally fall within these facility management categories:
 - Emergency
 - Preventive
 - Janitorial
 - Repair
 - Deferred
 - Project work



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Coordinating Work

- Work orders and resulting service must be documented in case repair or preventive maintenance records are required later.
- Work orders might be documented via spreadsheet or in FM software application.


Facility Management Work Order/Maintenance Log (Which?) Qtr. (What Fiscal Year?)											
Order #	Location	Requester	Problem Identified /Work Requested	Priority	Category	Assigned To	Date Assigned	Date Completed	Parts Used	Cost	Remarks

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 **Discussion Question**

What is your preferred method for coordinating work orders and documenting maintenance procedures?

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On-Hand Inventory

- Inventory items may include:
 - Specialized equipment.
 - Power tools.
 - Maintenance supplies.
 - Commonly replaced parts.
 - Appliances.
 - Hand tools.



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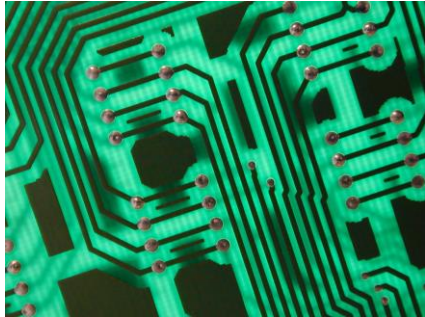
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Managing Work Requests Through Technology

- Two common types :
 - Computerized maintenance management systems (CMMS)
 - Computer-aided facility management (CAFM)



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CMMS

- Stand-alone software
- Provides visibility of maintenance decisions and work orders
- Tracks work costs, equipment information and history, and labor resources
- Optimized preventive maintenance opportunities




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CAFM

- Usually module in enterprise resources planning (ERP) system
- Helps facility managers track and manage how facilities are used
- Performs analytics to help identify trends and patterns to help make operations decisions
- Typically extends reach of CMMS and integrates with other technology such as CAD and BIM




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Customer Feedback, Reporting, and Metrics

- Using CMMS, automated emails can be sent to gather feedback when work orders are closed.
- Using this feedback, facility manager can request reports with variety of parameters.
- Feedback may also be gathered and analyzed at monthly or yearly intervals.



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Setting up WRC/Facility Helpdesk

- Requires groundwork, such as determining which of the functions is appropriate.
- Facility manager will be involved at every step of process.

1. Business case created
2. Initial review/upward submission
3. Top management review/approval
4. Finance-assigned details
5. Workforce planning completed
6. Hiring process completed
7. Space procured/built out
8. Software purchased and configured
9. Training created/implemented
10. WRC staff operating model created
11. WRC goes live

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Maintenance Classifications

- Preventive
- Condition-based
- Unplanned

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Preventive Maintenance

- Required for equipment and machinery warranty requirements and to maximize useful life.
- Can be scheduled by:
 - Maintenance log.
 - Monthly or quarterly spreadsheet.
 - Calendar entries in communications software.
 - CMMS.



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Subtypes of Preventive Maintenance

- Custodial maintenance
- Running maintenance
- Shut-down maintenance
- Opportunity maintenance
- Fixed cost



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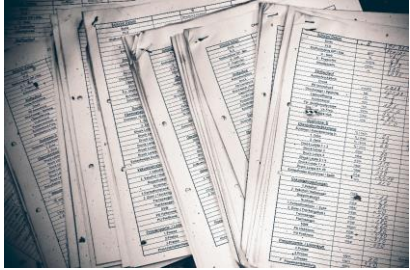
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Preventive Maintenance Task Lists

Task lists can come from many sources:

- Technical experience with asset type
- Other facility managers of sister buildings
- Contracted service suppliers
- Owners' manuals from manufacturers
- Governmental agencies
- Insurance companies



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Creating Preventive Maintenance Program

1. Create inventory of all elements.
2. Collate and review list of equipment.
3. Review its history.
4. Ensure that everything FM is responsible for is listed.
5. Choose where and how program will be housed.
6. Decide which items should never fail and put them on schedule.
7. Based on inventory, schedule refurbishments and renovations.
8. Obtain and train inspectors on use of preventive maintenance tools.
9. Populate task list based on each asset.
10. Assign time or work standards to task lists, with periodic reviews.
11. Decide on maintenance frequency for each asset.
12. Load system and implement maintenance schedule.

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Condition-Based Maintenance

- May be used in addition to cyclical preventive maintenance.
- Uses inspections to predict remaining useful life.
- To appraise condition, following may be used:
 - Tools and instruments
 - Comparisons to previous measurements
 - Technician experience



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Condition-Based Maintenance Variants

Variants on condition-based maintenance include:

- Reliability-centered maintenance (RCM).
- Total productive maintenance (TPM).

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Specialized Inspection Tools

- Vibration analysis tools
- Sound spectral analysis tools
- Power analysis tools
- Infrared cameras




Unusual readings or inefficiencies may indicate that repair or a setting adjustment is needed.

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Discussion Question

What other types of specialized tools do you have experience with? How do you employ them in your facility?

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Unplanned Maintenance

- Occurs after full or partial failure.
- Consists of corrective, breakdown, and emergency maintenance.
- Priority levels:
 - Emergency
 - “Fix-it-now”
 - High, medium, low



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FM Departmental Goals

- Goals may include levels of financial and time expenditures for maintenance, repair, and replacement.
- Management and staff should contribute.
- May include start of department standards.



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Key Performance Indicators for Maintenance

- Internal benchmarking is considered more important than external.
- Key metrics include:
 - Mean time to repair (MTTR).
 - Mean cycles between failure (MCBF).
- KPIs should include:
 - Quality and quantity of maintenance work.
 - Risk reduction to operating equipment.
 - Effective use of resources to meet desired results.



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Planning

- Vast majority of maintenance work should be planned and scheduled.
- FM has two major maintenance priorities:
 - General maintenance plans and budgets
 - Capital investment projects related to upgrades that will reduce maintenance expenses
- Conducting inventories of initial and ongoing conditions is key to planning.

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Cost of Ownership

- Annual FM budget should be about two to four percent of cost of replacing structures in facility.
- Discuss fund allocations from ROI perspective, including:
 - Replacement.
 - Maintenance.
 - Repair.

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Scheduling

- At least 90 percent of scheduled work should be completed every week to avoid backlogs.

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Management Support of Maintenance Function

- FM departments must have sense of ownership and pride regarding maintenance equipment.
- Operations is often required to take proactive role to allow for opportunity maintenance to occur.

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User Input on Maintenance Plans

End users can reduce maintenance costs by about 10 percent by:

- Using trash and recycling receptacles correctly.
- Reporting deficiencies like flickering lights.
- Turning off lights and water faucets when not in use.
- Putting signs only in approved areas.
- Reporting unsafe conditions like icy sidewalks.
- Wiping shoes on entryway mats.



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Inspections and Condition Surveys

- Annual inspections can provide evidence of maintenance plan's efficacy.
- Condition surveys should be conducted about every five years, identifying at-risk structures.

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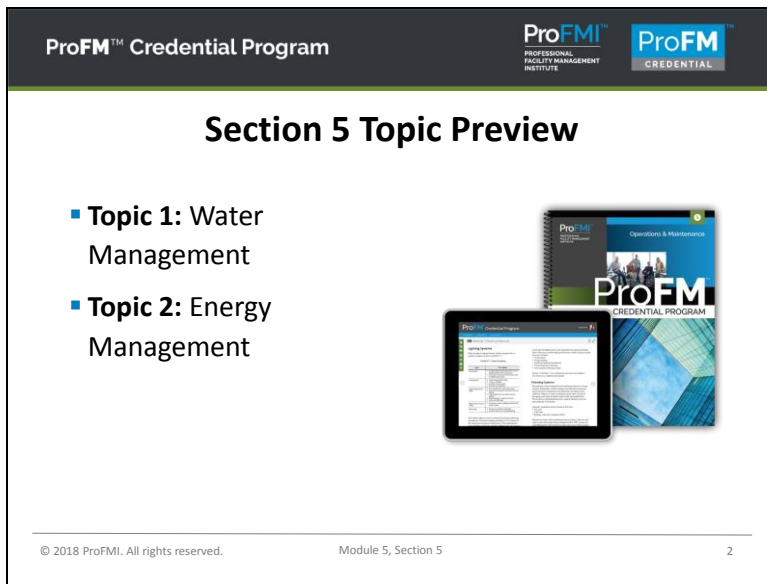
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Critical Maintenance Indexes

Machine downtime for maintenance reasons	• World class is under 2%
Percentage of hours on weekly work schedule	• More than 90%
Percentage of schedule completed	• More than 95%
Percentage of hours on preventive maintenance	• More than 40 %
Percentage of hours on emergency work	• Less than 10%
Backlog	• Between 3 and 6 weeks

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Section 5: Utility Management




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Consumption and Demand

- Demand impacts organization's utility bill.
- Rates that entities are charged are based on both peak use and total consumption at meter level.
- Having multiple master meters can result in organization losing volume-based price breaks.



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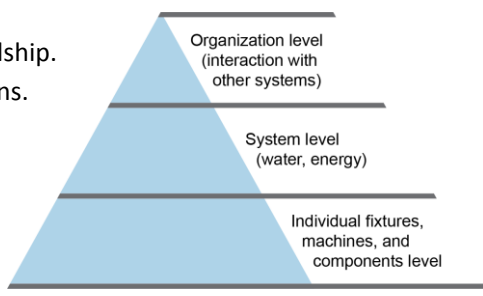
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FM Role in Utility Management

Facility managers are charged with moving to best practices in utility management, due to:

- Desire for cost savings.
- Environmental stewardship.
- Federal/local regulations.




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Water Management

Water consumption is impacted by many factors:

- Location of facility
- Type of building
- Design of building
- Facility use/size



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Water Systems

System	Components	
Heating and cooling	<ul style="list-style-type: none"> • Chillers • Cooling towers • Boilers 	<ul style="list-style-type: none"> ▪ Water systems move hot or cold water between locations. ▪ Proper operation and maintenance allow for maximization of life spans of systems.
Domestic plumbing	<ul style="list-style-type: none"> • Toilets/urinals • Faucets/showerheads 	
Irrigation	<ul style="list-style-type: none"> • Landscape design • Daily operations • Maintenance 	

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 **Discussion Question**

What different types of water systems do you work with at your current facility?

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Chillers

Chiller types:

- **Centrifugal**—Generally most popular way to cool large building. Uses vapor compression cycle to chill water and reject any heat. Capacities range from 100 to 10,000 tons.
- **Absorption**—Uses absorption fluid to remove heat from chilled water. Often used to avoid higher electric charges in summer. Capacity up to 1,600 tons.
- **Helical rotary screw compressor**—Positive displacement compressor. Systems are very quiet and feature basic components similar to those found in centrifugal chillers. Capacity range of 40 to 2,000 tons.

Chillers are often the largest users of electricity in a facility.

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Cooling Towers

Cooling towers use water in four ways:

- Evaporation
- Drift
- Blowdown
- Make-up water

Be aware of following to keep them operating at maximum capacity:

- Corrosion
- Scale
- Biofouling



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Boilers

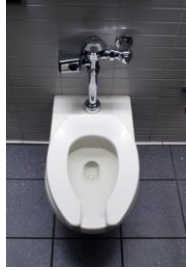
Type	Description	
Fire tube	<ul style="list-style-type: none"> • Combustion gas passes inside boiler tubes. • Water is between tube and outer shell. • Identified by number of passes. 	<ul style="list-style-type: none"> ▪ Fire and water tube boilers have thermal efficiencies ranging from 70 to 80 percent. ▪ Measurement of amount of energy converted to heat is called annual fuel utilization efficiency (AFUE). ▪ Common systems in boiler include burner, water feeder, boiler controls, and pumps.
Water tube	<ul style="list-style-type: none"> • Boiler water passes inside tubes. • Combustion gas passes between tube and outer shell. • Used when high steam pressure (>3,000 psi) is required. • Ideal for process industries. 	

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Domestic Plumbing

Fixture	Tactic
Toilets/ urinals	<ul style="list-style-type: none"> Reduce flush valve flow. Reduce volume of flushing water by installing toilet dams and early-closing flappers. Place water-filled plastic container in tank to conserve flow volume. Adjust auto-flush timing cycles. Install waterless urinals.
Faucets/ showerheads	<ul style="list-style-type: none"> Replace with reduced-flow models. Reduce water use by installing aerators. Use metered faucets that dispense limited quantity of water on demand. Use automatic sensor-controlled faucets.



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Irrigation

- Good landscape design will help reduce water consumption.
- Set irrigation system so all areas receive same amount of water.

Modification	Tactic
Daily operations	<ul style="list-style-type: none"> Keep area weed-free. Water in early morning or evening to avoid evaporation. Water roots, not leaves. Use recycled water. Water deeply fewer times per week.
Maintenance	<ul style="list-style-type: none"> Check for leaks or other damage. Monitor irrigation system for broken/misspraying sprinkler heads. Check sprinkler head pressure.

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Water Use—Metering and Submetering

- In order to determine water use in facility, submeters must be used.
- Identifying leaks early minimizes damage and controls loss.

Gallons Lost per Month	Malfunction
21,600	Leaking toilet
43,200	Drip irrigation
216,000	Stuck float valve in cooling tower
648,000	Broken distribution line

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Discussion Question

What are some other areas in which you have identified leaks, and what water savings have you realized by fixing these leaks?

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Water Management

Four primary areas for water reduction:

- Decreasing unplanned water losses
- Improving efficiency of water use
- Reusing water
- Encouraging changes in occupant behavior via awareness and education

```
graph TD; A[Gain commitment] --> B[Audit water use]; B --> C[Establish and communicate program goals]; C --> D[Create an action plan]; D --> E[Implement the plan]; E --> F[Evaluate progress]; F --> G[Celebrate successes];
```

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Audit Water Use

- A water audit begins by:
 - Determining annual volume.
 - Calculating total annual water use costs.
 - Calculating annual water-related energy costs.
- Break down major areas of water use, determining exactly where, how, and when water is used.

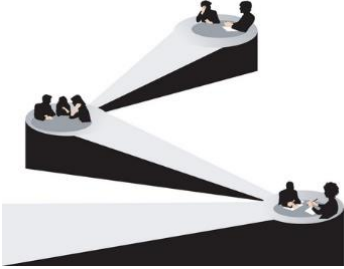
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Establish and Communicate Program Goals

- After establishing current state of water use, determine desired state.
- Create goals with individuals across all areas and levels of organization.
- Communicate goals to entire organization.



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Create Action Plan

Step	Tasks
1. Identify potential projects.	<ul style="list-style-type: none"> • Use water audit/facility water use chart to create list of projects. • Research codes/standards that may mandate changes in near future. • Estimate costs by project.
2. Secure financing.	<ul style="list-style-type: none"> • Determine if projects can be completed with operating expenses or if they require capital funding. • Research opportunities for rebates. • Calculate cost to lease versus buy.
3. Calculate payback.	<ul style="list-style-type: none"> • Calculate simple payback period by project to help with financing and prioritizing.
4. Prioritize projects.	<ul style="list-style-type: none"> • Compare projects proposed against program goals and cost savings. • Rank projects using established criteria.
5. Document priorities.	<ul style="list-style-type: none"> • Create list of the projects, including what each is and why it was placed in this priority.

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Wastewater Management

- Five primary types of wastewater: black, gray, yellow water; highway, surface drainage.
- Reduce amount of wastewater being sent back into system by using:
 - Waterless urinals.
 - Automatic faucets.
 - Faucet aerators.
 - Low-flow showerheads.
 - Boiler blowdown optimization.
 - Detention pods.
 - Storm water wetlands.
 - Porous pavement.



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Water Efficiency Standards, Codes, and Guidelines

- Standards**
 - Usually adopted as part of legislation, generally action written in enforceable language; require mandatory participation.
- Codes**
 - Similar to standards, written in enforceable language.
- Guidelines**
 - Usually voluntary; not written in enforceable language.



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Energy Management

Inflows

- Electricity
- Fossil fuels (coal, natural gas, fuel oil)
- Renewables (biomass, geothermal, solar, wind)

Outflows

- Direct greenhouse gas emissions
- Waste (heat, air, water, garbage)
- Light pollution

Energy use

- Space heating
- Lighting
- Refrigeration
- Ventilation
- Cooling
- Cooking
- Water heating
- Computers and office equipment

Indirect carbon emissions

- Energy management aims for efficiency in:
 - Overall system.
 - Individual components or fixtures.
 - Operations and maintenance strategies.
- Facility managers are responsible for reducing:
 - Energy costs.
 - Carbon emissions.
 - Risk.

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Regulated and Deregulated Markets

- In a **regulated market**, utilities own the flow of energy, which is controlled all the way from generation to the meter.
- In a **deregulated market**, utilities do not own generation or transmission; they are only responsible for distribution, operations, and maintenance from the grid connection to the meter.

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Key Energy Roles

Role	Description
Aggregator	Intermediary that groups agents in power system to act as one when sourcing energy.
Curtailement service provider (CSP)	Interface between independent system operator and end-use customer.
Electric distribution company (EDC)	Reduces voltage received from transmission and then delivers electricity to retail customers.
Independent system operator (ISO)	Electrical power transmission system operator that coordinates movement of wholesale electricity within small area.
Regional transmission organization (RTO)	Electrical power transmission system operator that coordinates movement of wholesale electricity within region.
Transmission system operator (TSO)	Transports energy on regional or national level using fixed infrastructure.

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Key Energy Types

Electricity

Natural Gas

Heating Oil

- Powers lights, computers, boilers, elevators, fans, generators, etc.
- Sold by maximum kilowatts used during time period or total consumption (kilowatt-hours).

- Fossil fuel used for heating, cooking, and generation of electricity.
- Cost is direct result of supply and demand.
- Measured by volume and stated in cubic feet or Btu.


- Liquid petroleum product used as fuel for boilers and furnaces.
- Seasonal product made in summer and stored for use throughout year; cost varies.
- Measured in gallons or liters.

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Energy Use Intensity (EUI)

- Measure of how efficiently facility is using energy.
- If using building automation or energy management system, facility manager may be able to monitor this in real time.
- EUI gives facility manager baseline for building.



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Metered Energy



Facility managers must be aware of:

- Time when consumption occurred.
- Peak demand cost.

Terms	Definition
On-peak hours	Time period when demand is highest.
Off-peak hours	Time period when demand is low.
Consumption	Amount used in given period of time.
Demand	Average highest amount of energy meter registers in 15-minute period.
Demand charge	Additional fee.
Demand-response incentives	What organization can gain by reducing demand during peak times.

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Controlling Energy Costs

Load factor

- Actual number of kilowatt-hours delivered to facility in particular amount of time versus total possible



Power factor

- Ratio between power that electrical device uses to perform work and power that same device draws but does not directly use



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Correcting Low Power Factors



Correcting power factor of <1.0 can:

- Reduce power factor charge on electric bill.
- Decrease number of oversized transformers, conductors, etc.
- Reduce voltage drop and line losses.
- Increase usable power to facility.

Efficiencies	Description
Energy systems	<ul style="list-style-type: none"> Automate processes. Request submetering of systems.
Components and fixtures	<ul style="list-style-type: none"> Use time switches on lighting. Use occupancy sensors. Select energy-efficient equipment. Verify that insulation is adequate. Investigate alternate heat sources. Reduce outside air infiltration. Change to natural refrigerants.
Operations/maintenance strategies	<ul style="list-style-type: none"> Increase workplace participation. Encourage mobile workforce. Use data for predictive maintenance.

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Energy Programs

Energy Star

- Voluntary program created in 1992 by US EPA; adopted by many other countries.
- Created performance ranking system for several types of facilities, which can be used in benchmarking.

USGBC and Leadership in Energy and Environmental Design (LEED)



- US Green Building Council created LEED green building certification program.
- Four levels of LEED certification: certified, silver, gold, platinum.

BREEAM (Building Research Establishment Environmental Assessment Method)

- Oldest method for assessing and rating sustainability of buildings.
- Buildings receive ratings of pass, good, very good, excellent, or outstanding.

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Machine Efficiency Ratings

- Every piece of equipment that consumes electrical power has efficiency rating.

Equipment	Rating
Cooling equipment	<ul style="list-style-type: none"> • Energy efficiency ratio (EER) • Seasonal energy efficiency rating (SEER) • ENERGY STAR–certified HVAC equipment
Electric centrifugal chillers	<ul style="list-style-type: none"> • Kilowatts per ton of refrigerant • Federal Energy Management Program (FEMP) efficiency requirements • ENERGY STAR–qualified chillers
Heat pumps	<ul style="list-style-type: none"> • Coefficient of performance (COP) for water source heat pumps • SEER for air source heat pumps • Heating season performance factor (HSPF) for air source heat pumps • ENERGY STAR–certified

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Renewable Energy Sources

- Geothermal heat pumps
- Solar power
- Wind power
- Hydroelectric power
- Biomass




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Discussion Question

What renewable energy sources does your facility currently use? What energy sources do you think are the most applicable to your facility?

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Section 6: Space Management

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5 Operations and Maintenance
Section 6: Space Management

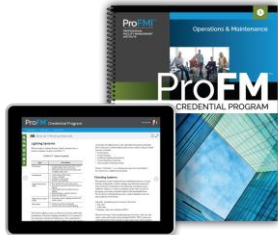
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Section 6 Topic Preview

- **Topic 1:** Determining Space Needs
- **Topic 2:** Space Planning and Design
- **Topic 3:** Relocation/ Move Management



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Space Management

- **Space management** is the efficient use and control of the space occupied by an organization.

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Disabilities Acts

- Americans with Disabilities Act (ADA): United States
- European Accessibility Act: European Union
- Requirements:
 - Doorways and corridors wide enough for wheelchairs
 - Wider restroom stalls for wheelchair-bound
 - Ramps and/or elevators for those unable to climb
 - Voice recognition software for hearing-impaired
 - Larger monitors and bigger work surfaces
 - Enlarging features in software for vision-impaired

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Space Guidelines

To be most helpful, space guidelines should:

- Encourage flexibility.
- Define how effective space management helps organization.
- Contain organizational standard that focuses on function.
- Contain guidelines for supplementary and supporting spaces.
- Have process for soliciting user feedback and input.
- List measures of space use.
- Contain control mechanisms for accountability.
- Include provisions for use of software.

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Forecasting Space Needs

Forecasting is a planning tool used to predict a future event or trend.


Forecasts Can Be Driven by:	Criteria Needed to Forecast Reliably:
Industry growth	How much space is available and when
Organization's growth	Space type and condition
Workforce growth	Space location, shape, volume, dimensions
Individual needs	How the space will be used

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Macro Forecasting versus Micro Forecasting

- Macro forecasting is done at organizational level; it calculates space as square units of measure per staff member multiplied by number of seats.
- Micro forecasting is done for specific buildings for gross external and internal area and net internal, usable, and lettable area.



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Programming

Programming steps:

1. Write goal statement to define need.
2. Answer key questions.
3. Generate space concept and establish needs.
4. Compile and present findings and recommendations.


		○ Satisfaction rating	● Importance rating								
Space	Space to think and concentrate		●								
	Formal meeting space	○	●								
	Space for phone calls	○	●								
	Impromptu meeting space	○	●								
	Multipurpose space	○	●								
	Break space	○	●								
Features	Right balance between quiet and collaborative space	○	●								
	Mobile connectivity in all workspaces	○	●								
	Proximity to colleagues in my group	○	●								
	Work environment that encourages healthy behaviors	○	●								
	Access to natural light	○	●								
	Availability of spaces for formal meetings and presentations	○	●								
	Proximity to colleagues in other groups	○	●								
	Availability of spaces to collaborate and brainstorm ideas	○	●								
	Positive brand image	○	●								
			1	2	3	4	5	6	7	8	9

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 **Discussion Question**

What are some examples of key questions that should be asked during programming?

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Space Planning Considerations

Key factors to consider:

- Amount of space needed
- General condition and limitations of space
- Configuration of space
- Utilization of space and user requirements



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Churn Management

- **Churn management** means planning, reconfiguring, and coordinating movement of personnel into and out of workspaces.

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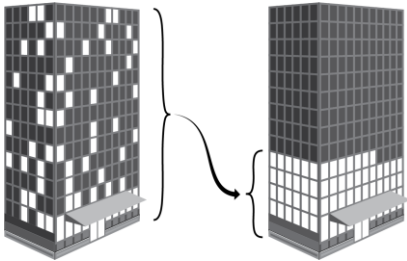
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Space Utilization Optimization



Makes difference to organization's profitability by:

- Freeing up space to be used to generate rental revenue.
- Potentially increasing utilization efficiency by up to 25 percent.
- Reducing operating costs.



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Measuring Space Performance



Two ratios used to measure space performance:

- Financial
- Physical

















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Adjacency Matrixes

-  Essential—continuous interaction
-  Meaningful—more than once daily
-  Occasional—once or less a day
-  Project-dependent
-  Too infrequent to quantify

	Finance	Business Development	Marketing	Construction	Estimating	HR	Legal	Training
Finance								
Business Development								
Marketing								
Construction								
Estimating								
HR								
Legal								
Training								

Show who needs to be physically near each other to best fulfill organizational functions

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Bubble Diagrams

- Show relationship and importance of relationships between departments or functions.
- Proportional bubble diagrams show size comparisons between departments.

Circles show departments' size in comparison with others.

Departments with close relationship are clustered together. Line widths show importance of relationships.

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Zone, Stacking, and Block Plans

- Zone plans show circulation routes and are often color-coded.
- Stacking plans represent vertical plane for building floor.
- Block plans are result of zone and stack plans being combined.

Public Private

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Planning Grids

Common types:

- Structural
- Shell
- Servicing
- Settings
- Furniture

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Requirements for Workspaces

Workstations

- Should be modular and relocatable.
- Maximizing space is goal.

Ergonomics

- Workplace-caused injuries are preventable productivity killers.
- Health insurance claims and productivity losses have significant impact on profitability.

Lighting


- **Lumen** is measure of amount of visible light from light source.
- Standard office lighting is typically 200 luxes, with minimum of 100 luxes.

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 **Discussion Question**

In what ways does your organization focus on improving productivity via workstations, ergonomics, or lighting?

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Flexible Work Arrangements

- Use mobile office equipment correctly.
- Take break every hour to get up and move around.
- Minimize clutter.
- Look away from screen frequently.
- Ensure good posture.
- Prevent hazards like tripping over cords.
- Obtain adequate space and lighting.
- Beware of signs of strain.
- Schedule meetings or work events.
- Get outside for fresh air and activity once a day.



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Flexible Work Arrangements

Nontraditional methods and tools:

- Homeworking
- Hotdesking
- Hoteling
- Team space
- Laptops
- Mobile phones



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Sustainable Space Management

Approach	Benefit	Effect
<ul style="list-style-type: none">• Encourage alternative workplace styles.• Maximize utilization.• Decrease churn.• Introduce flexible workspaces.	<ul style="list-style-type: none">• Decrease build-out specifications.• Soften demand for space.• Decrease number of changes/moves.• Restrain need for new construction or space.	<ul style="list-style-type: none">• Reduce build-out resources.• Curb churn costs.• Curtail new construction expense.• Decrease overall occupancy cost.

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Relocation/Move Steps

1. Distribute packing boxes and inform occupants of packing requirements.
2. Designate and communicate to team and security date and time of move, including how and resources used during move.
3. Assign staff to help with post-move adjustments.


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Churn

To minimize impact of churn:

- Get as close to single space standard per person as possible.
- Up-to-date wiring for IT and telephony.
- Modern telephony with voice over internet protocol (VOIP).
- Work from open floor plans.



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Furniture Acquisition, Inventory, and Movement

- Purchase or rental
- Plan to replace as needed or every 10 years



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Technology to Support Move Management

Required data for move plan generated by CAFM:

- Current open space in organization
- Application of move or installation policy and standards
- Available furniture and furnishings inventory
- Employee job classes
- Internal connections and communications affected by move

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