

Operation and Maintenance



Chapter 1

Introduction



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بب واستشارات

Chapter 2

Assess and Inspect Facility Needs



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Chapter 3

**Manage, Oversee,
and Monitor O&M
of Building, Systems
and Equipment**



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Chapter 4

Manage, Oversee and Monitor Occupant Services



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Chapter 5

Select the Best Resources



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Chapter 1

Introduction



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Contents

1- O&M Overview

2- Begin with a Plan



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1- O&M Overview

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Operation

VS

Maintenance

مرافق



Operation

Ensure that all processes in the facility have achieved the objectives

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Maintenance

Ensure that all infrastructure components are effective

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2-Begin With Plan



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Begin With Plan

1- Strategic Planning

2- Inventory

3- Maintenance Cycle





Begin With Plan

- 4- Maintenance Schedule
- 5- Regulations, Codes
- 6- Occupant Services



1- Strategic Planning

1

Purpose Level

3

FM Strategic Level

2

Corporate level

4

Tactical Level

1- Strategic Planning

5

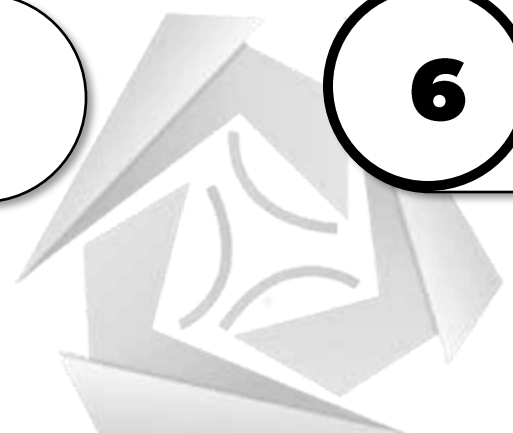
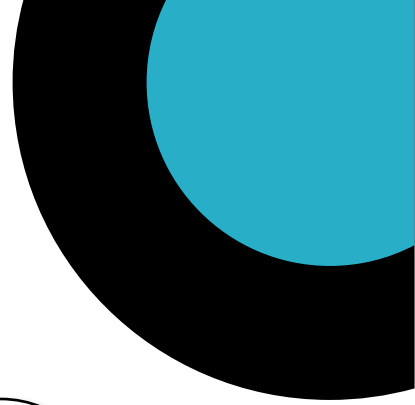
Execution Level

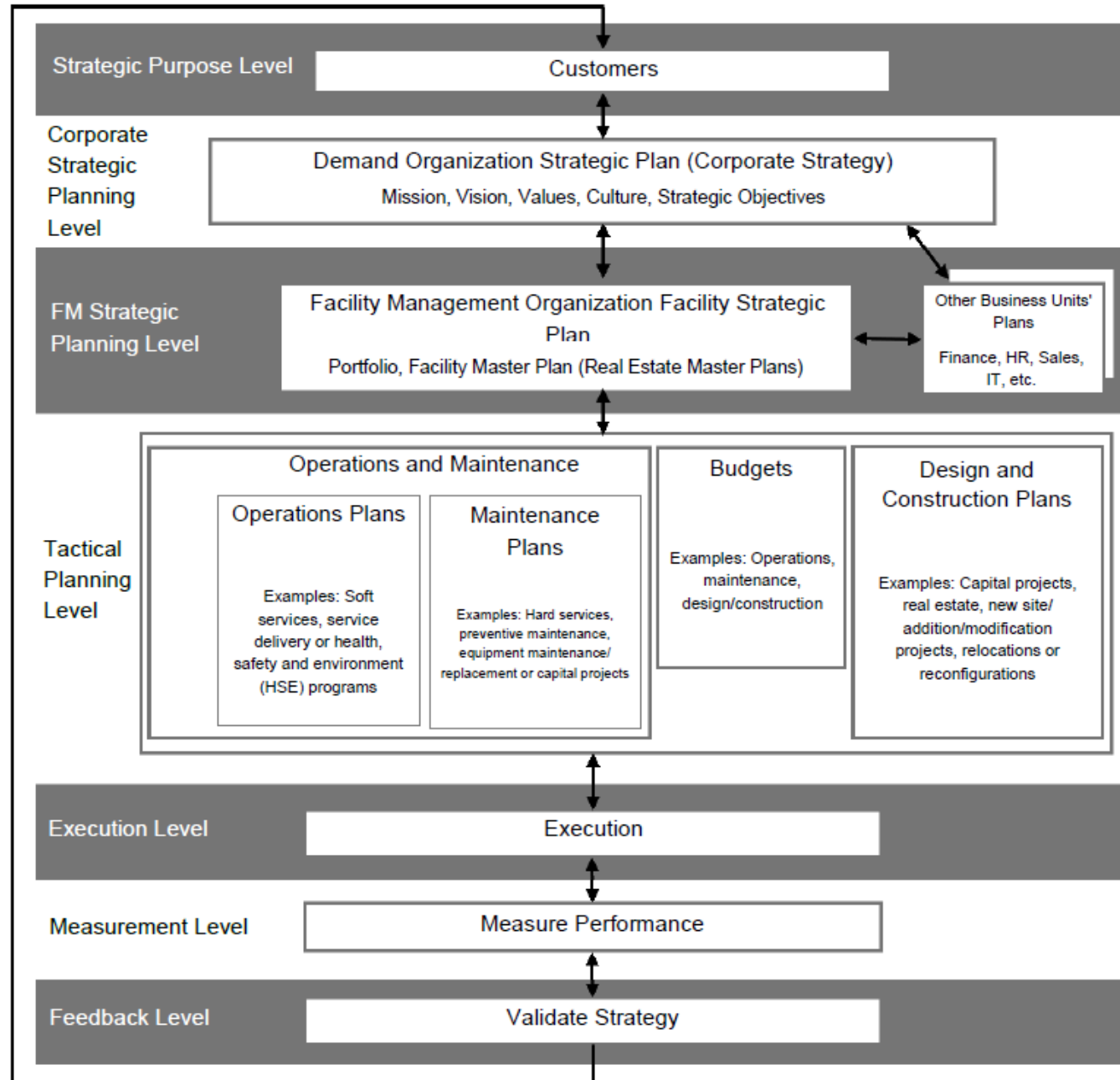
6

Measurement Level

7

Feedback Level







2- Physical Assets Inventory

Maintaining an Asset Inventory





2- Physical Assets Inventory

Conducting
Inspections





2- Physical Assets Inventory

Integrating the
Inventory
into O&M Plans





2- Physical Assets Inventory

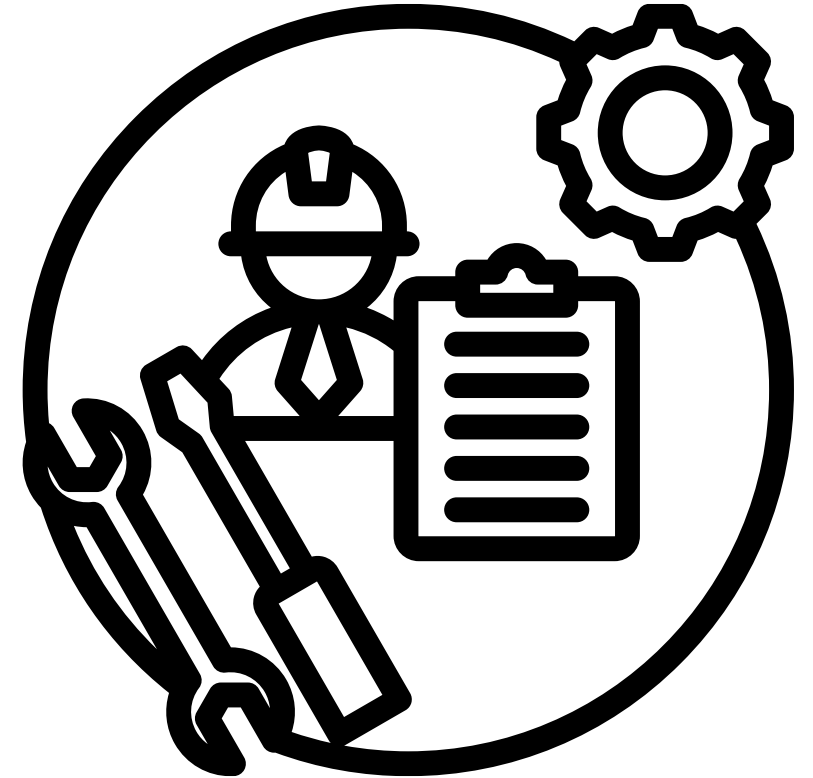
Facility Asset
Management
Considerations





3- Maintenance and Repair Cycle

- 1- Needs and Expectations
- 2- Current Conditions and Gaps
- 3- Assign Resources



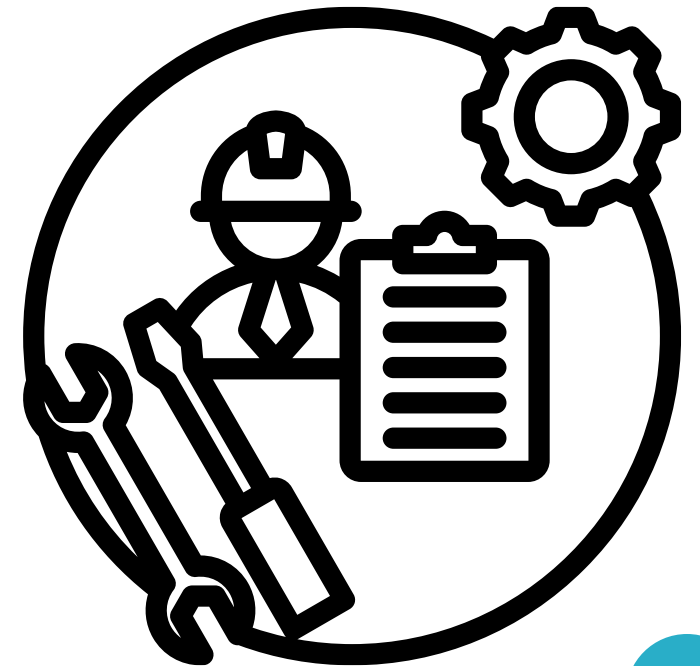


3- Maintenance and Repair Cycle

4- Prepare a Work Plan

5- Execute Works

6- Commissioning and Feedback





4-Determine Maintenance Schedule

Plan
Maintenance





4-Determine Maintenance Schedule

Unplan
Maintenance





5-Regulations, Codes and Standards





5- Determine Occupant Services and Requirements



Chapter 2

Assess and Inspect Facility Needs



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Contents

1-Assess Building Structure

2-Assess Exterior Structures

3-Assess Building System

4-Assess Interior

5-Assess Grounds



1- Assess and Inspect Condition of Building Structure

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Assess Building Structure

Foundation

Substructure (below-grade)

Superstructure (above-grade)



Superstructure

Floor slabs

Wall

Ceiling



Building Structural Deficiencies

Cracks

Floor Slab Differential

Standing Water



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HSSE Consideration

Moisture promote mold

Decay of Wood

Leaking or Standing Water



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مؤسسة الدراسات والبحوث





2- Assess and Inspect Exterior Structures and Elements



Assess Exterior Structures

Building envelope

Roof Systems

Signage



Some common deficiencies

Deteriorating foundation,
wall, roof

Poor joints, anchoring,
ventilation



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HSSE Consideration

Risk of Falls

Risk of Falling Objects

Storm Preparedness



3- Assess and Inspect Condition of Building Systems



Assess Building Systems

Transport Systems

Plumbing Systems

Fire & Life Safety Systems



Assess Building Systems

HVAC System

Electrical Systems

Electronic & IT Systems

Safety and Security Systems



Some common deficiencies

Backflow and overflow potential

Inadequate heating or cooling

High or low voltage, unbalanced loads



HSSE Consideration

Environmental Sustainability

Workplace Safety

Workplace Risk Assessment
(JSA / JHA / SDS)



4- Assess Interior Furnishings, Fixtures and Equipment

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Lighting

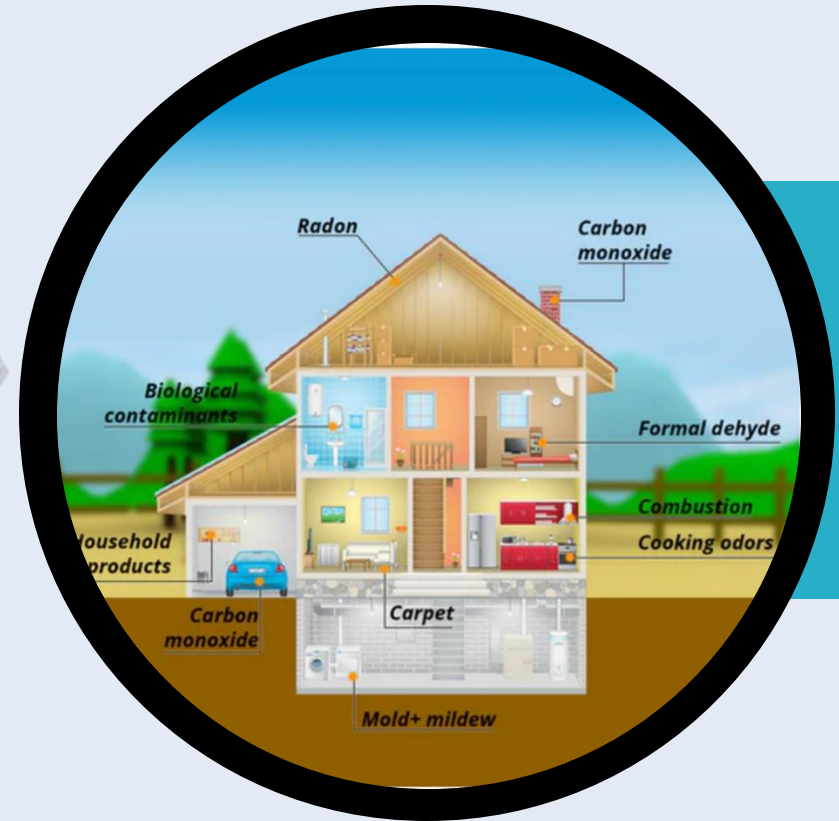
Noise



Air Quality and Contaminants

indoor air quality (IAQ)

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VOCs

HSSE Consideration

Hazardous Materials



HSSE Consideration

Indoor Environmental Quality (IEQ)

Air quality

Cleanliness

Temperature and humidity



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5- Assess and Inspect Grounds



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Landscaping

Hardscaping

Roads



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Chapter 3

**Manage, Oversee,
and Monitor O&M
of Building, Systems
and Equipment**



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Contents

1- Acquire Systems, Materials and Equipment

2- Install Systems, Materials and Equipment

3- Maintain Systems, Materials and Equipment



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Contents

- 
- 4- Operate Building Systems and Equipment
 - 5- Monitor Use and Performance of Facilities
 - 6- Replace Systems, Materials or Equipment



1- Acquire Systems, Materials and Equipment

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Life Cycle Cost

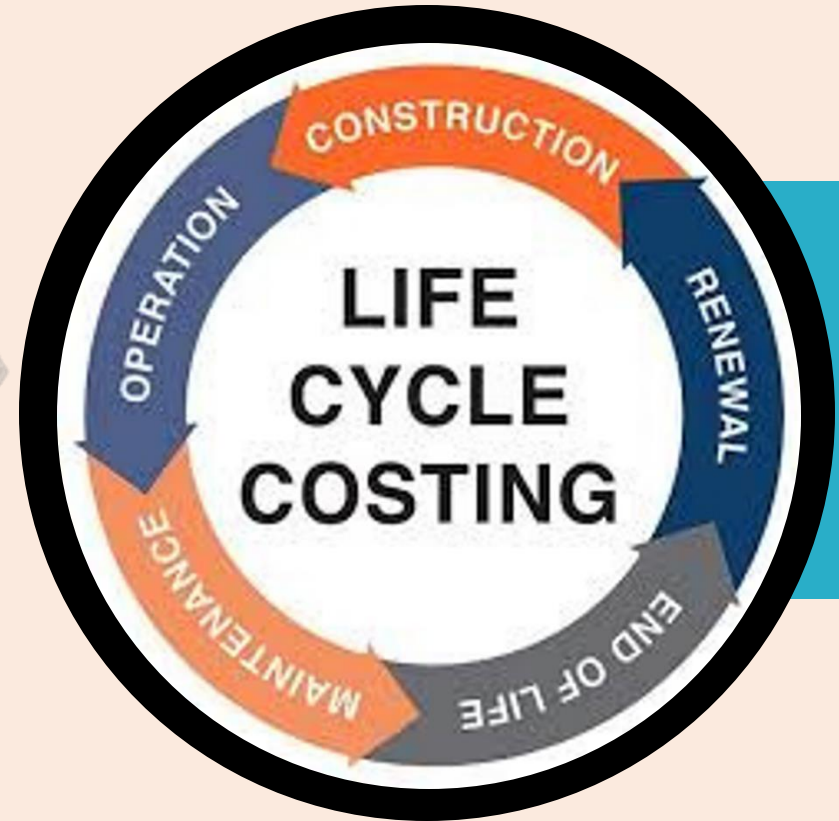
1- Initial Costs

2- Recurring Costs

3- Added Value



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تدريب واستشارات



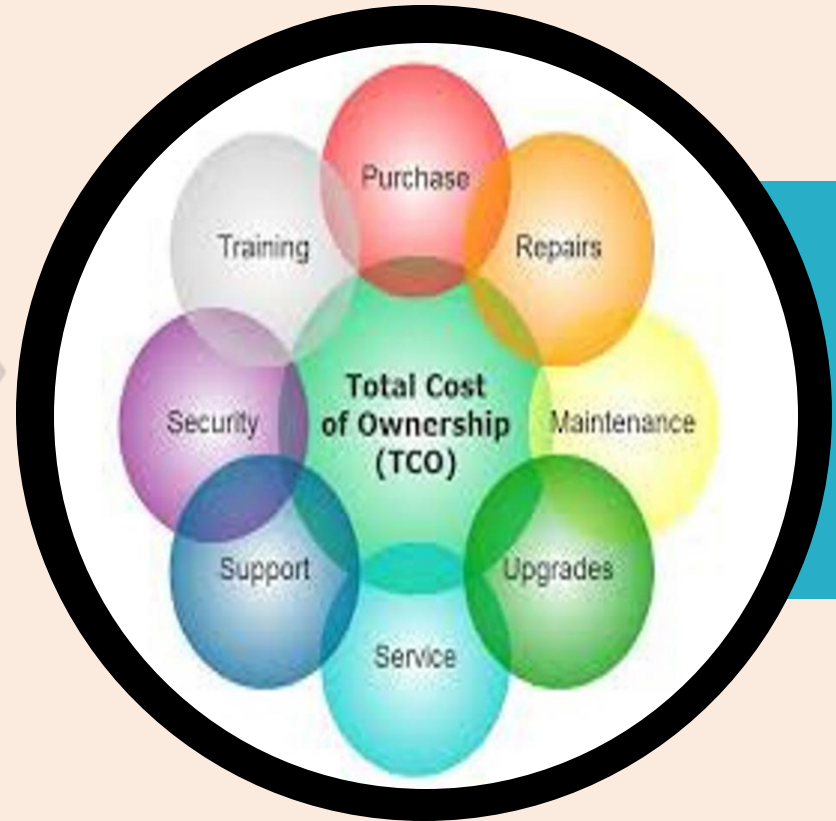
Total Cost of Ownership

Loan Payments

Environmental Costs

Insurance

Training Expenses



Reliability and Maintainability

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Sustainability Considerations

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Ranking

1-Perpetual resources

2-Renewable resources

3-Recyclable resources



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Ranking

4-Reducible resources

5-Nonrenewable resources



2- Install Systems, Materials and Equipment

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Commissioning

- Initial Commissioning
- Recommissioning/ Retro-Commissioning
- Continuous Commissioning



Integration





Documentation



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Education and Training



3- Maintain Systems, Materials and Equipment

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Types of Maintenance

1. Planned Maintenance

2. Unplanned Maintenance



1. Planned Maintenance

- Preventive (PM)
- Predictive (PdM)



1. Unplanned Maintenance

- Corrective
- Run-to-Failure
- Emergency



Balancing Maintenance

Reliability Centered
Maintenance
(RCM)



3- Maintain Systems, Materials and Equipment

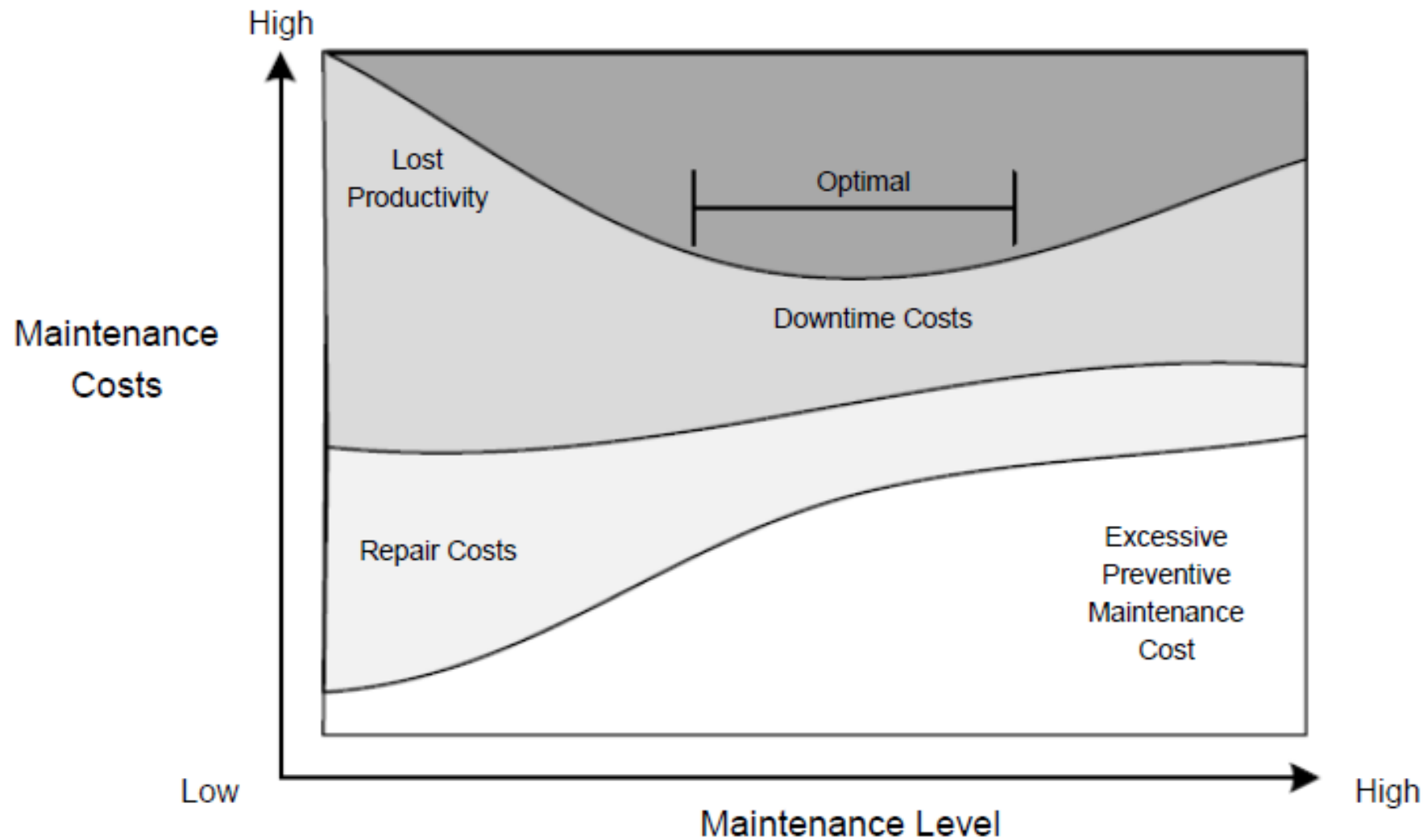


Exhibit 3-8: Reliability-Centered Maintenance Approach





Failure Modes and Effects Analysis (FMEA)

Severity	Classification	CONSEQUENCES				PROBABILITY				
		Safety	Equipment/ Maintenance Cost	Production	Environmental	1	2	3	4	5
						< 1% Remote	1% - 5% Extremely Unlikely	5% - 25% Very Unlikely	25% - 50% Unlikely	> 50% Likely
5	Disastrous	Multiple fatalities, > 5. Large effects on large external inhabited zones-several fatalities	Extensive damage >\$8M	Major loss, not recoverable. More than 3 days lost production	Major pollution with sustained environmental consequences external to the site	5	10	15	20	25
4	Catastrophic	Lethal effect on several persons (several fatalities). Lethal external effect - one fatality, several physical injuries	Major damage \$6M-\$8M	Major loss. Up to 50% not recoverable Up to 3 days lost production.	Major pollution external to the site. Evacuation of persons	4	8	12	16	20
3	Major	Lethal effect on one person and/or several permanent invalidities. Permanent external effects	Localized damage \$2M - \$6M	Medium loss, not wholly recoverable through normal production < 24 hours lost production	Moderate pollution, within site limits. Product liability	3	6	9	12	15
2	Serious	Permanent injury, lost time accident. Non-permanent external effects	Minor damage \$200K - \$2M	Minor loss, recoverable through normal production 2 to 8 hours lost production	Spill or release of pollutant requiring a declaration to authorities but without environmental consequences	2	4	6	8	10
1	Moderate	No permanent injury, recordable with no lost time/medical treatment. No external effect	Slight damage < \$200K	Little to no effect. Production easily recovered. < 2 hour lost production.	Minor spill or release of pollutant, not requiring a declaration	1	2	3	4	5





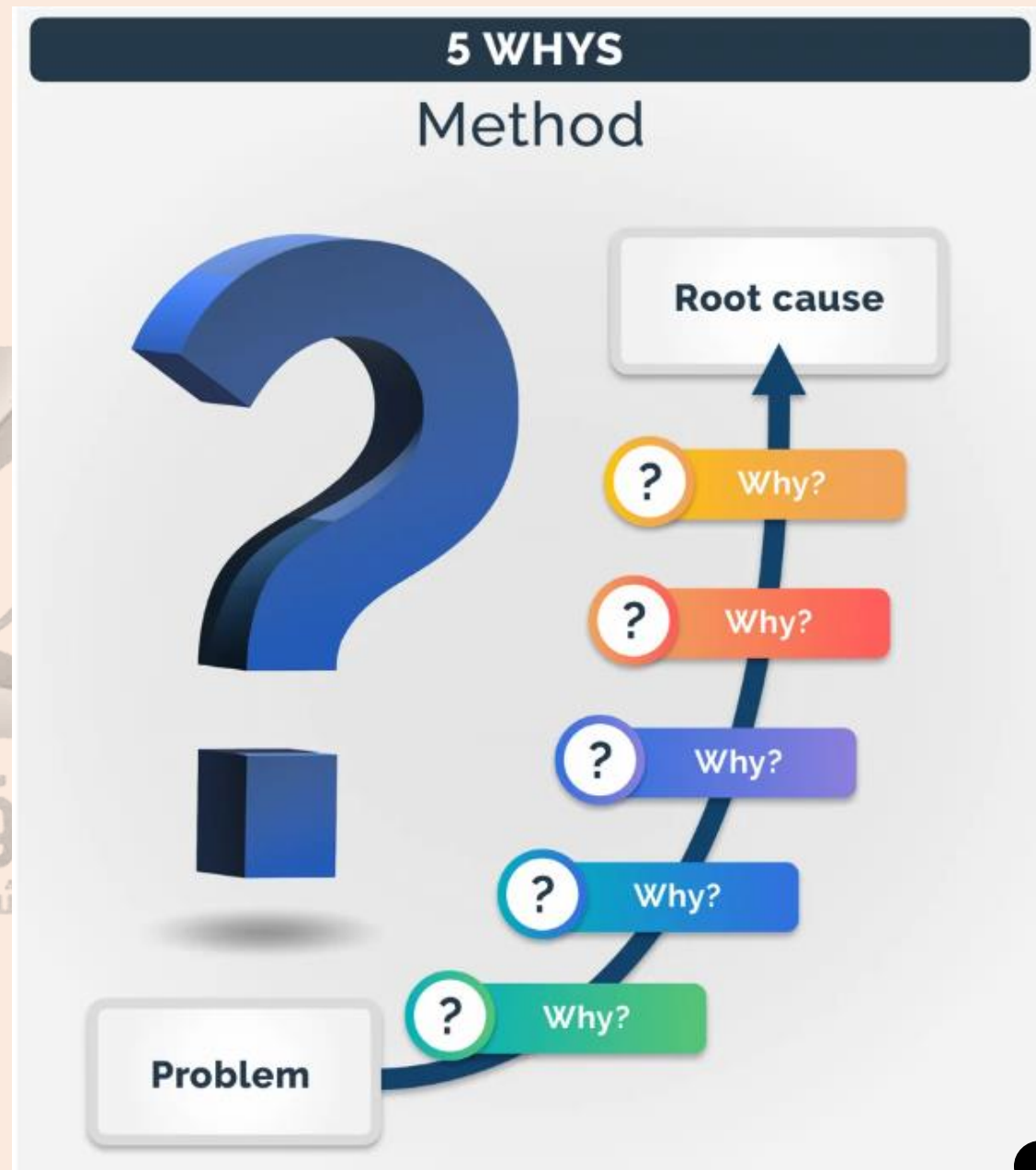
Root Cause Analysis

Age Exploration





Root Cause Analysis Age Exploration





Maintenance Management Workflow

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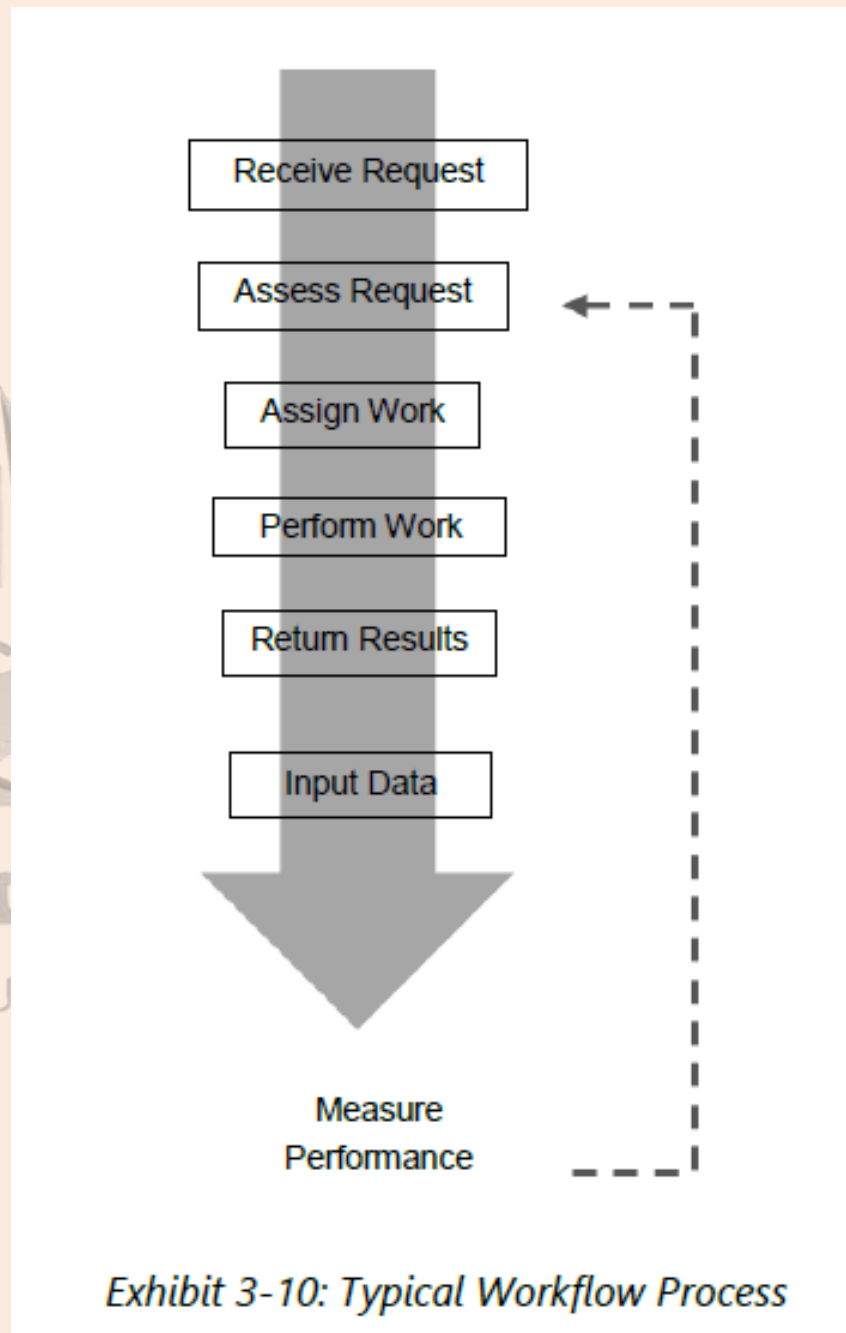
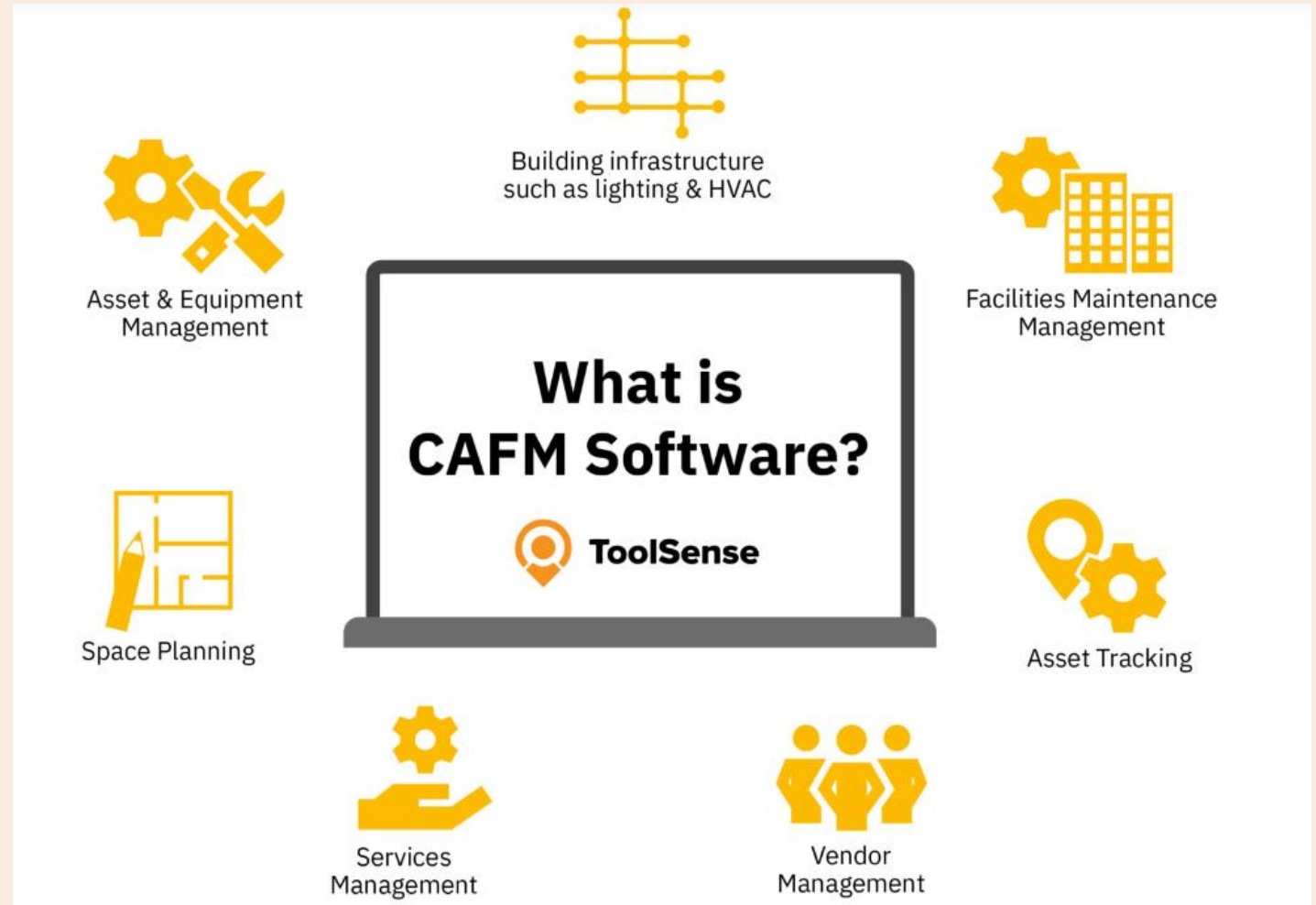


Exhibit 3-10: Typical Workflow Process



CMMS

IWMS



4- Operate Building System and Equipment

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1- operation and monitoring

2-Building automation

3-Energy management

4-Health and safety inspections

5-Appearance inspections



6- Emergency planning and preparation

7- Material handling and storage

8- Snow and ice removal

9- Policies, procedures, and safety



Building Automation Systems (BMS /BAS)



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تدریس و اساتذات

Inspections



5- Monitor Use and Performance of Facilities

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Respond to the Plan



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Determining Performance Measurements

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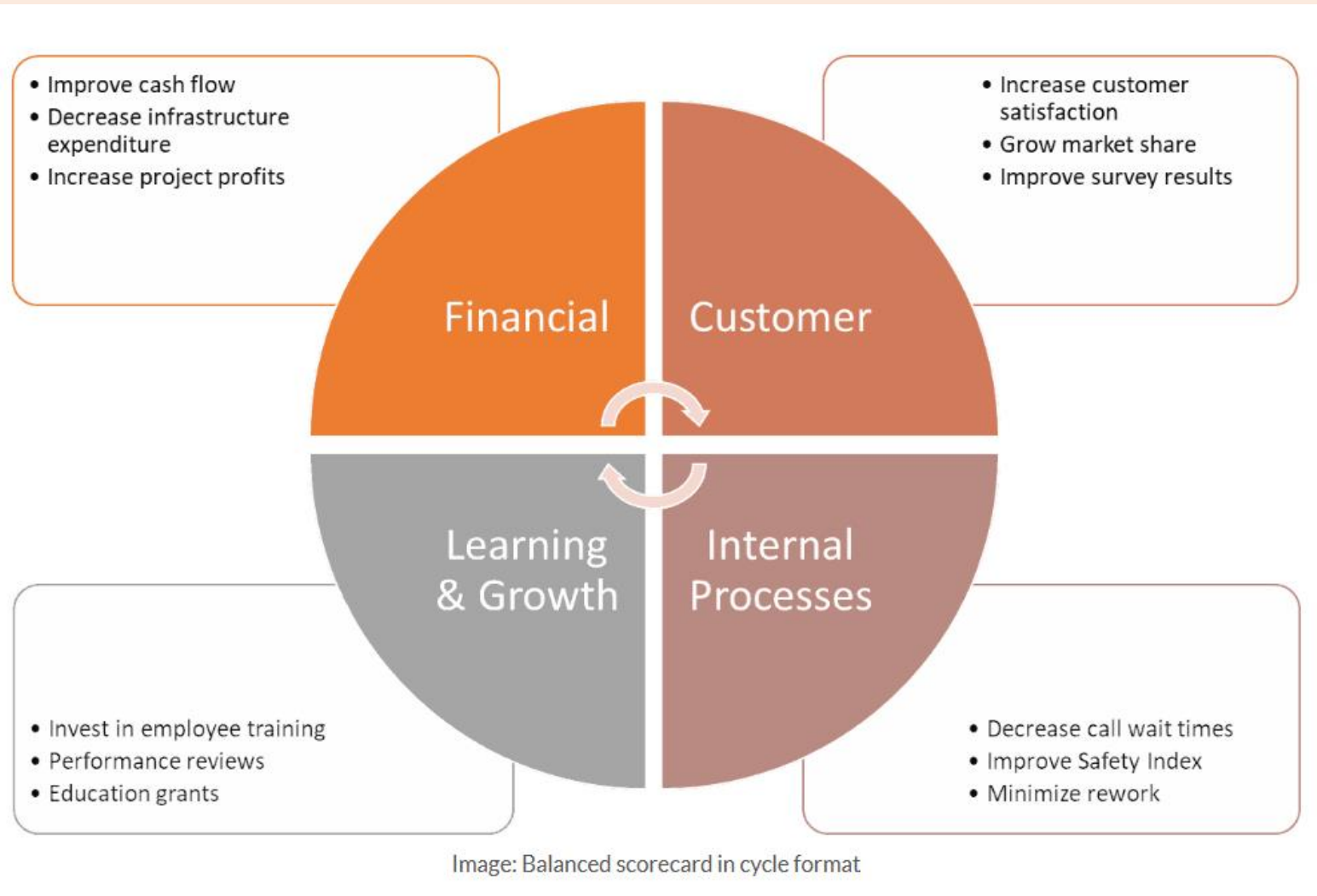


Determining Performance Measurements

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Balanced Scorecard (BCS)





6- Replace Systems, Materials or Equipment



1- Reuse

2-Reduce

3-Recycle

4-Salvage

5-Disposal



REDUCE



REUSE



RECYCLE



Recognizing an Asset's Useful Life

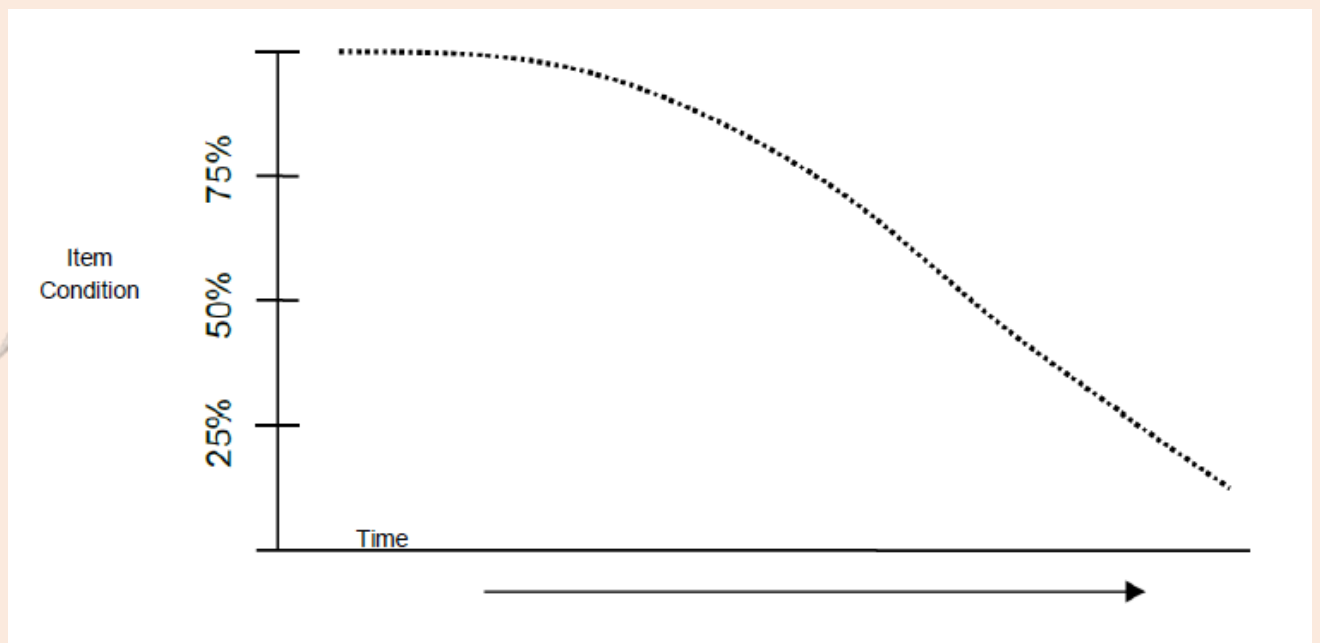
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Tools

1-Degradation Curves



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Tools

2-Data-Measuring

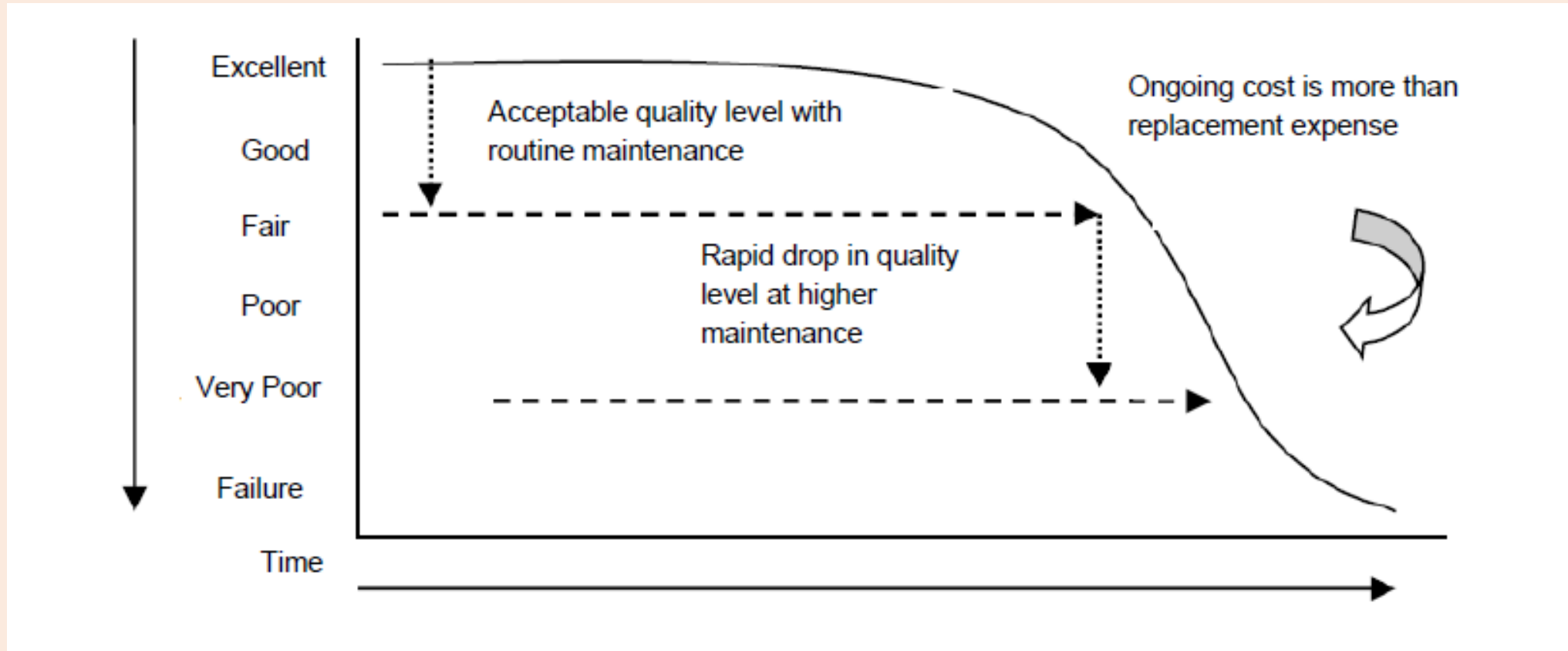
Tools

RCM

TPM



Life-Cycle Costs and Estimated Useful Life



Tools

3-Facility Condition Assessment (FCA)



Facility Condition Index:

Good: 0-5% FCI

Fair: 5-10% FCI

Poor: 10-30% FCI

Critical: Over 30% FCI



Managing Disposal

Resale

Reuse

Recycling

Donation



Chapter 4

Manage, Oversee and Monitor Occupant Services



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Contents

1-Service Level Guidelines

2- Modifications

3-Occupant Satisfaction



Soft Services



1-Service Level Guidelines

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Recognize Occupant Needs:

1- Identify Needs
and Expectations





2- Evaluate and Communicate



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3- Implement the Occupant Services Plan



4- Measure Performance





Workplace Design and Space

1- Company Culture and Needs

2- Optimizing Space Usage

3- Flexible Workstations

4- Communication and Responsiveness





Custodial Cleaning Example (APPA Levels of Appearance)

L1: Orderly Spotlessness

L2: Ordinary Tidiness

L3: Casual Inattention



1-Service Level Guidelines

L4: Moderate Dinginess

L5: Ordinary Tidiness



2-Prepare and Execute Modifications to Occupant Services

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Alterations

Improvements

Conversion

Rehabilitation

Modernization



Move Management

churn rate



3-Monitor Occupant Satisfaction

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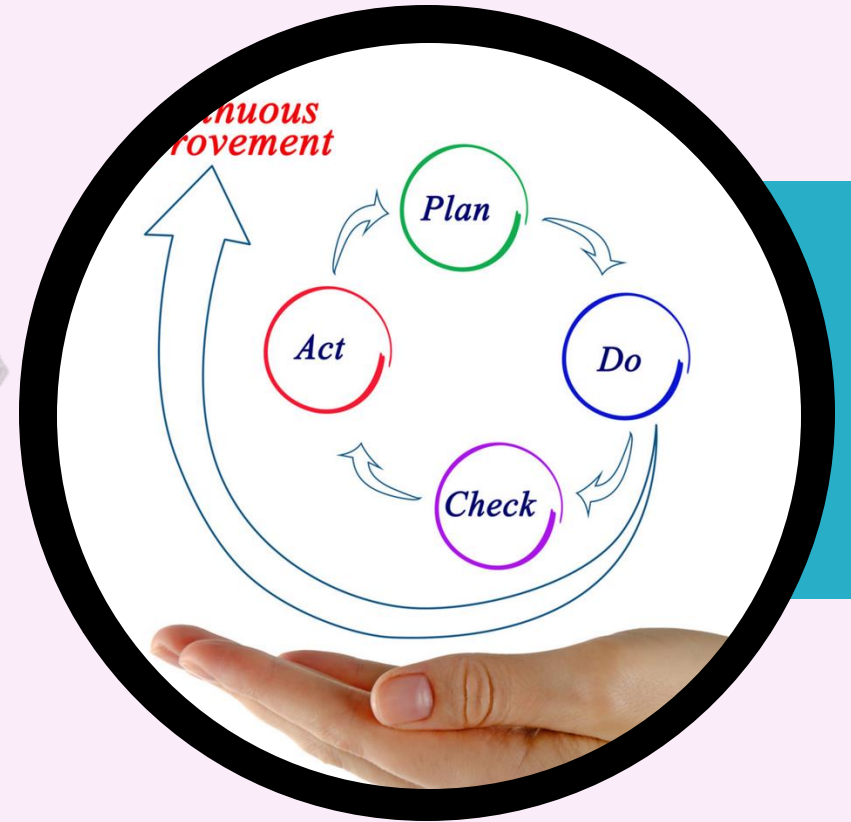


Service Quotient



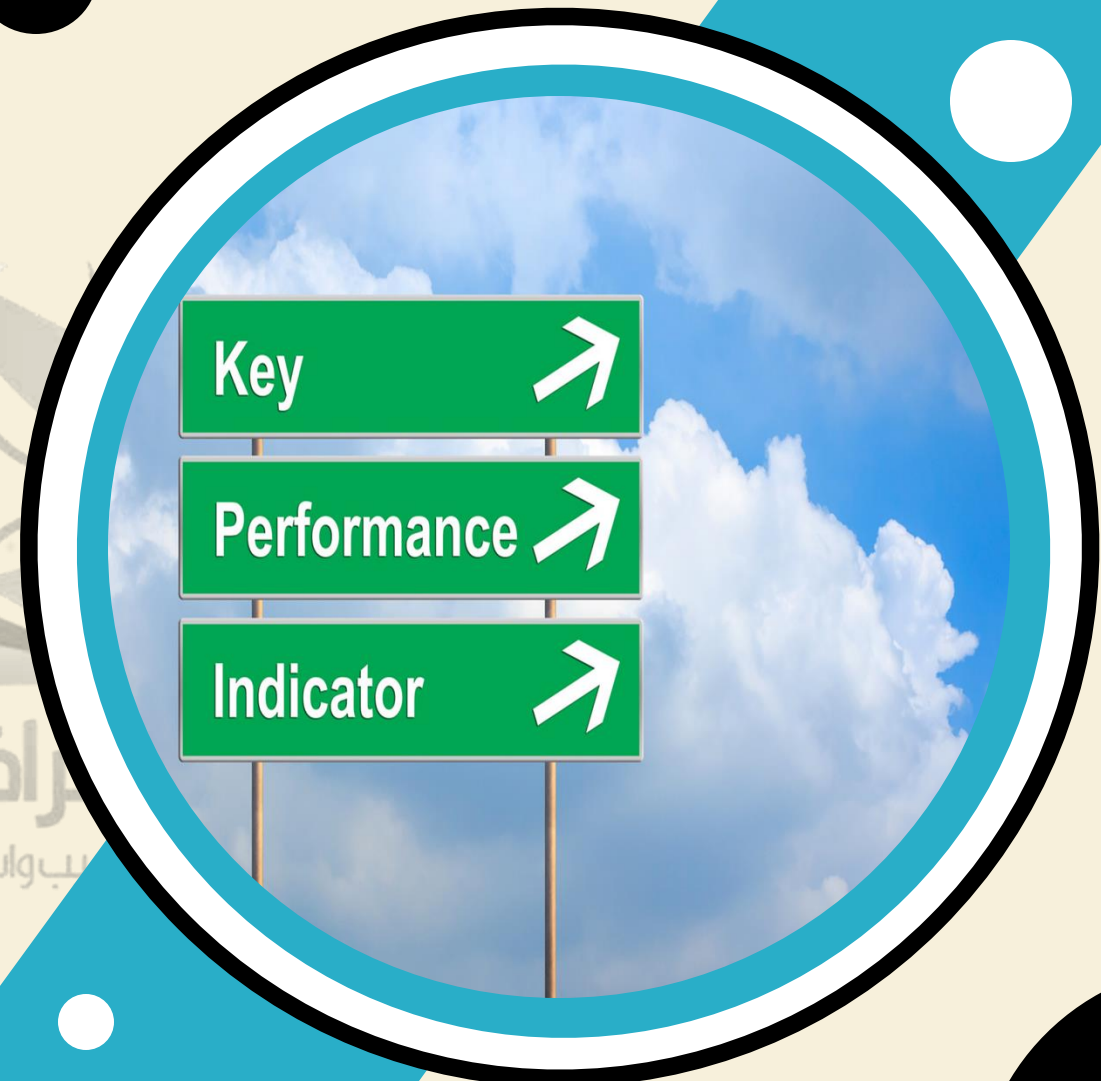


Improving occupant satisfaction



Chapter 5

Select the Best Resources





Contents

- 1- Service Specifications
 - 2- Select Service Providers
 - 3- Agree on Service Level
 - 4- Monitor Performance
 - 5- Resolve Contract Disputes
- 



1-Maintenance and Occupant Service Specifications



Service Level Agreements





SLA Key Components

1-Service Delivery Specifications

2-Level of Service

3-KPI





4-Oversight & Review

5-Incentives & Penalties

6-Work Schedules and SOPs



2- Select Service Providers (Staff or Contract)

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Contract or Staff Assignments

Specialized Capabilities

Resource Allocation

Complex or Dangerous

Tasks



Contract or Staff Assignments

Facility Mission

Cost Considerations



Contract Advantages

Cost Control

Less Liability

Increases Expertise



Contract Disadvantages

Lack of Loyalty

Immediate control

Poor Service



3-Agree on Service Level



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Agree on Specifications



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Negotiated Terms:

Statement of Work

Contract Cost

Schedules and SOPs



4-Monitor Performance



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Measures of Competency

Performance Criteria

Oversight Plan

KPIs and SLAs



Outcomes

1- Identify Known Outcomes

2- Evaluate Results





Incentive-Based Contracts

1- Fixed-Price-Incentive

2- Cost-Plus-Award

3- Award-Term



5-Resolve Contract Disputes



Start with the SLA



Managing the Relationship

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THANK YOU



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