Information & Technology

Chapter 1

Information Technology, FM, and the Organization.

Chapter 2

Data Collection and Information Management

Chapter 3

IT & Security Basics for FM.

Chapter 4

Computer Aided Facility Management Systems

Chapter 5

Tools and Concepts

Chapter 6

Assessment

Chapter 1

Information Technology, FM, and the Organization.

Contents

1- Technology Support Strategy

2- Trends and Technology

3- Tech. and Stakeholder Needs.

4- IT and the Impact on FM

5- IT & FM Relationship?

1- Using Technology to Support

Organizational Strategy

Technology's meet

21st Century needs

1- Using Technology to Support Organizational Strategy

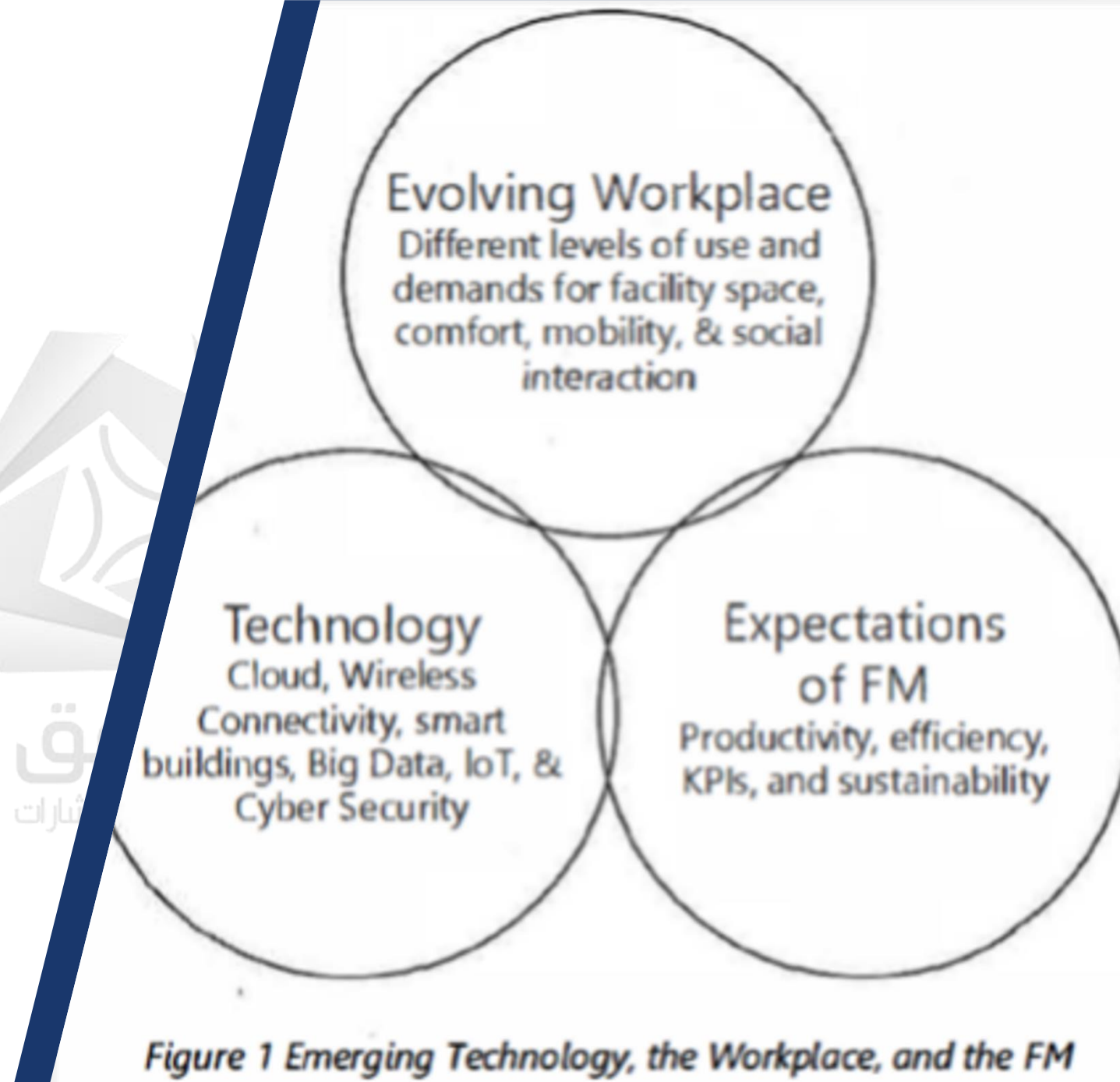


Figure 1 Emerging Technology, the Workplace, and the FM

Expectation of FM and Technology Trends

1- Purpose Level

2- Corporate level

3- FM Strategic Level

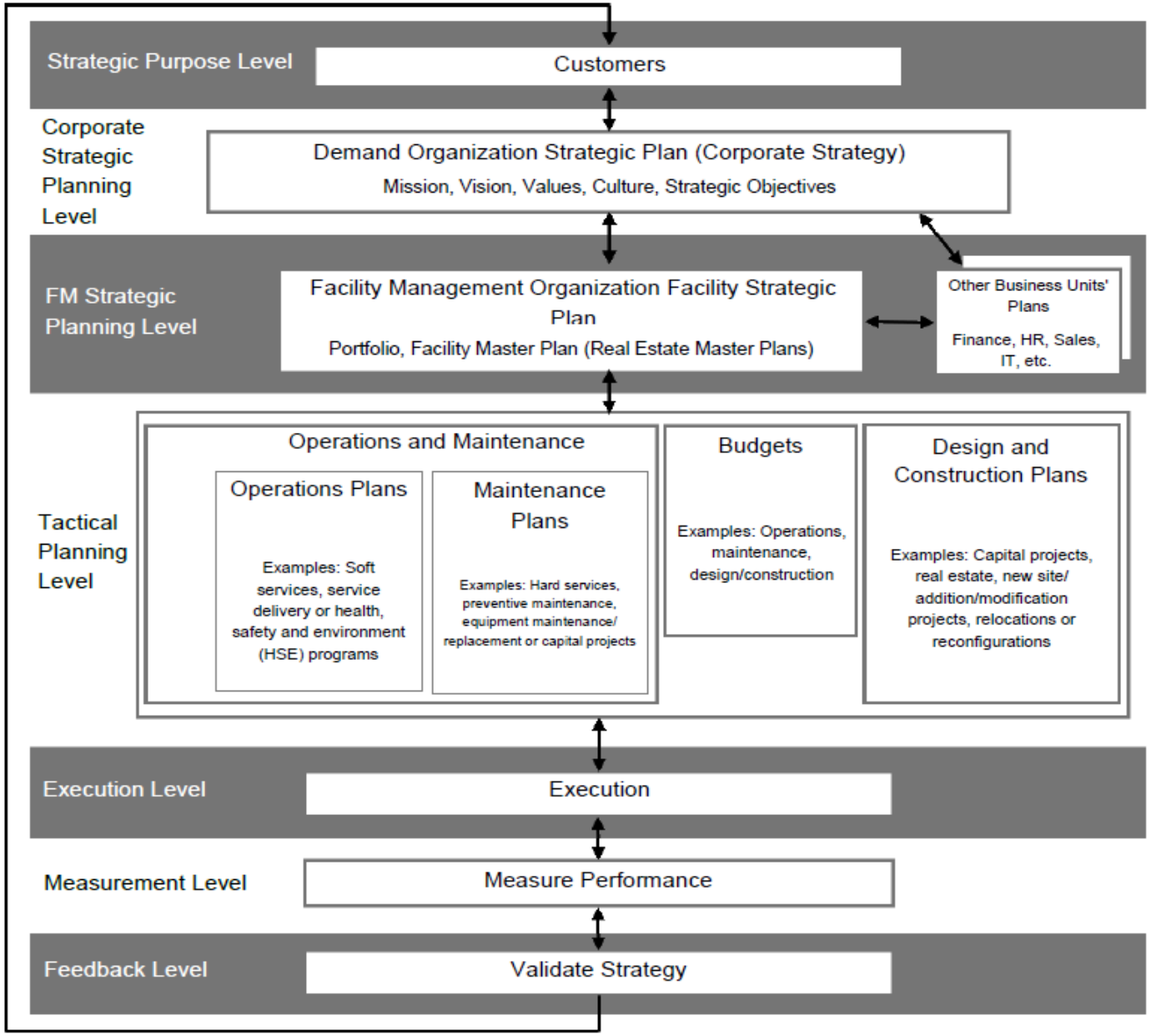
4- Technical Leve

5- Execution Level

6- Measurement Level

7- Feedback Level

1- Using Technology to Support Organizational Strategy



Shifts in Organization Strategy and Technology

Property Management

Healthcare Company

Manufacturing

Private University

2- Organizational Trends and Technology

2- Organizational Trends and Technology

Figure 3 Organizational Trends & Facility Management

1-Globalization

2-Economic Competition

3-Knowledge Workers

4-Green Technology & Sustainable Facilities

5-Changing Demographics

6-Virtual/Remote Workplace:

7-Safety and Security

Benefits of Technology to Organizations

Cost Savings

Alignment with Values

Regulatory Compliance

Improved Safety and Security

Strategic Alignment and Technology

Projects

3-Technology and Stakeholder

Needs

Internal Stakeholder Needs

Senior Management

Boards of Directors

Line Management

Occupants (Employees, Users)

External Stakeholder Needs

Investors or Shareholders

Customers and Visitors

Suppliers

Regulatory Agencies

4-IT and the Impact on Facility Management.

4-IT and the Impact on Facility Management.

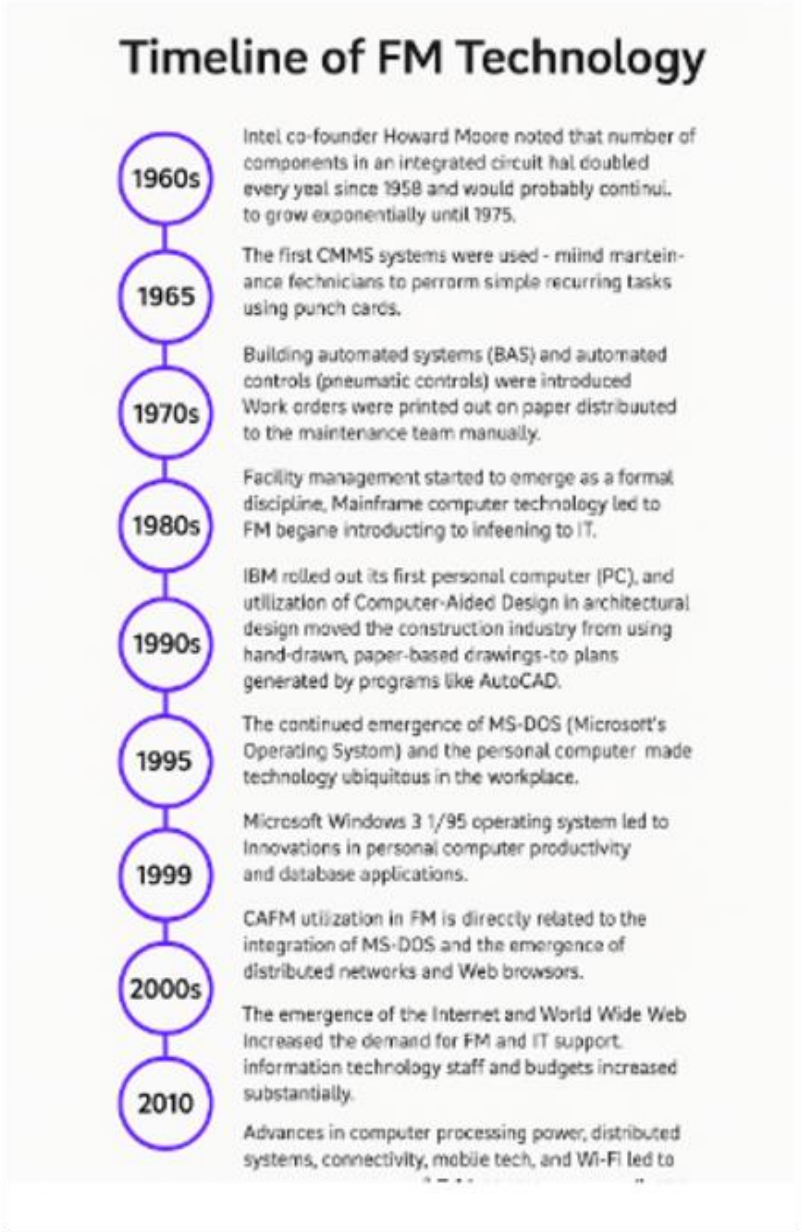
1960s

1970s

1980s

1990s

1999



4-IT and the Impact on Facility Management.

2000s

2010s

2020s

Technology Trends

and FM

4-IT and the Impact on Facility Management.

1- Interoperability

2-Virtualization

3-Cloud Computing

4-Software as a Service (SaaS)

5-Wireless Communication

6- Cybersecurity

7- Big Data

8-Artificial Intelligence (AI)

9-Internet of Things (IoT)

10-Augmented & Virtual Reality

(AR/VR)

5-IT & FM: What is the Relationship?

Building a Strong IT/FM Relationship

IT as a customer of FM

FM as a customer of IT

IT & FM Applications

1-Inventory and Asset Management

2-Space Management

3-Real Estate & Contract

Management

Chapter 2

Data Collection and Information Management

Contents

1-Data Collection and FM.

2-Data-Driven FM.

3-Minimizing the Risks of Data

Corruption..

4-Data Backup for Resilience.

1-Data Collection and FM.

Data and Its Implications on FM

Types of Facility Data

1-Alphanumeric (ASCII)

2-Graphic Data

3-Media/Multimedia

Best Practices

1-Holistic View of FM

2-Inventory of Current Data

3-Ensure Accuracy and Relevance

4-Roadmap for the Future

Data Storage

1- (CMMS)

2-Building Control Systems

3-(CAFM)

4- (BIM)

5-(ERP)

Data Standardization

1- ISO 16739-1:2018

2-OSCRE Industry Model™ (IDM)

3- Project Haystack

4-COBie – Construction-Operations Building

2-Data-Driven Facility Management.

Data Analytics

Collect data

Analyze it for performance

Develop benchmarks and goals

2-Data-Driven Facility Management.

Types of Analytics in FM

1-Descriptive Analytics

What happened?

(e.g., reports and KPIs)

2-Diagnostic Analytics

Why it happened?

(real-time operational issues)

3-Predictive Analytics

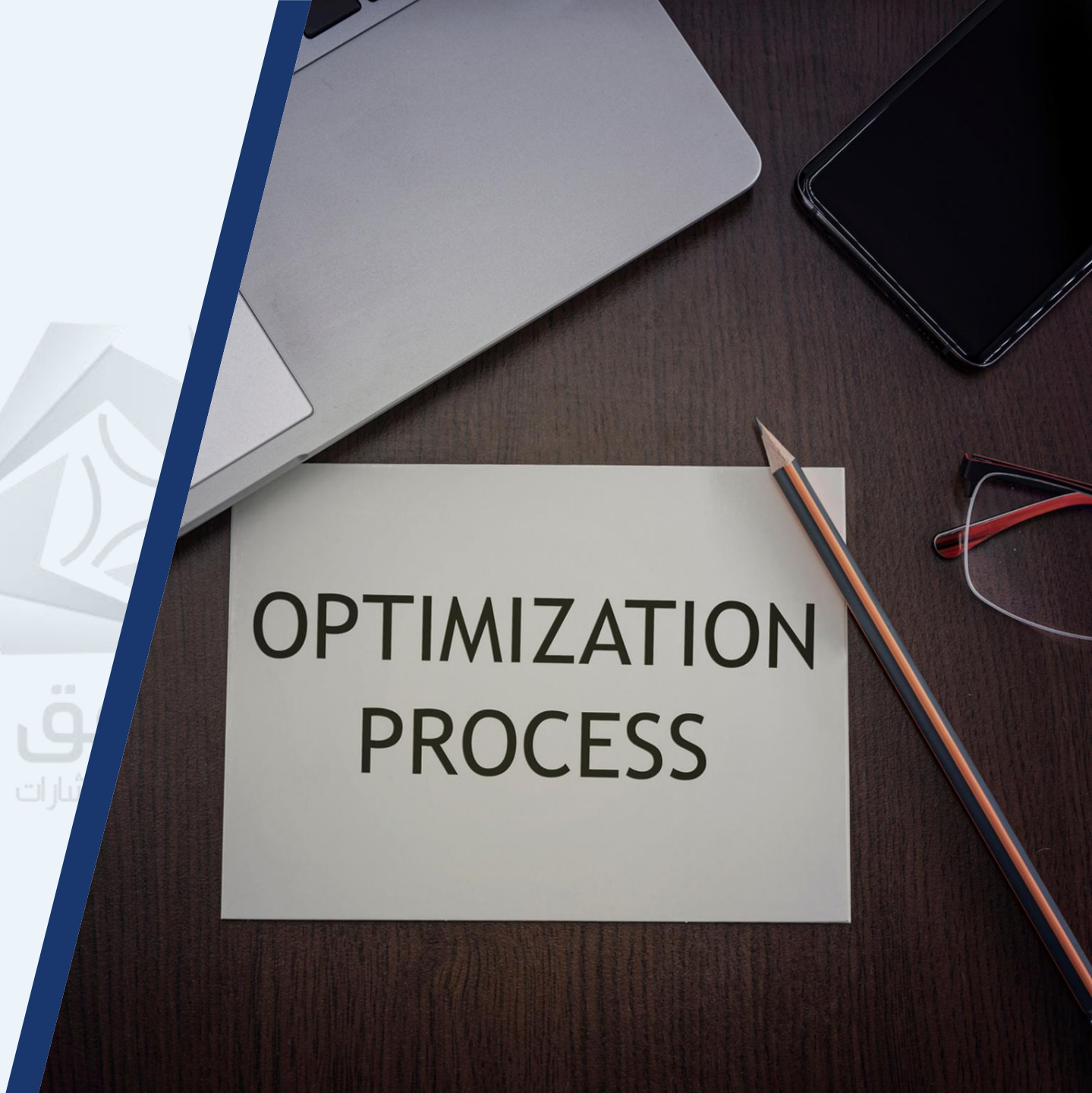
What will happen?

(forecast future outcomes)

4-Prescriptive Analytics

What action to take?

(Optimizes performance with minimal human intervention)



3-Minimizing the Risks of Data Corruption

Common Causes

Human Error

Viruses and Malware

Power Outages

Internal Data Theft

User Authorization and Governance

Preserving Data Integrity

1-Validate Input

2-Validate Data

3-Eliminate Duplicate Data

Preserving Data Integrity

4-Backup Data Regularly

5-Control Access to Data & CAFM

6-Audit and Document

4-Data Backup for Resilience

Top Threats by the BC Institute

Cyber-attacks

Data breaches

Unplanned IT/telecom outages

Developing a Data Backup Plan

1-Identify critical data across

2-Coordinate with IT and stakeholders

3-Choose backup types and schedules

4-Test and validate

Backup Storage Options

Local options

1-External Drives (USB)

2-NAS (Network Attached Storage)

3-Network Shares

Backup Storage Options

Cloud-based options

1-SaaS Solutions

2-Cloud Storage Providers

3-CAFM Vendor Storage

Chapter 3

IT & Security Basics for FM.

Contents

1-Networking Principles.

2-Wireless Networks.

3-Databases and Software

4-IT Security for Facility Managers

1-Networking Principles

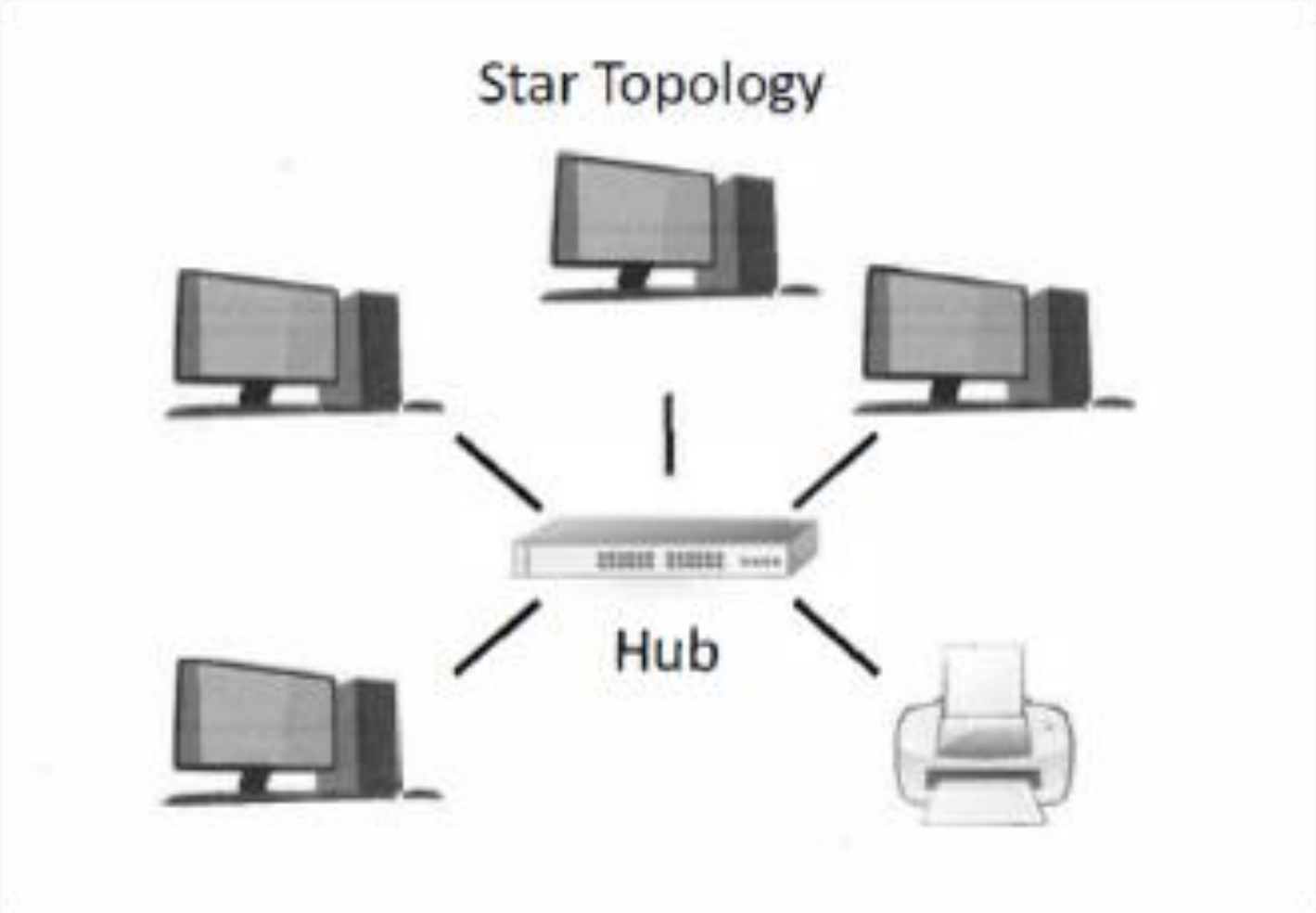
Types of Network Topology

1- Physical Topology

2-Logical Topology

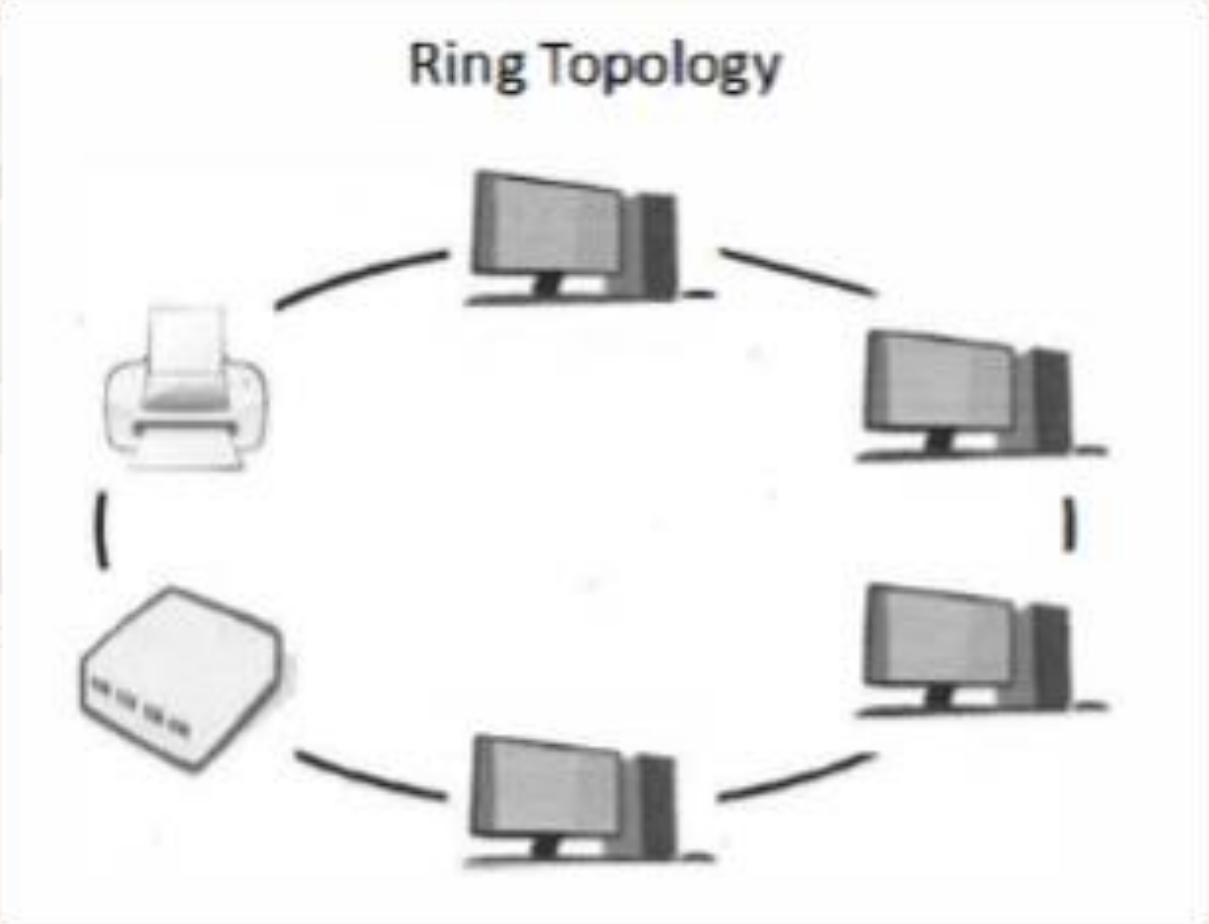
Common Network Topology Structures

1- Star Topology



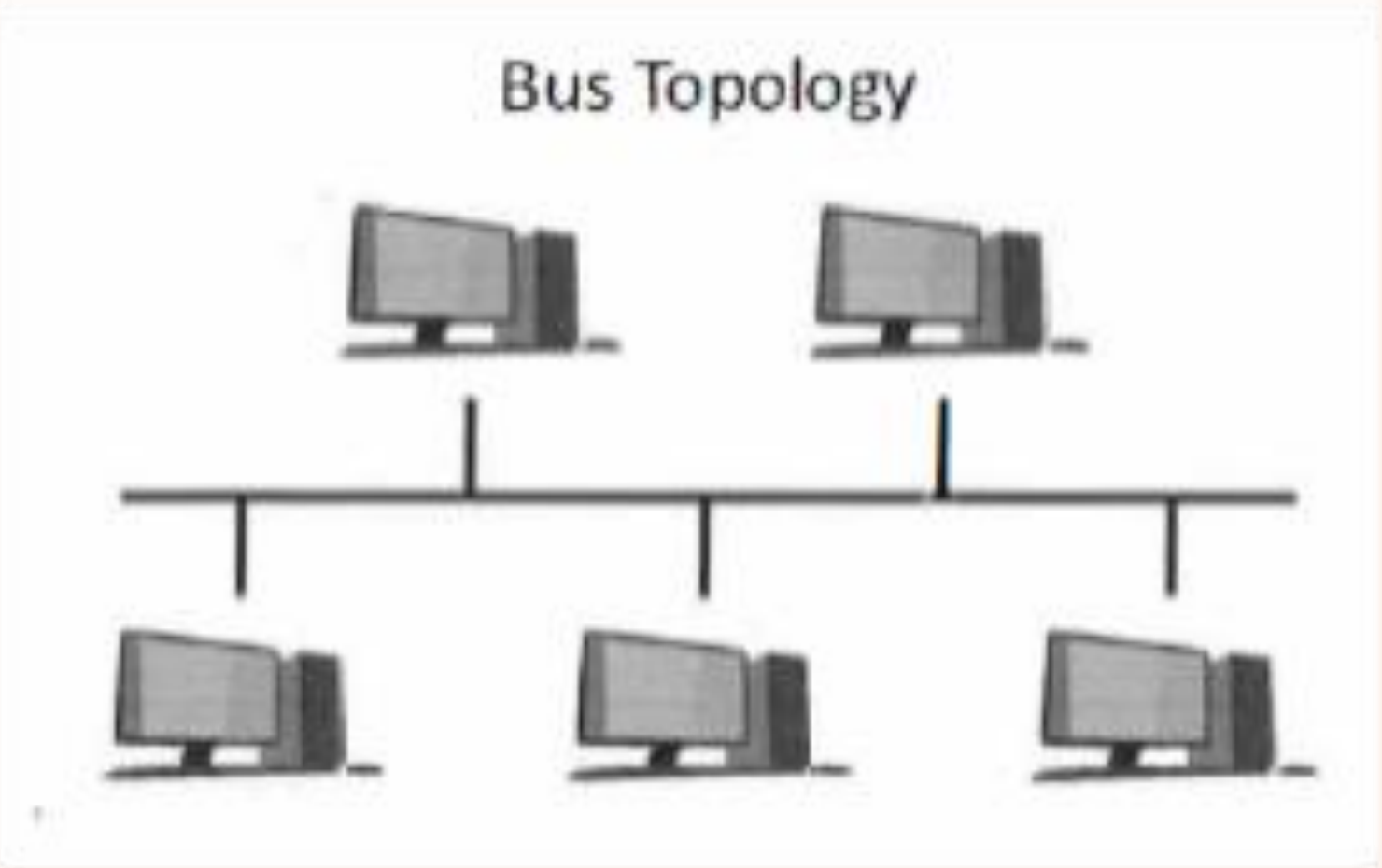
Common Network Topology Structures

2- Ring Topology



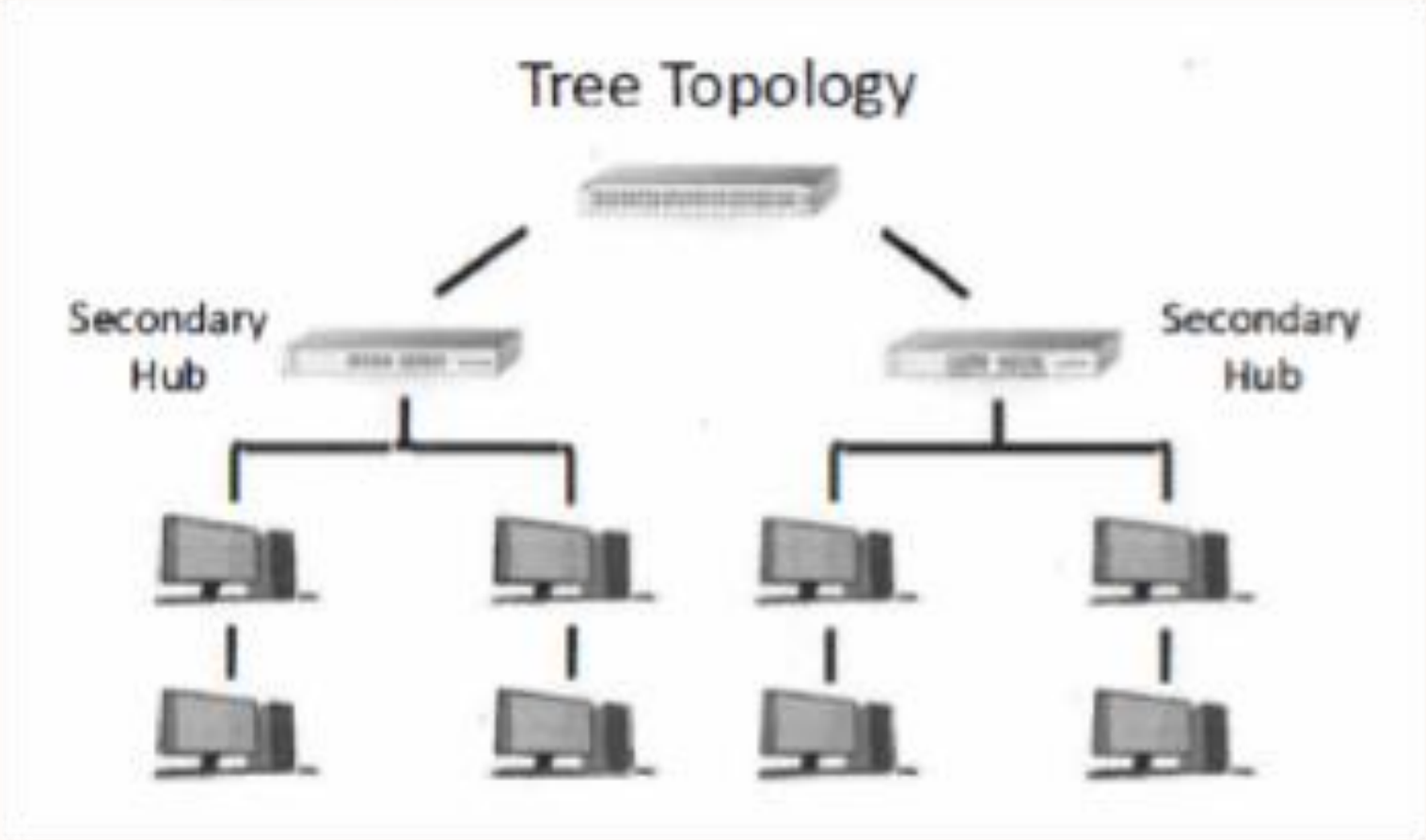
Common Network Topology Structures

3- Bus Topology



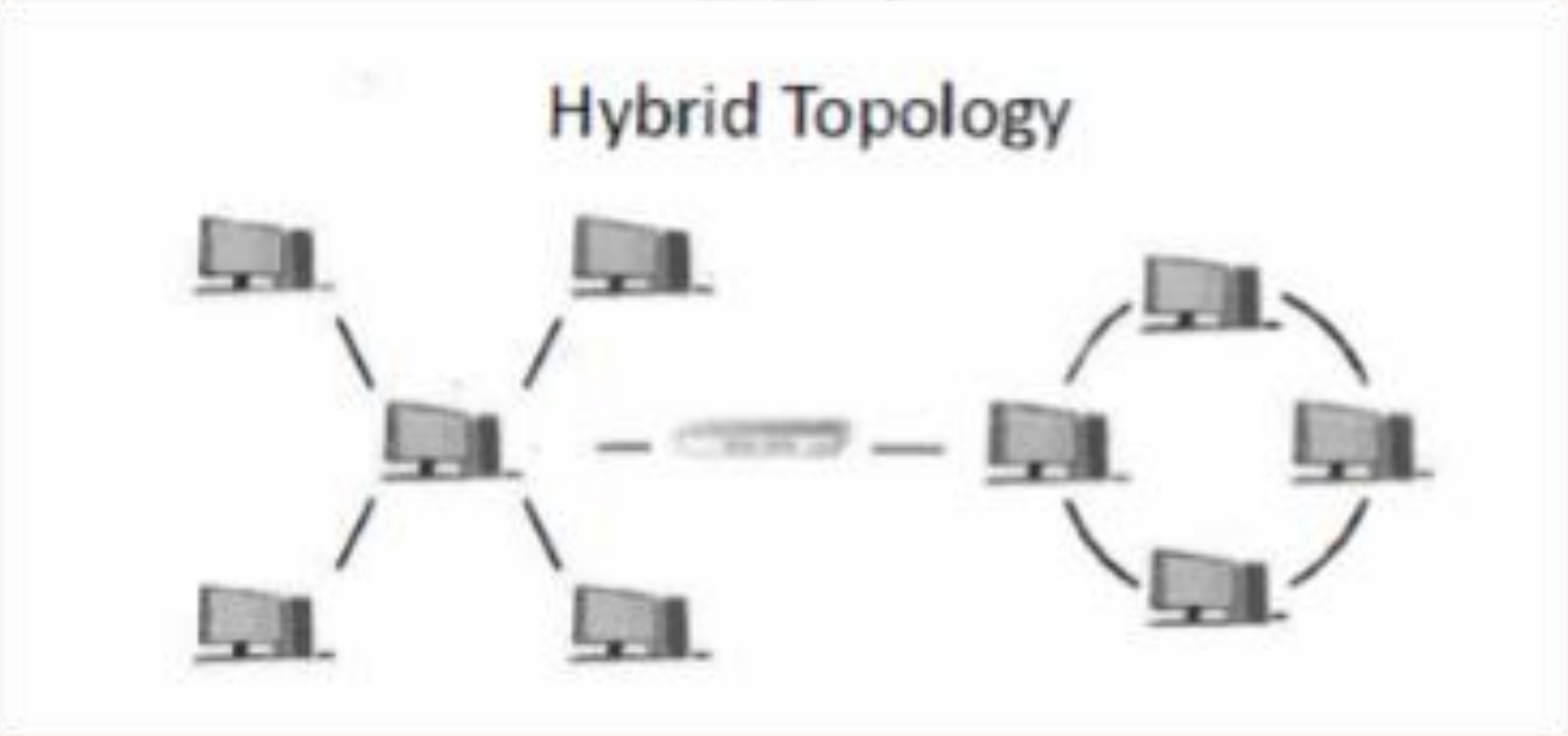
Common Network Topology Structures

4- Tree Topology



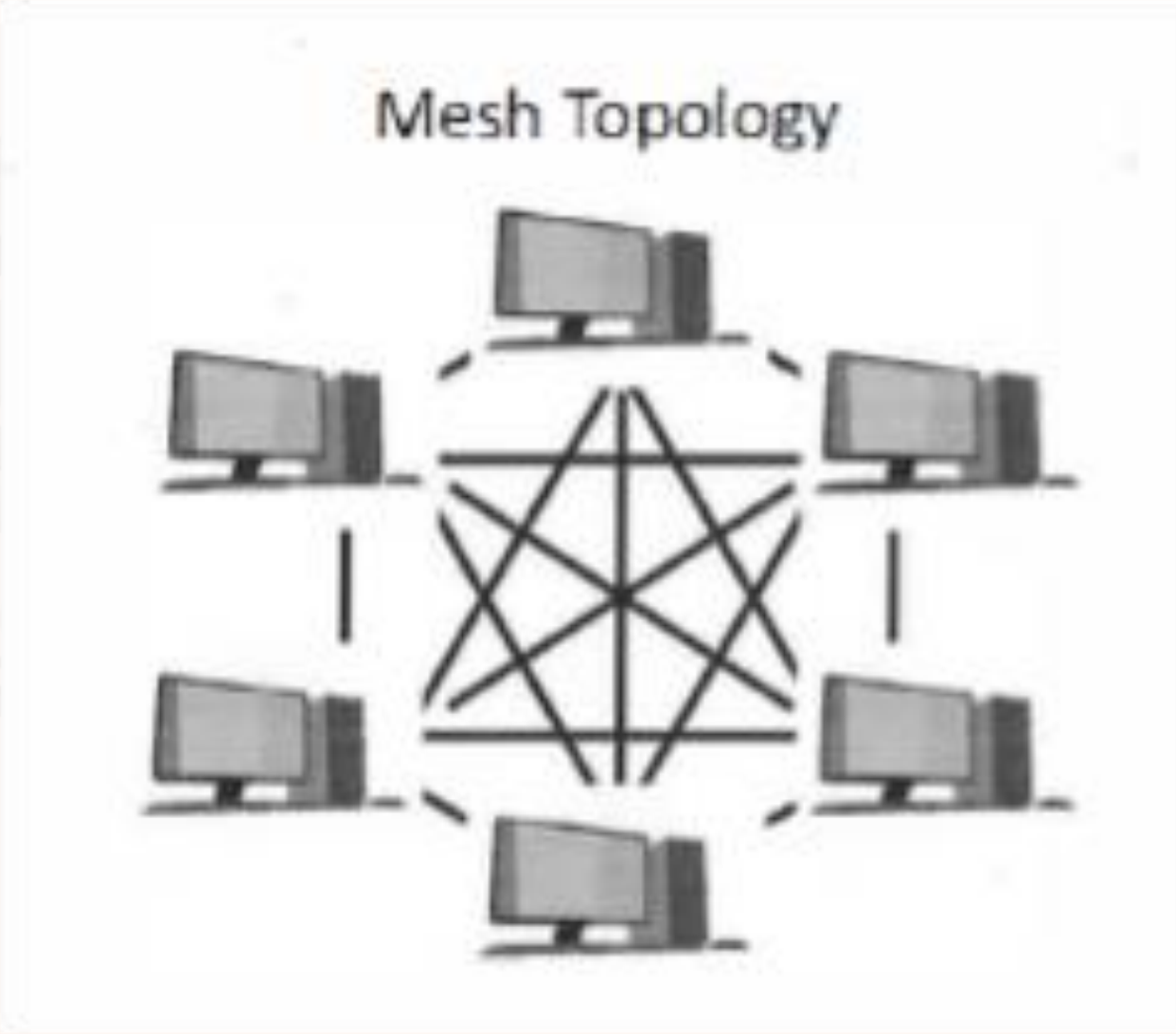
Common Network Topology Structures

5- Mixed Hybrid Topology



Common Network Topology Structures

6- Mesh Topology



Key Network Devices

1- Switches

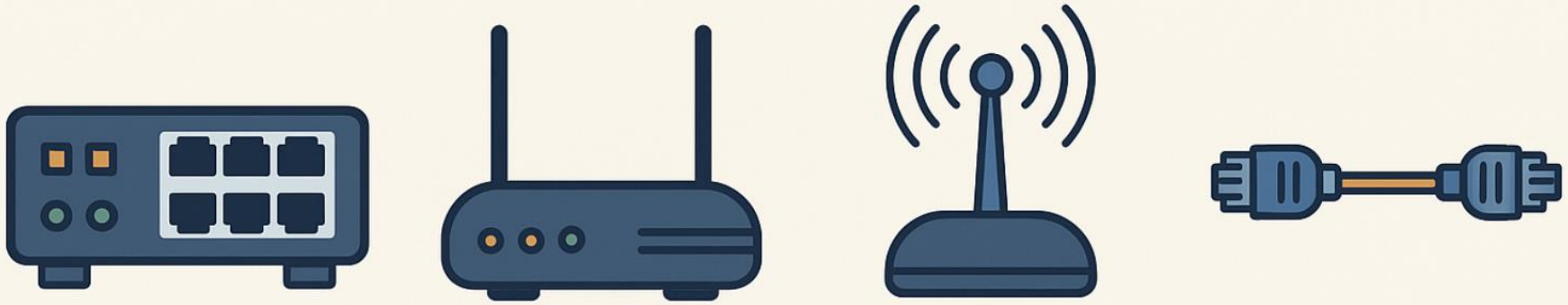
2-Routers

3-Wireless Access Points (WAPs)

4-Network Cables

1-Networking Principles.

Key Network Devices



Switch

Router

Wireless Acces Point (WAP)

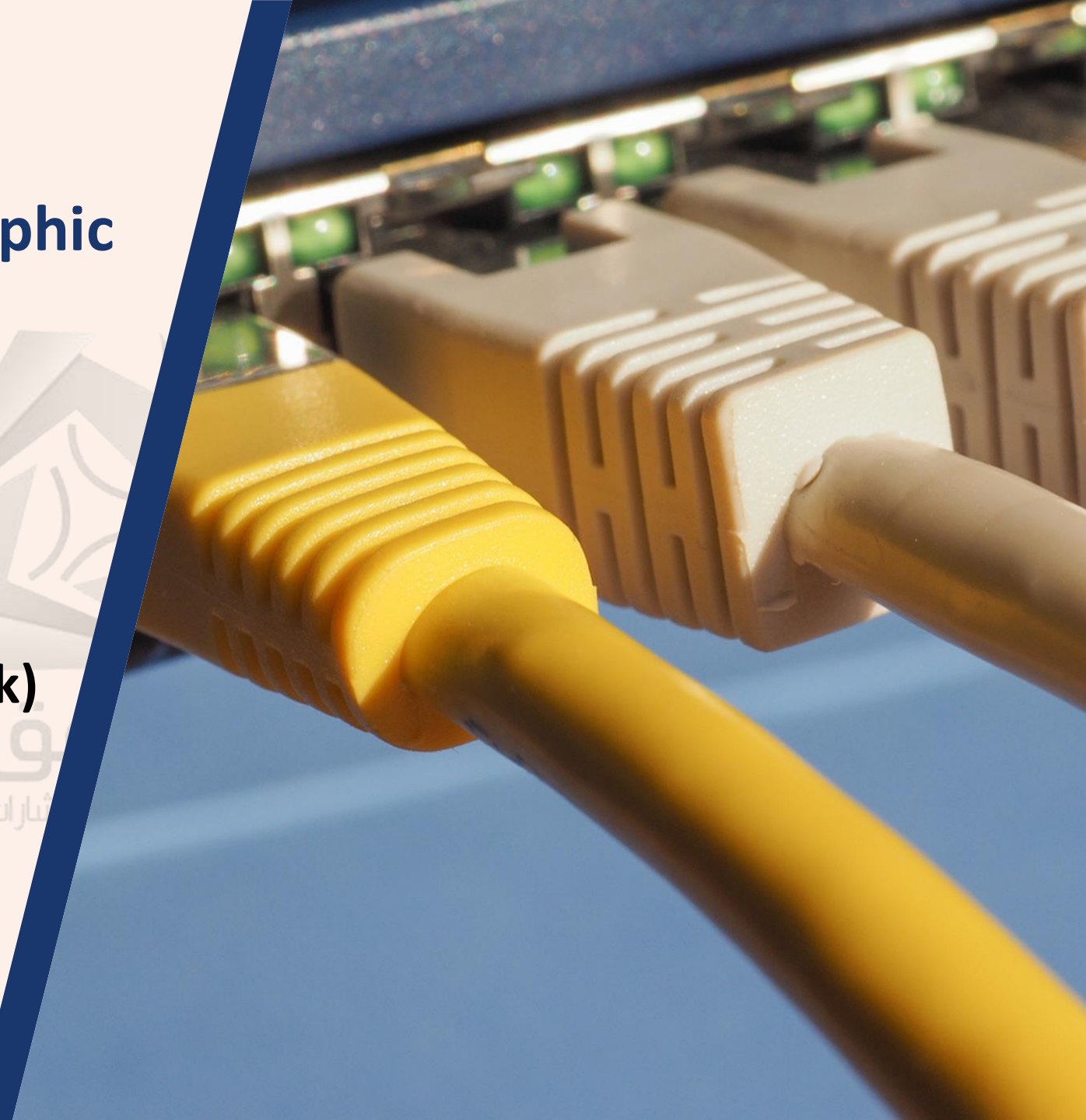
Network Cable

Types of Networks by Geographic

1- LAN (Local Area Network)

2-WAN (Wide Area Network)

3-MAN (Metropolitan Area Network)

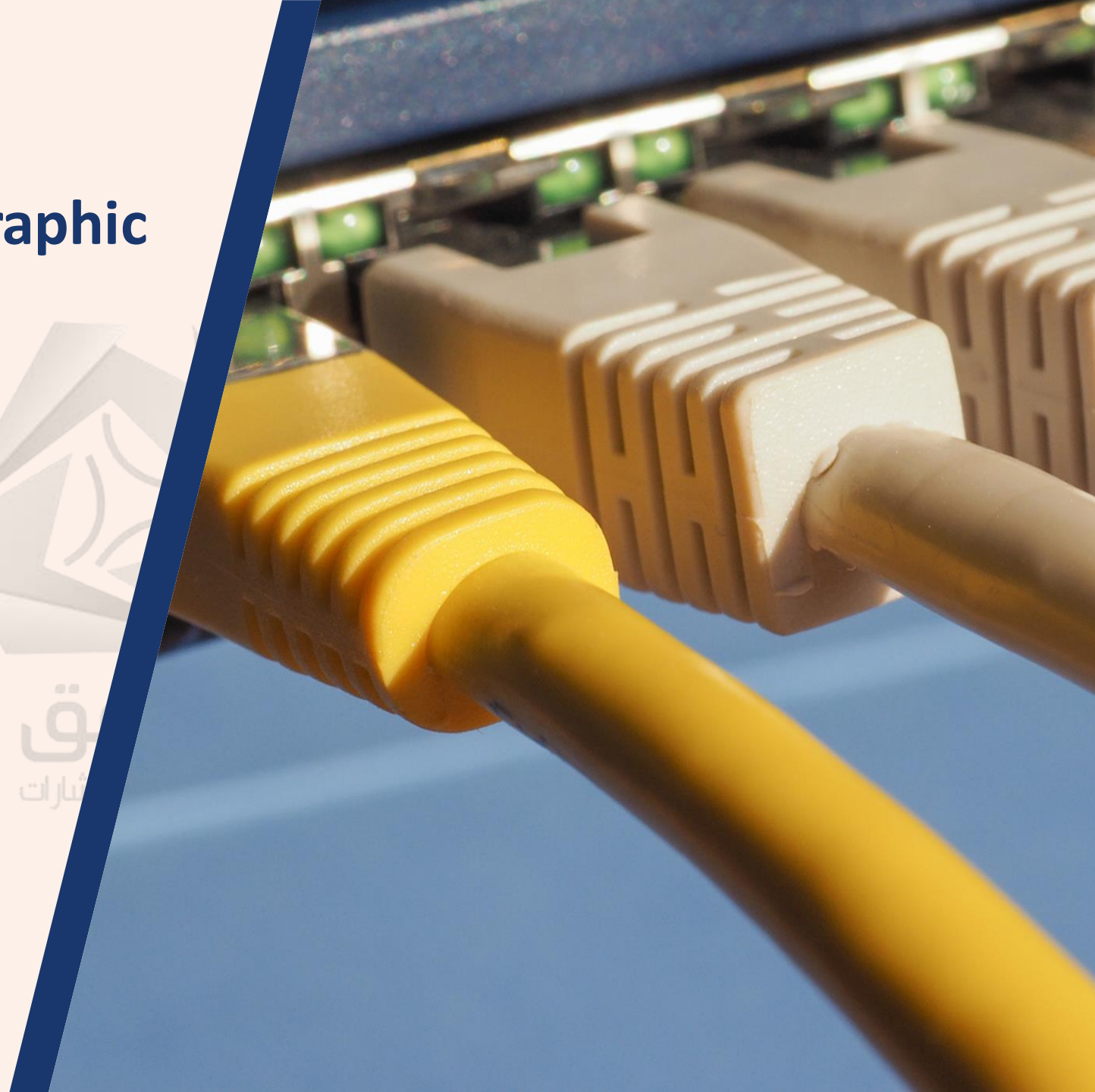


Types of Networks by Geographic

4- GAN (Global Area Network)

5-SAN (Storage Area Network

6-VPN (Virtual Private Network)



Terms

1- Internet

2-Intranet

3- Extranet

4-Cloud-Based Applications

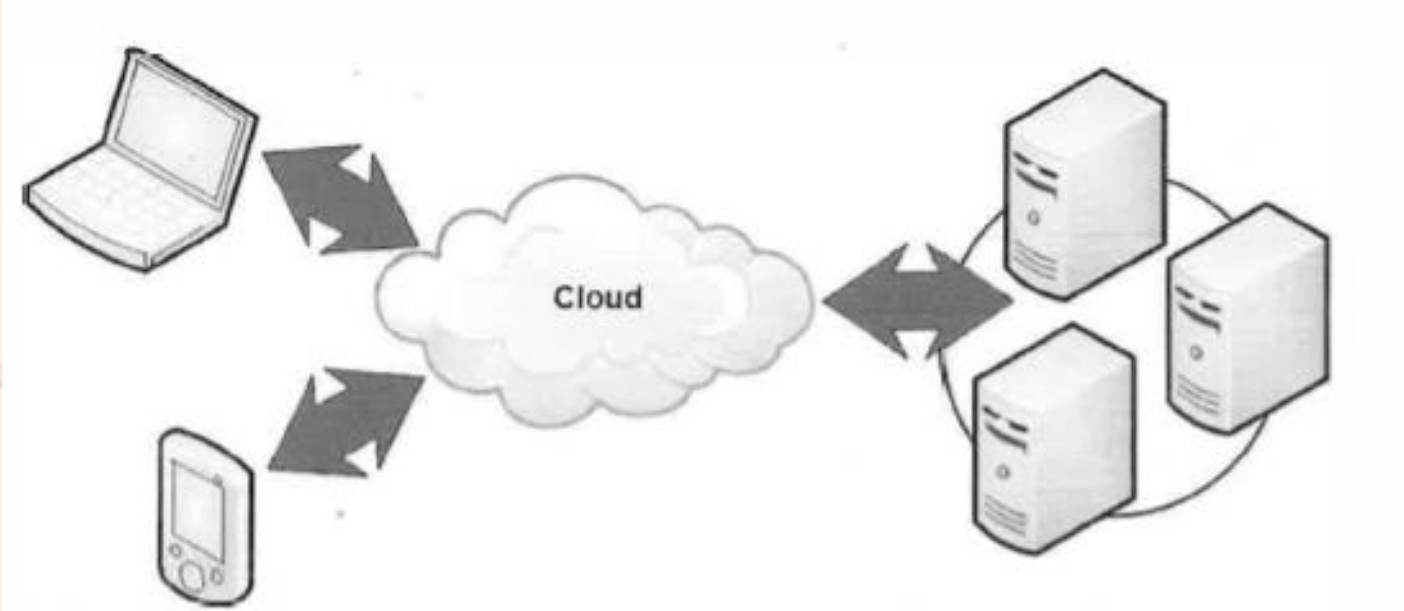


Figure 14 Cloud-based Applications

2-Wireless Networks

Four main types

1-WLAN: Short-range (e.g., Wi-Fi in buildings)

2-WMAN: City-wide networks

3-WPAN: Personal, short-range (e.g., Bluetooth)

4-WWAN: Large-scale mobile networks (e.g., 4G/5G)

Hybrid communication system

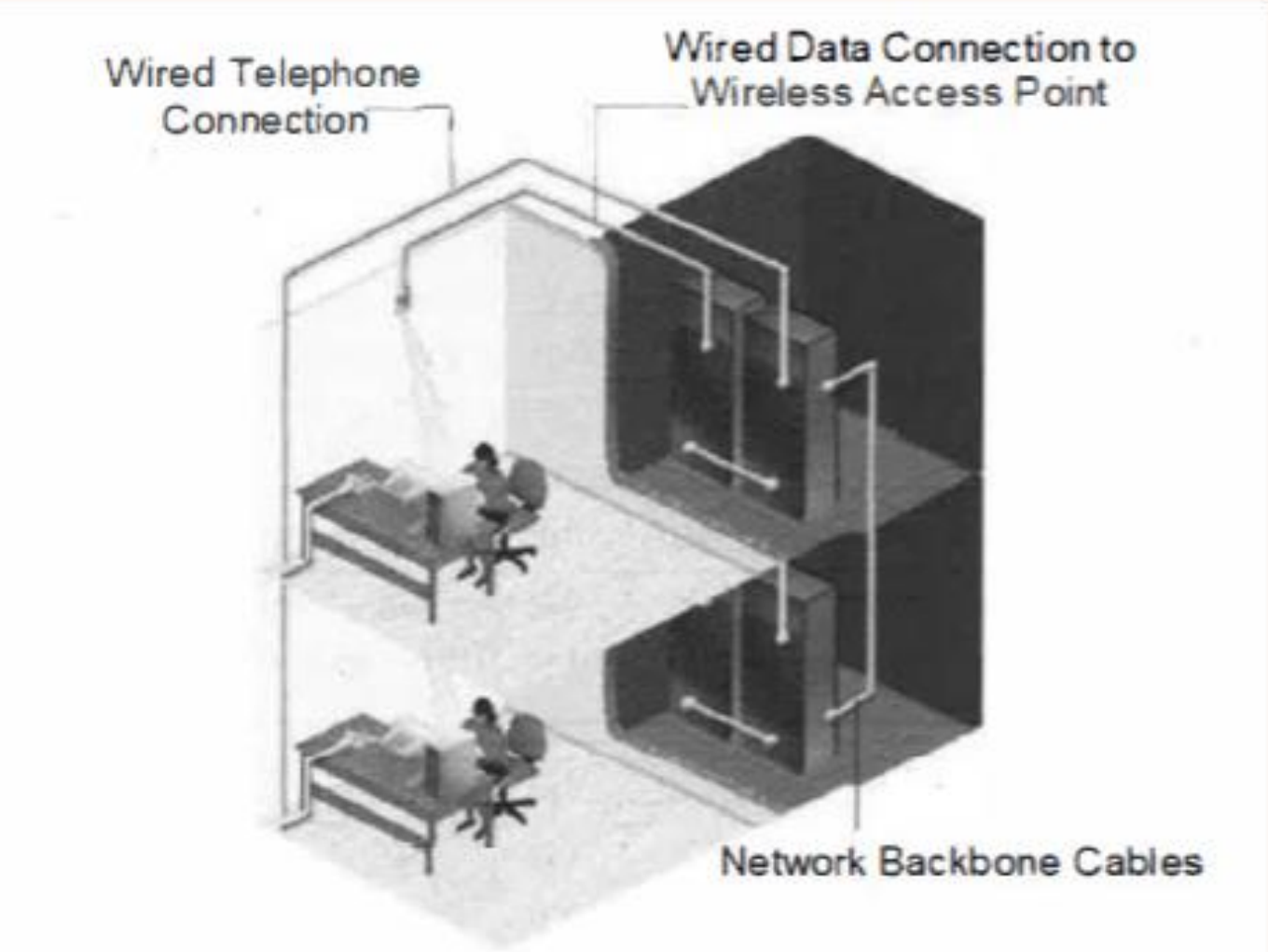


Figure 15 Wireless Data Network

Benefits of Wireless

Integration with core building systems

Support for mobile work processes

Increased tenant satisfaction

Reduced costs for cabling and installation

Factors to Consider

1-Signal Coverage

2- Interference

3-Wi-Fi and WLAN Security

3-Databases and Software

What is a Database?

1-Hierarchical Database

2-Relational database

3-Object-Oriented Database

4-Object-Relational Database (DBS

Software

1-System Software

2-Application Software

Software Life Cycle

1-Development

2- Implementation

3- Use

4-Deactivation

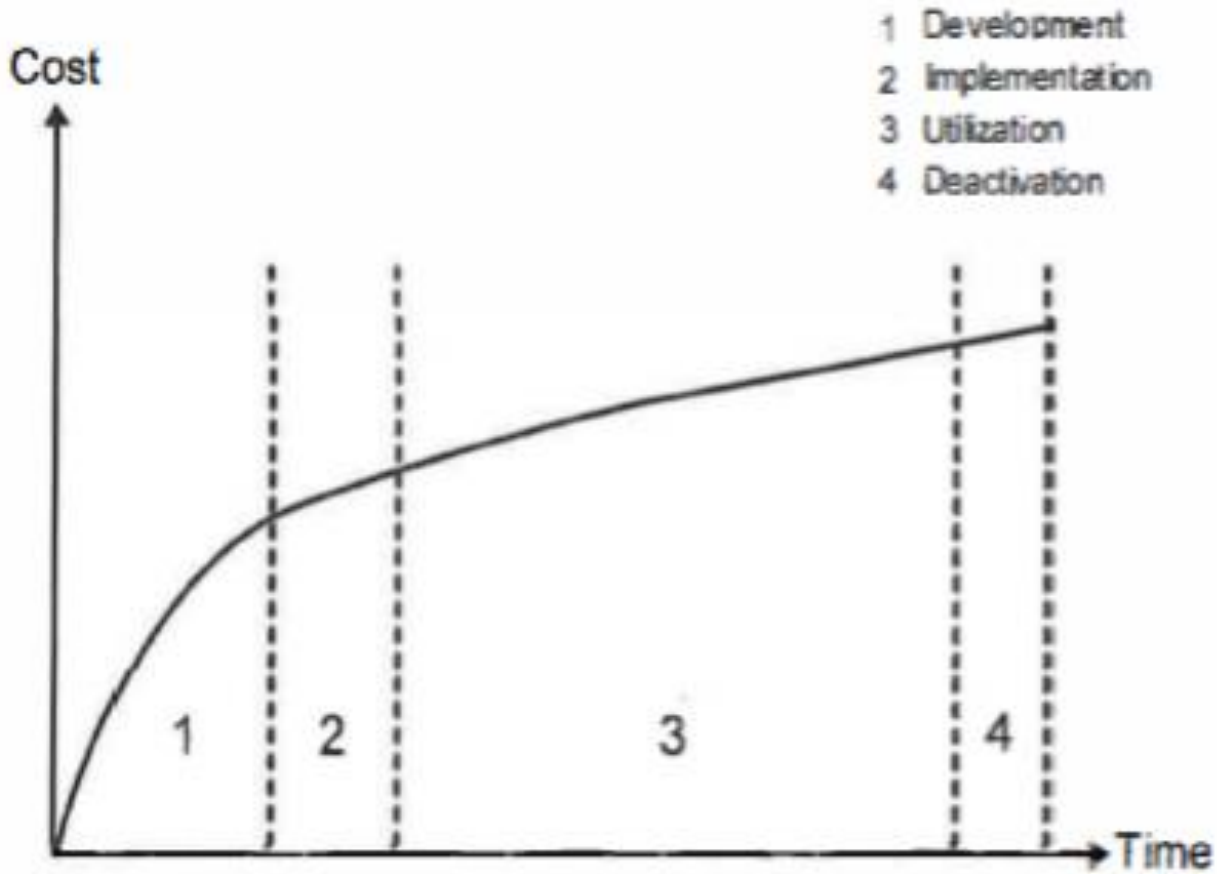


Figure 17 Life Cycle of a CAFM Software

4-IT Security for Facility Managers.

Common Threats

1-Ransomware

2-Spyware

3-Malware Viruses

4-Phishing Attacks

1-Internal Software and Applications Security

Network Security

Internet Security

Endpoint Security

2-External Applications and Network Security

Cloud Security

Application Security

Critical data in CAFM must be secured

Inventory documentation

Contract management records

Asset management data

Human resources & Financial

information

Authorized Concepts

Maintain user access control

Protect data integrity

Ensure network security.

Information Security Via the Internet

HTTP is not secure

HTTPS more secure

Remote Access VPN

Methods Firewalls Use to Grant Access

Encrypted username and password

Verifying the computer’s IP address

Using a published security key

Cloud Security shared responsibility

1-The FM organization.

2-The IT department.

3-The third-party cloud provider

Data in Transit

VS

Data at Rest

FM Reduce Impact of Cloud Service Loss

Host critical in-house

Backup data to the cloud

Establish SLA (cost of downtime)

Develop a plan to address service failures.

Chapter 4

Computer Aided Facility Management Systems

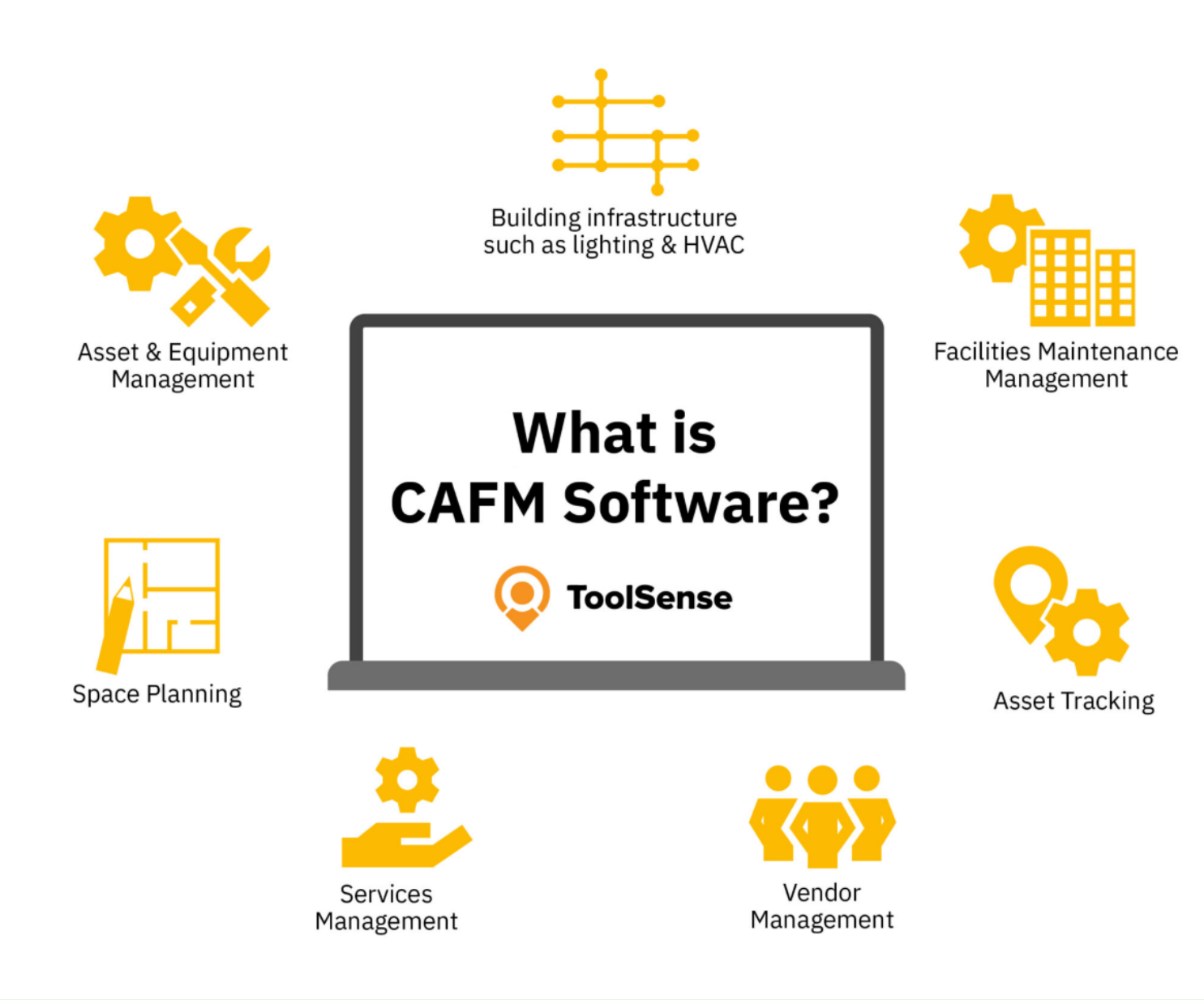
Contents

1-What is a CAFM?

2-Why Use CAFM?

3-FM Applications and IT Support.

1-What is a CAFM?

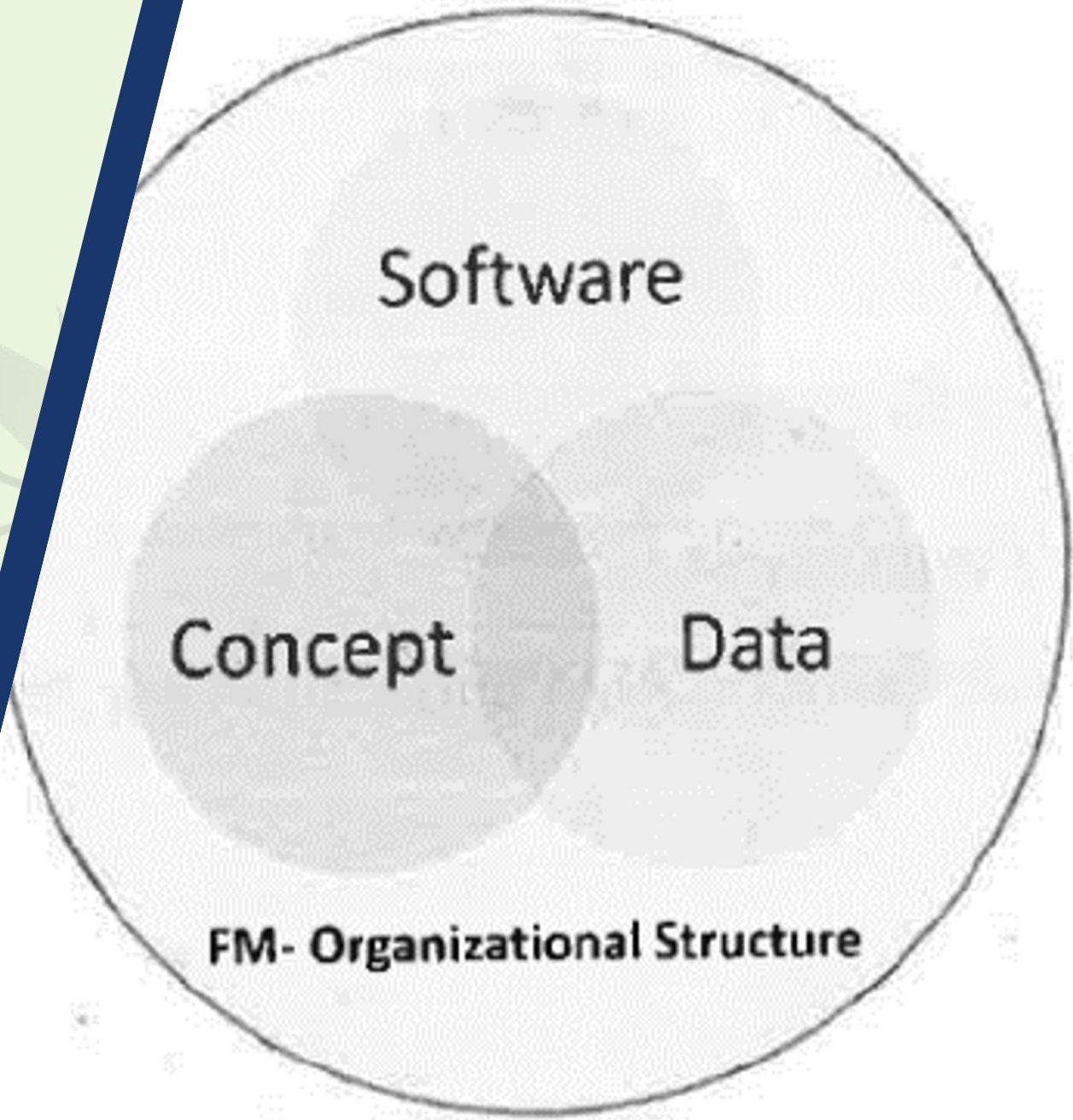


Components of a CAFM System

Concept

Software

Data



CAFM System Functions

1-Combines CAD and database technologies

2-Track, manage, report, and plan FM activities

Integrations with CAFM

Relational/Object-Oriented

Databases

ERP, CAD, BIM

Capital Planning Software

CMMS, IWMS

Core Features of CAFM

- Space Management
- Inventory Management
- Cleaning Management
- Move Management

Core Features of CAFM

- Maintenance Management
- Property Management
- Financial Management
- Energy Management
- Security & Access Management

Core Features of CAFM

- Occupancy Management
- Asset Management
- Real Estate and Contract
- Management
- Security & Access Management

Additional Features of CAFM

Project Management

Purchasing

Fleet Management

Access and Control Management

Additional Features of CAFM

Room Booking

Document Management

Change Management

Benefits of CAFM

- Efficient space utilization
- Reduced moving costs
- Continuous improvement of FM
- Better project planning

Modern CAFM

Relational database with APIs for integration

Integration of CAD and BIM

Business Intelligence (BI) Tools

Emerging Technologies:

3-FM Applications and IT Support

FM Register Data
Accurate, up-to-date data

Land - Buildings

Plants - Equipment

Facility services

FM Register Data
Data in various formats

Documents

Spreadsheets

CAD files & scanned images

Methods of Collecting Inventory Data

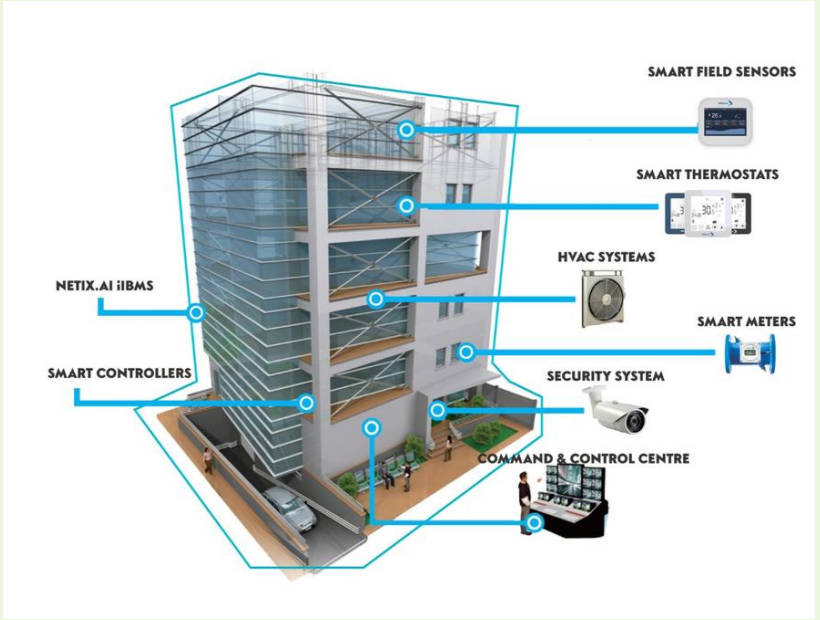
1-Drawing-Oriented / CAD Acquisition

2-Model-Oriented CAD / BIM Acquisition

3-Alphanumerical Data Collection

4-Semiautomatic Data Collection

VS



Building Energy Management System

(BeMS)

Building Management System

(BMS)

Chapter 5

Tools and Concepts

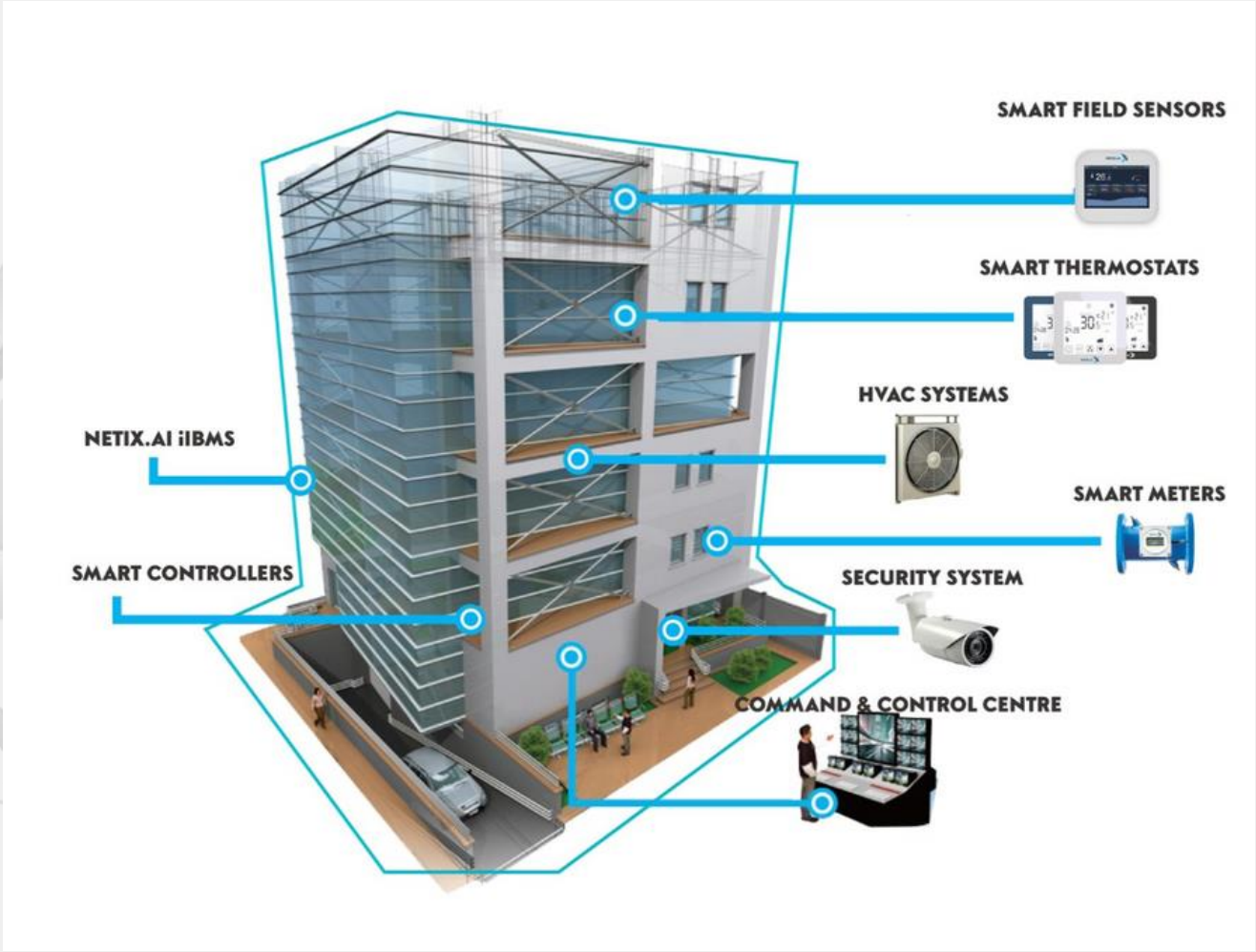
Contents

1-FM and Control Systems

2-Building Imaging & Modeling.

3-Emerging Tools

1-Facility Management and Control Systems.



Integrated Workplace Management System (IWMS)

1-Facility Management and Control Systems.

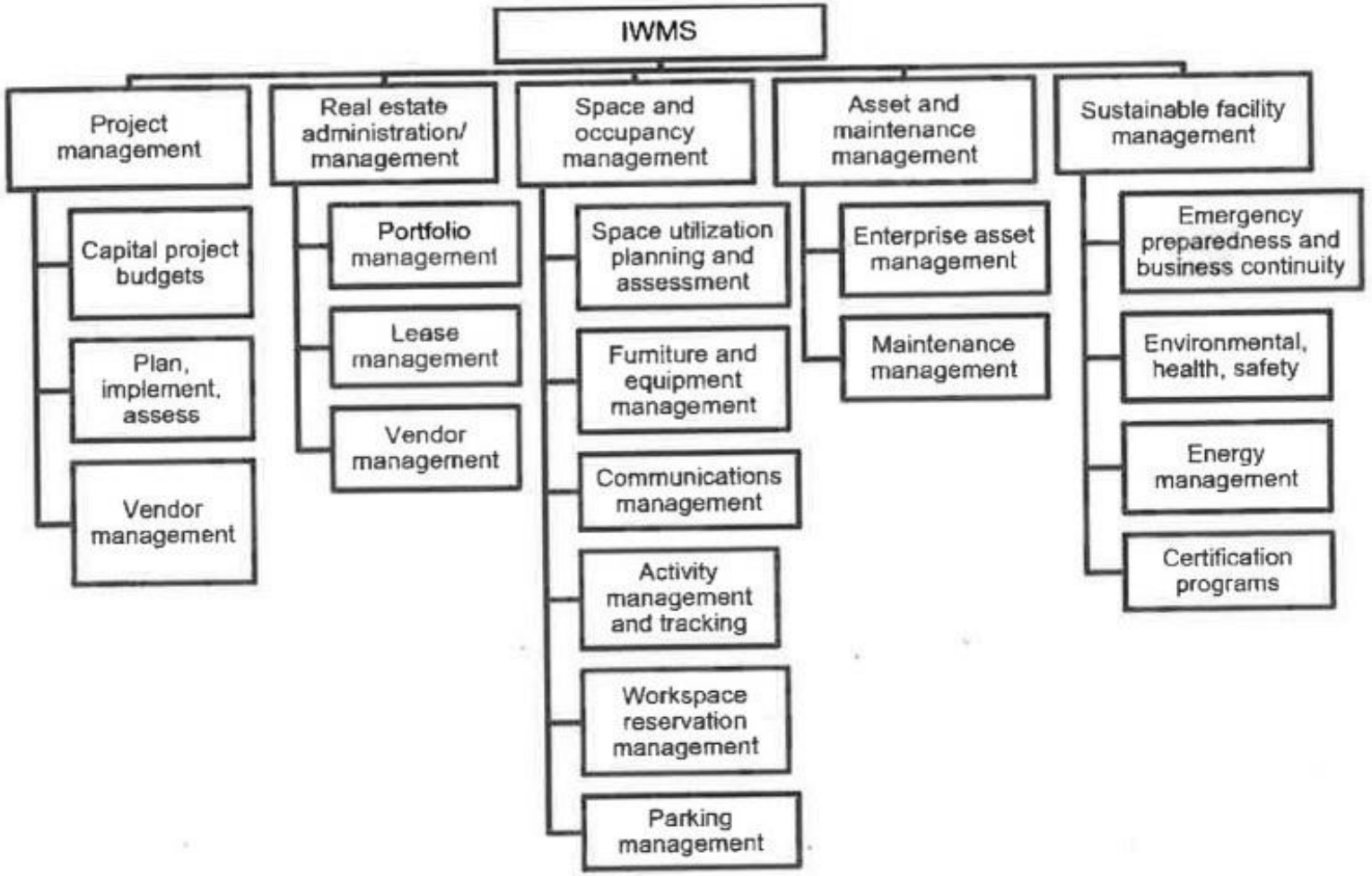


Figure 22 Integrated Workplace Management System

Evolution stages of IWMS

1-Departmental Tool

2-Organizational Tool

3-Enterprise Performance Management Tool

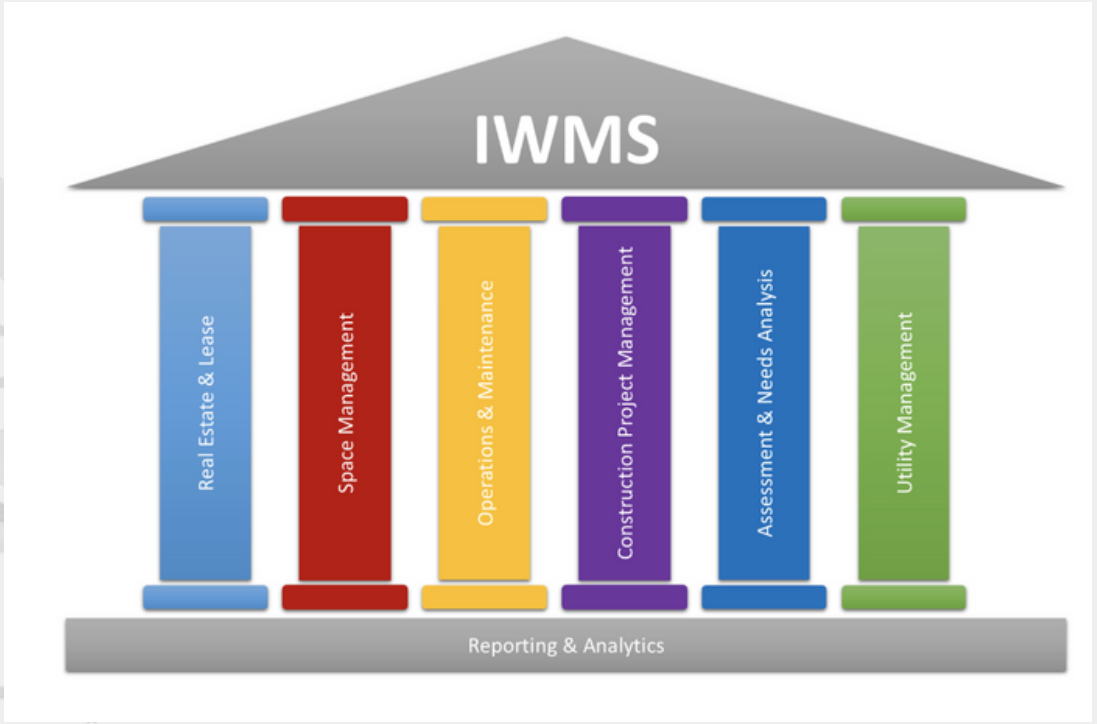
4-Strategic Tool

IWMS Architecture

1-Facility Databases Integration

2-ERP Databases Integration

3-Special-purpose Databases Integration

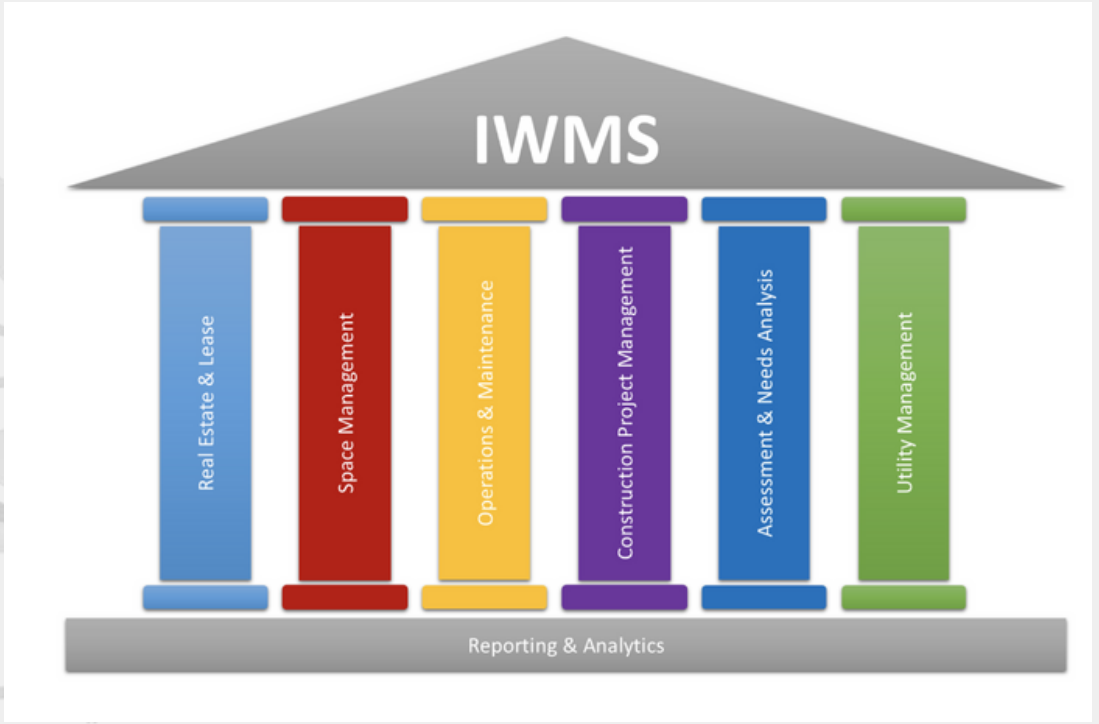


IWMS Architecture

4-External Databases

5-Hosting Options

6-Data Standards and Interoperability



1-Facility Management and Control Systems.

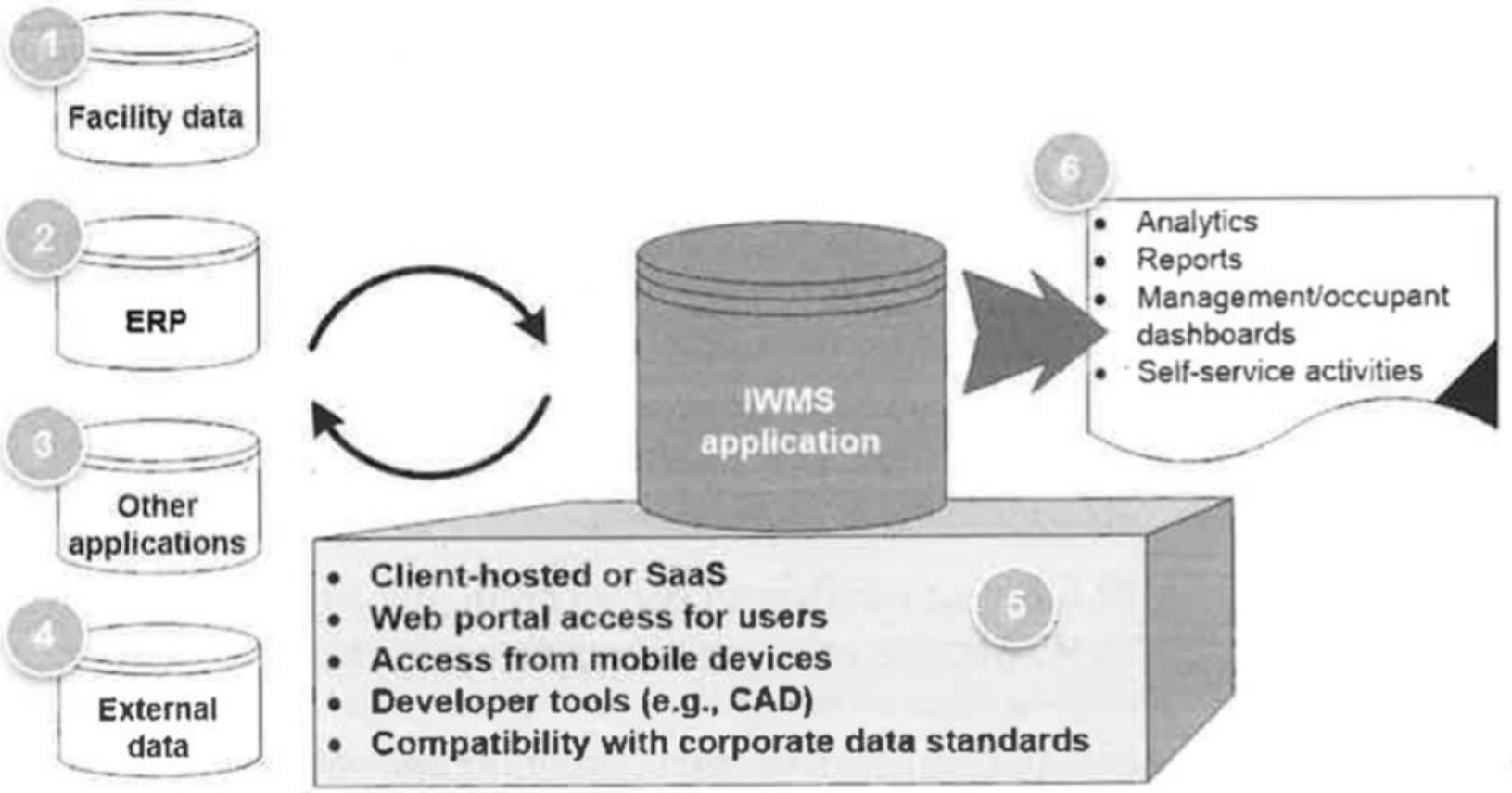


Figure 23 IWMS: Integration Information

Benefits of Integrated IWMS

1-Transparency

2-Control

3-Agility

4-Flexibility & Compliance

Application of IWMS in FM

1-Project Management

2-Real Estate Portfolio Management

3-Space Management:

Selecting Process

1-identify needs

2-stakeholder team to participate in the selection

3-Review different IWMS products

4-Evaluate vendor features & Partner with IT

1-Facility Management and Control Systems.

Computerized Maintenance Management Systems (CMMS)

1-Facility Management and Control Systems.

Evolution of CMMS:

Period	Development
1960s	Punch cards and mainframes handled maintenance tasks; data punched and input manually.
1970s	Transition to paperwork orders; technicians filled forms manually, data entry clerks entered into mainframes.
1980s	Smaller, more powerful computers (IBM-PC); CMMS became more affordable and accessible.
1990s	Networking advancements allowed sharing data over LAN; early "homegrown" CMMS using MS Access, FileMaker.
2000s	Rise of the **browser-based CMMS** with the spread of the World Wide Web.
2010s+	Emergence of **Cloud-based (SaaS) CMMS**, offering:

CMMS Architecture

Heart of a CMMS is its database

Assets under FM responsibility

Equipment, materials, resources

1-Facility Management and Control Systems.

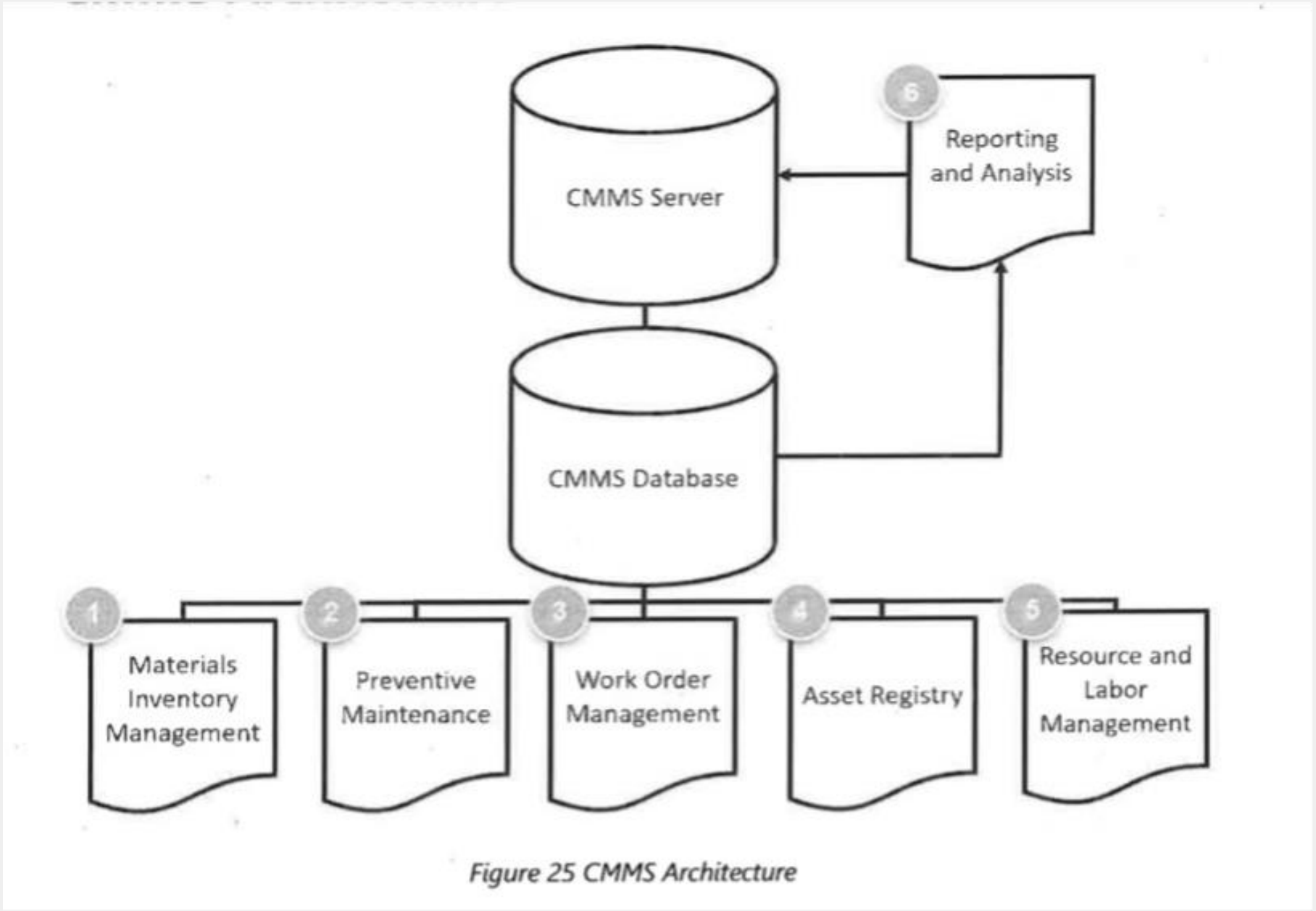


Figure 25 CMMS Architecture

System supports functions

1-Materials Management

2-Preventive Maintenance

3-Work Order Management

System supports functions

4-Asset Information

5-Resource and Labor

6-Reporting and Auditing

Benefits of CMMS

Tracking and Reporting

Workflow Visibility

Automation

Preventive Maintenance

1-Facility Management and Control Systems.

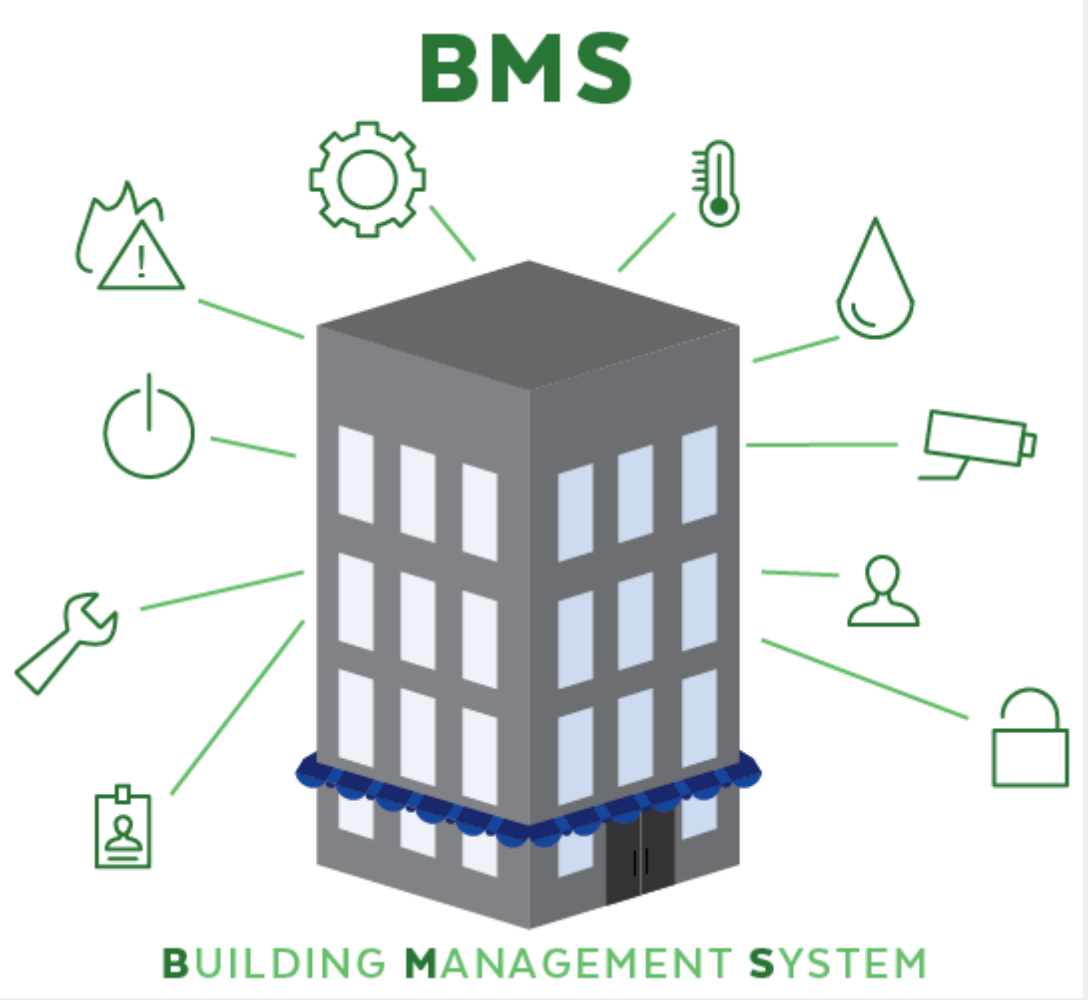
Building Automation System (BAS or BMS)

BAS Architecture (automated feedback loop)

Controllers devices and sensors

Devices and sensors send data back to

controllers



1-Facility Management and Control Systems.

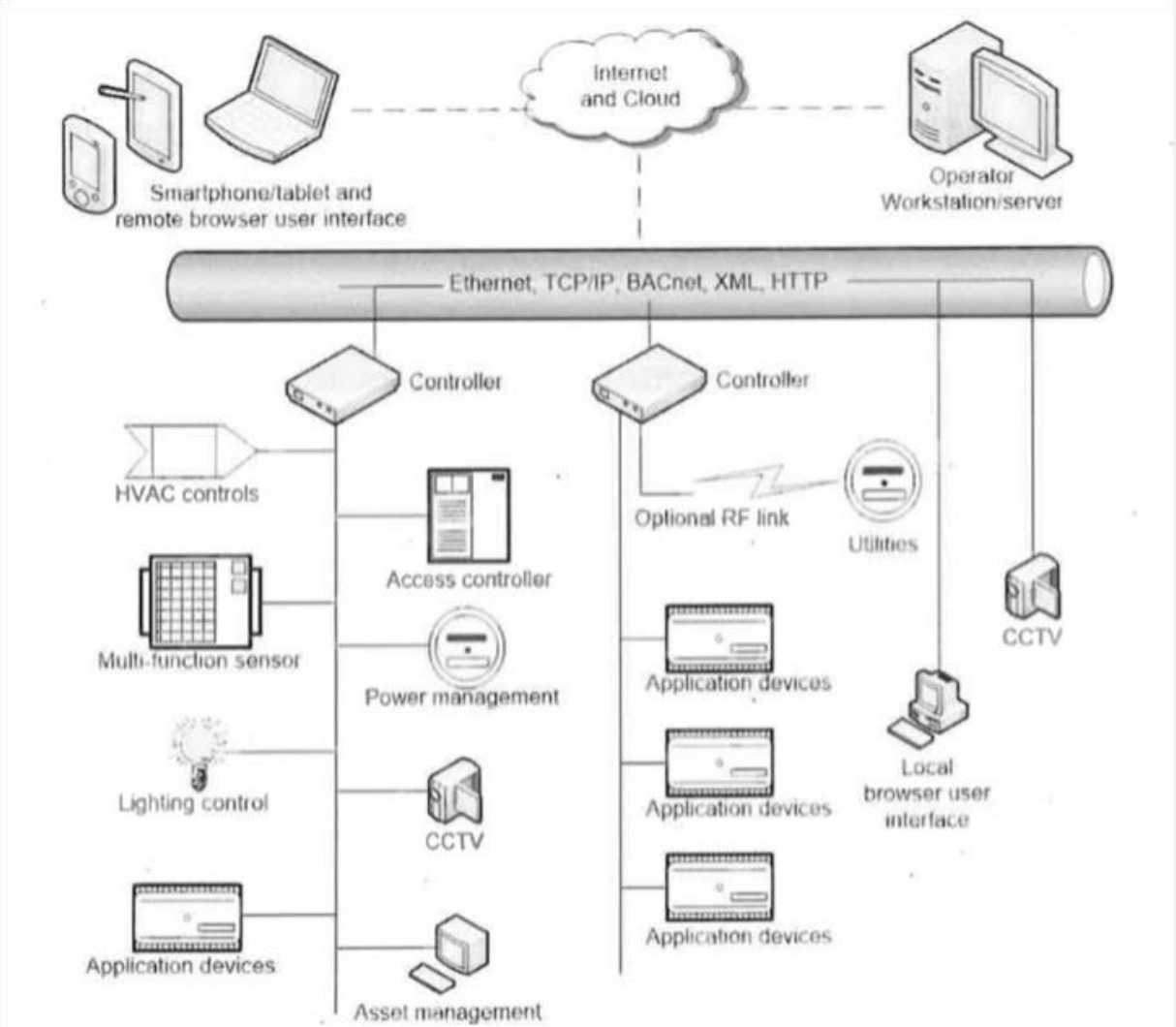


Figure 26 BAS Architecture

Components of BAS

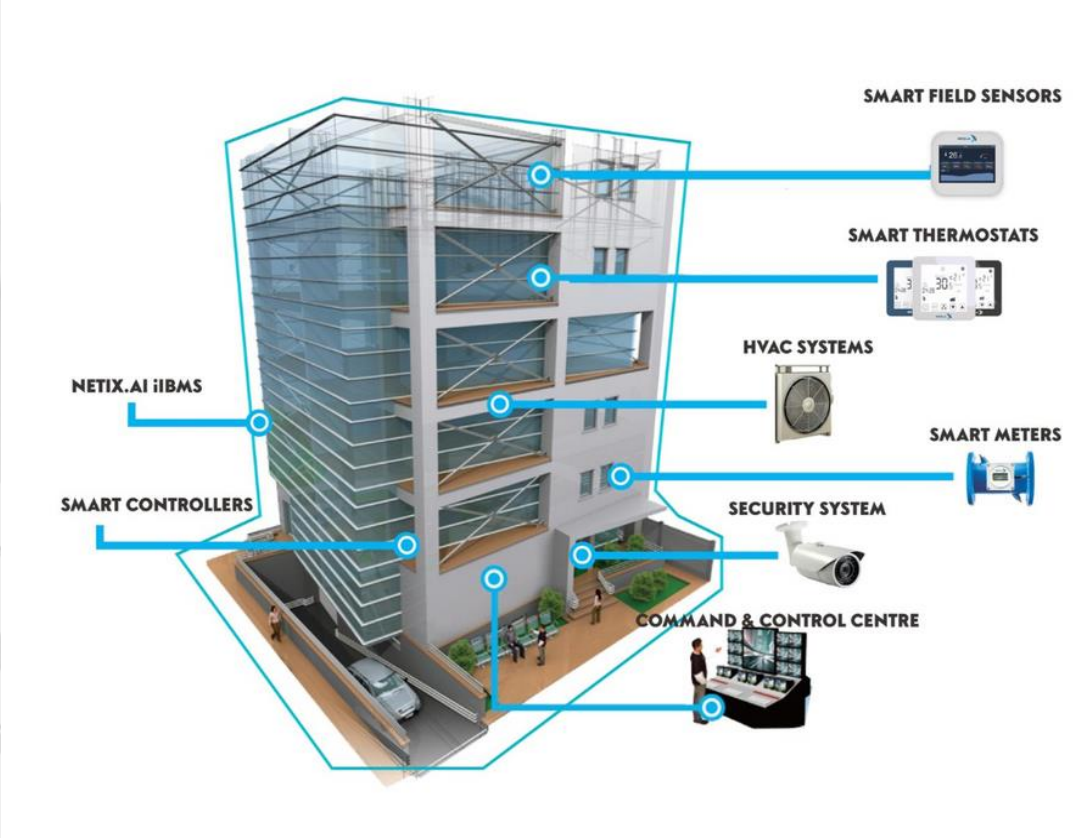
1-User Interface

2-Servers

3-Supervisory Networks

4-Controllers, Applications, Devices, and Sensors

4- Applications, Devices, and Sensors



2-Building Imaging & Modeling (BIM)

Perspectives on BIM

3D Representation

Logical System (4D Imaging)

BIM Architecture

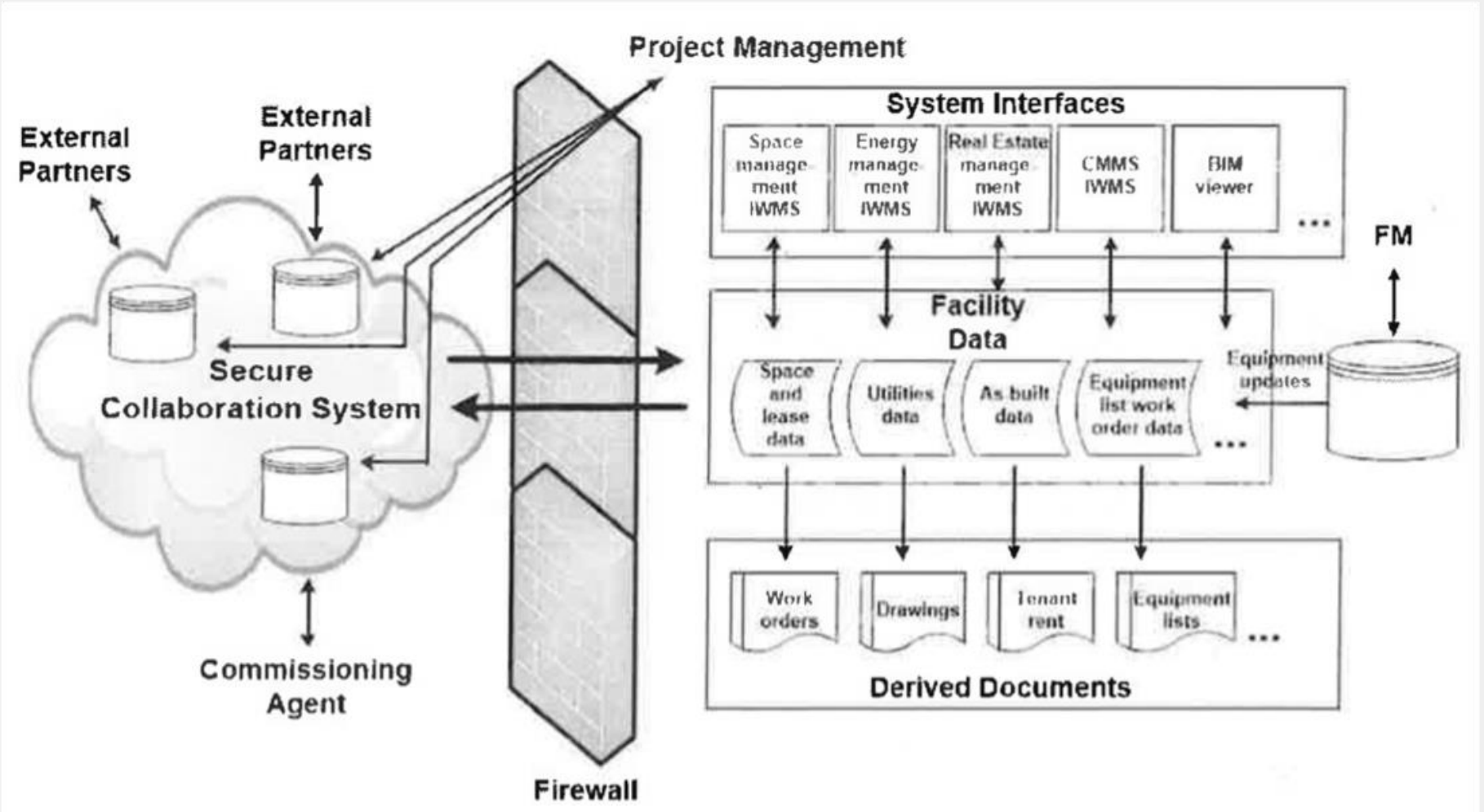


Figure 27 BIM Architecture and Integration (Retrieved from www.gsa.gov/bim)

BIM Integration

During projects and later with FM

FM uses BIM data lifecycle.

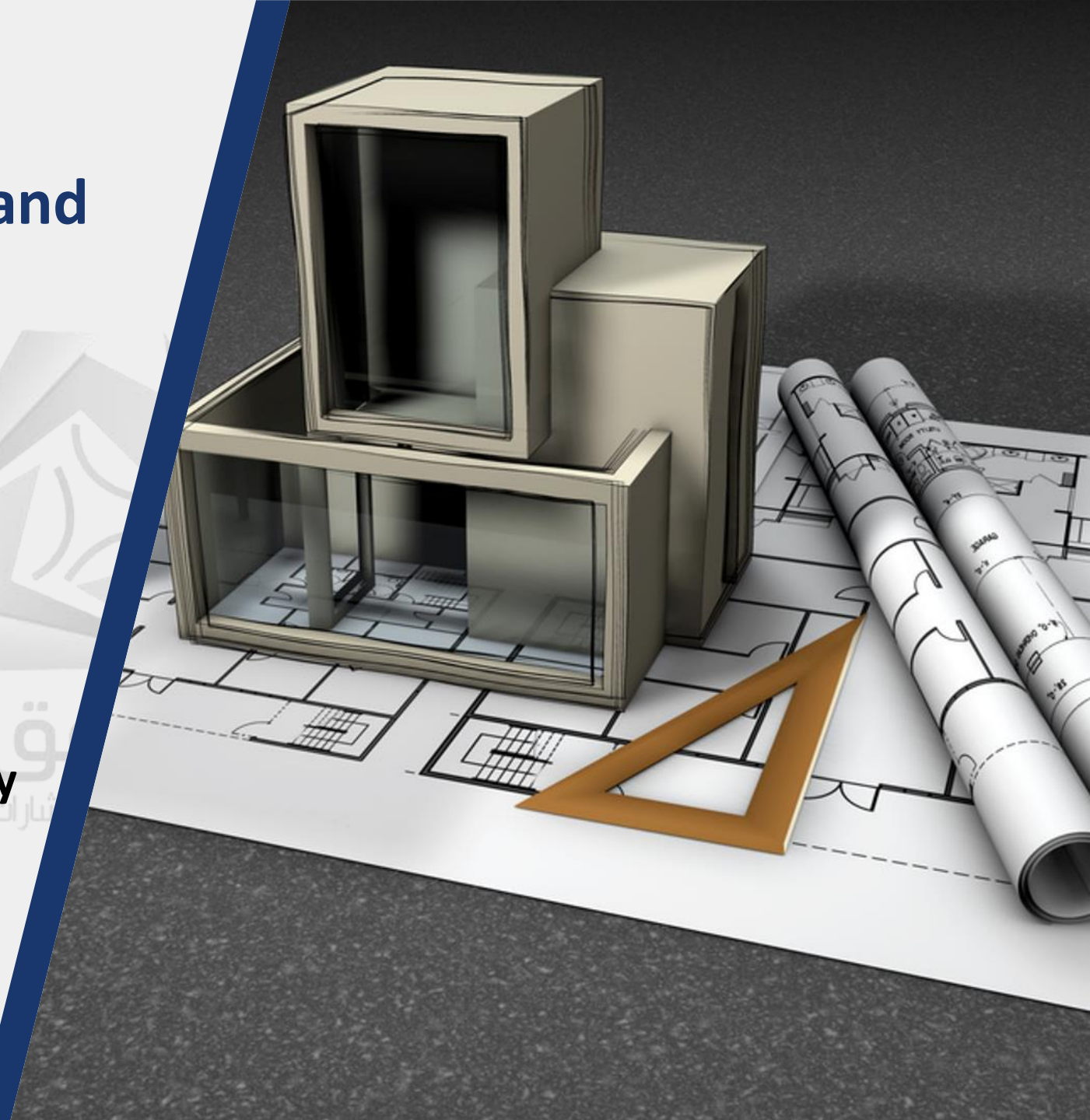
Advantages During Planning and Design

1-Simulate designs before construction

2-Improve information accuracy

3-Rapid cost calculation and analysis

4-Detect clashes in system designs early



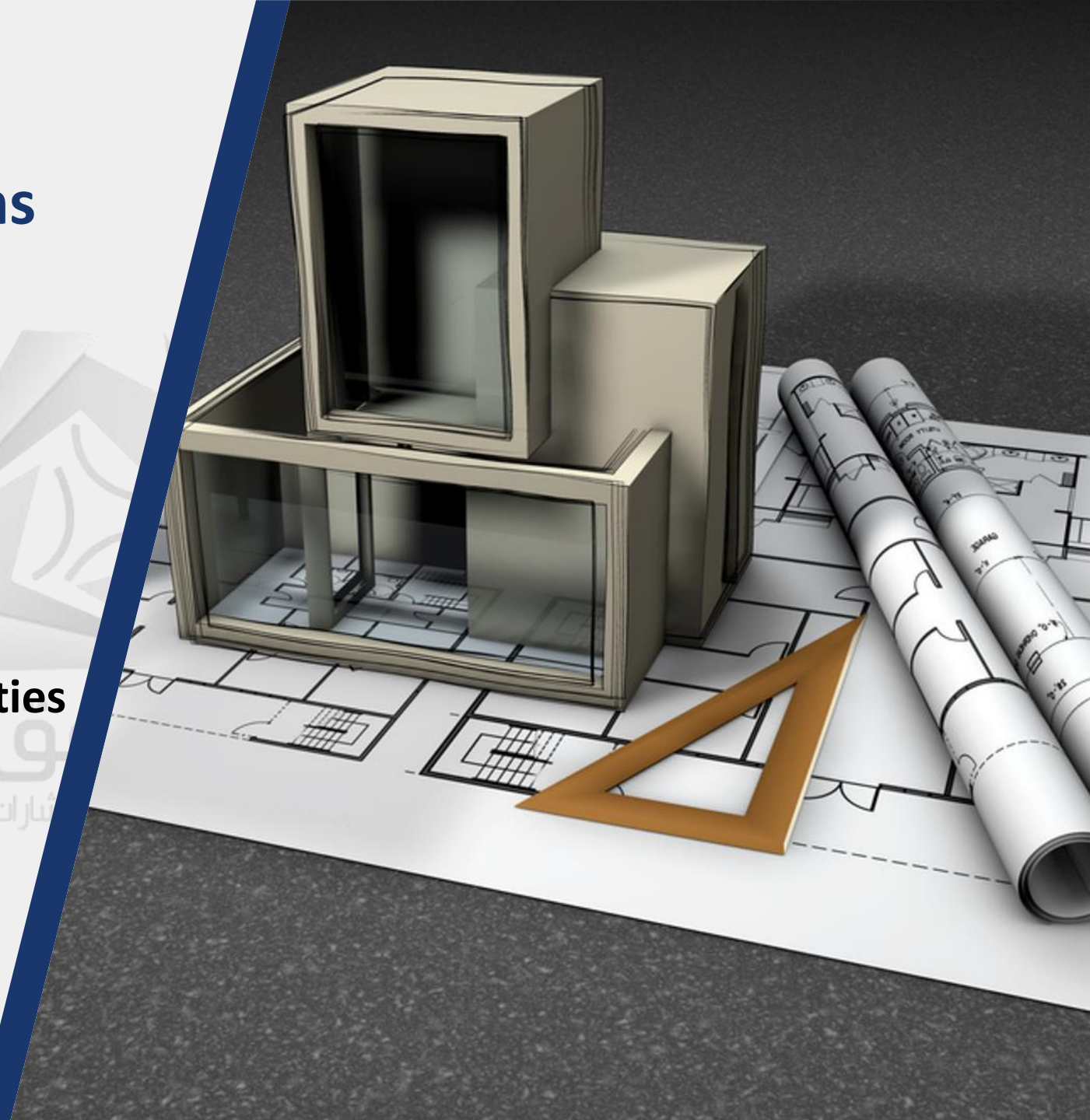
Advantages During Operations

1-Populate FM databases accurately

2-Visualize spaces and maintenance needs

3-Access real-time and historical data

4-Identify life-cycle cost savings opportunities



3- Emerging Tools, Technologies and Applications

Internet of Things (IoT) in FM

Building	**Experience**	User comfort & satisfaction	User Feedback
	Climate	IAQ, Temp, CO_2,	IAQ sensors
	Consumption	Sustainability	Smart metering
	Condition	Maintenance, Monitoring	Electro-mechanical sensors
	Demand	Just-Time facility use	Space/ Occupancy sensors

Table 9 IoT and Building Ecosystem (Williams and May, 2017)

Augmented Reality (AR)

Adds digital elements to the real world

Guides technicians in repairs and inspections

Virtual Reality (VR)

Users in a fully digital, simulated environment

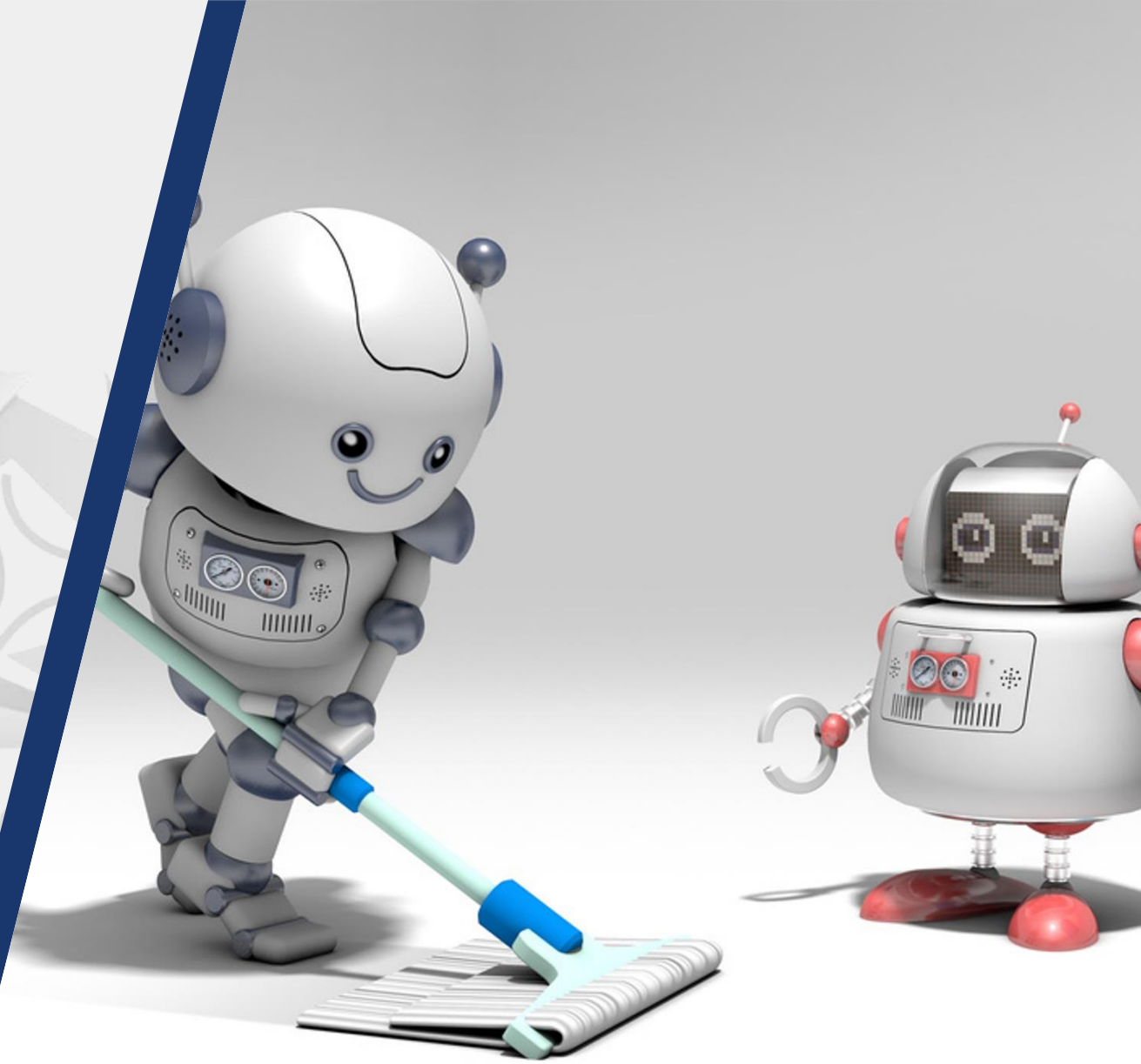
Used in BIM for facility design visualization

Artificial Intelligence (AI) in FM

Energy Management

Maintenance Planning

Operations Optimization



Drones and Aerial Imaging in FM

Chapter 6

Assessment

Contents

1-Needs Assessment

2- Implementation.

3-Facility Condition Assessment

4-CAFM Return on Investment (ROI)

1-NeedsAssessment

Characteristics of successful projects

Stakeholder participation in defining value.

Alignment with organizational goals

Realistic assessment of process, cost, and timeline

Organizational readiness for change

Project Planning Process

PLAN

DO

CHECK

ACT

Contents

2-Implementation

Developing Business Cases

- Scope and objectives
- Process overview
- Specific needs
- SWOT analysis

Developing Business Cases

- Cost-effectiveness analysis
- Recommended solution
- Next steps
- Metrics

Technology Implementation Process

1-Identify stakeholder needs

2-Develop a strategic tech plan

3-Analyze current processes

4-Evaluate and select technology

Technology Implementation Process

5-Implement selection

6-Manage technology

7-Measure output

8-Integrate technology

2-Implementation

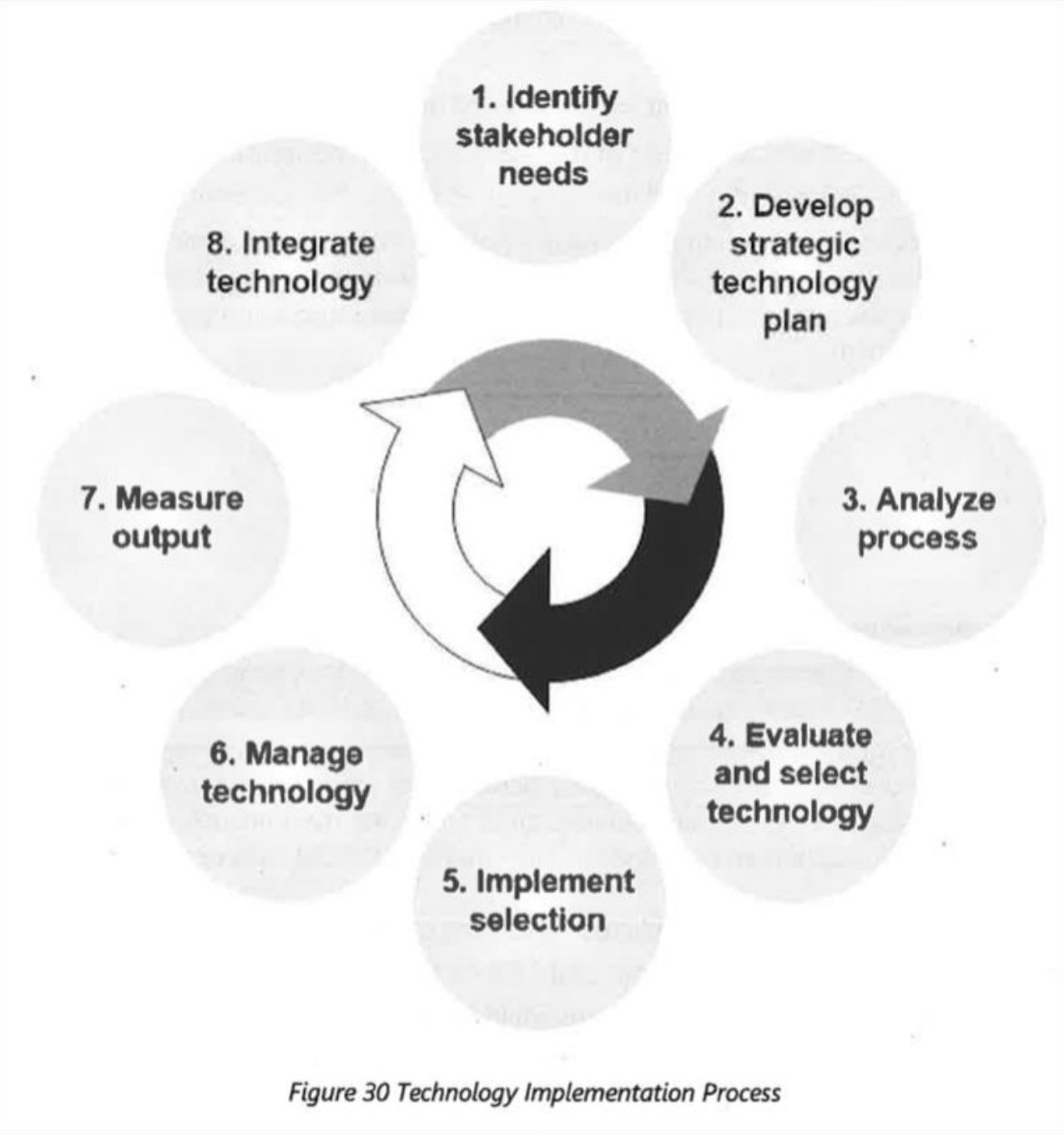


Figure 30 Technology Implementation Process

3-Facility Condition Assessment

FCA Process

Architectural and Structural

MEP

Roofing and Civil Works

Code Compliance and Accessibility

Evaluation is based on two core factors

1-Current condition

2- Remaining Useful Life

Benefits of FCA

Budget Planning

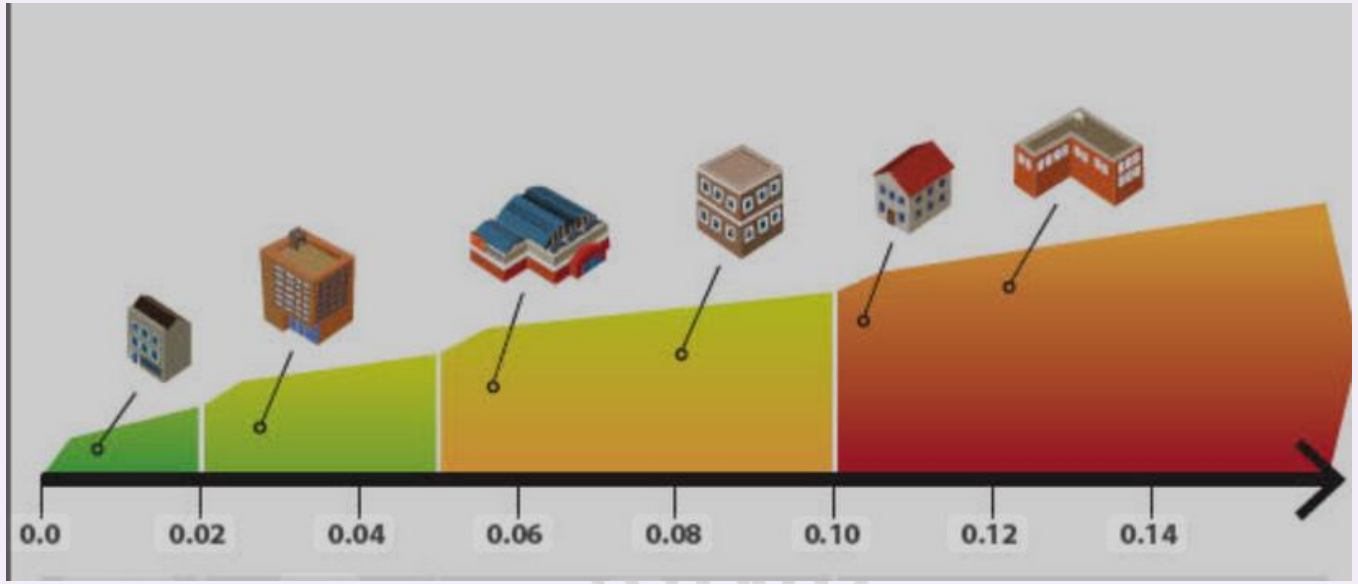
Life-Cycle Costing

Risk Reduction

Asset Inventory

Compliance and Benchmarking

Facility Condition Index (FCI)



- **Formula**:

$$\text{FCI} = \frac{\text{Deferred Maintenance} + \text{Capital Renewal}}{\text{Current Replacement Value}}$$

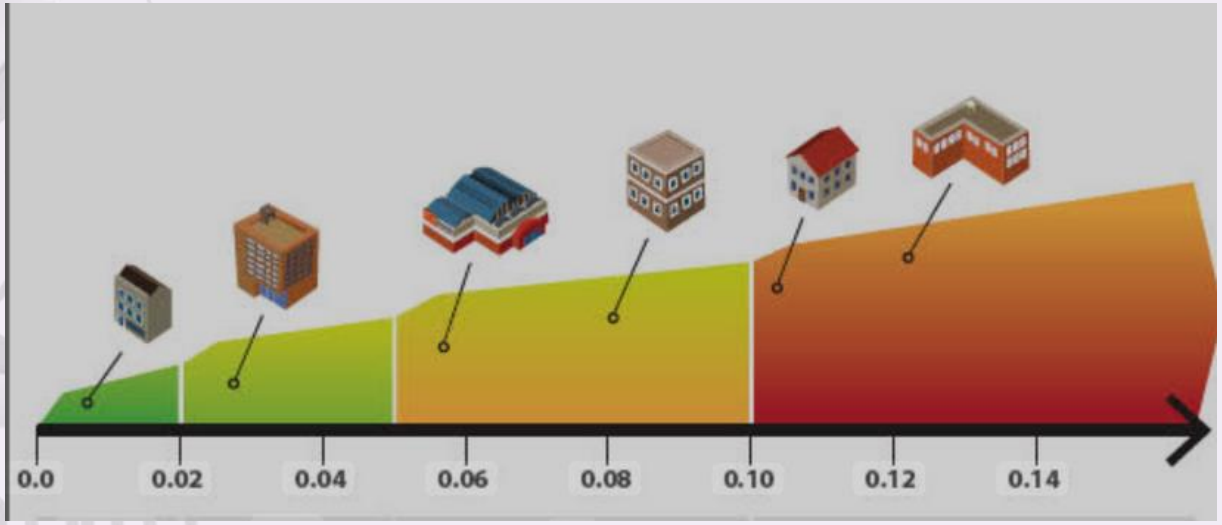
Purpose and Value of FCI

Budget prioritization

Determine annual reinvestment rates

Calculate catch-up costs

Act as a KPI for objective decision-making



Facility Condition Scale

Condition	Range (FCI)
Good	0%-5%
Fair	5%-10%
Poor	10%-30%
Critical	30% or higher

Table 10 FCI Scale

FCA Deficiencies

1-Building Deficiency

2-Programming Deficiency

3-Policy Deficiency

4-CAFM Return on Investment (ROI)

4-CAFM Return on Investment (ROI)

$$ROI(\,Return\ on\ Investment) = \frac{Value - Cost}{Cost}$$

initial costs

Software or SaaS/Cloud hosting fees

Implementation and user training

Hardware and equipment costs

Annual vendor support and maintenance

Determining CAFM Value

1-Reduced maintenance costs

2-Decreased downtime of equipment and systems

3-Lower inventory and spare parts waste

Determining CAFM Value

4-Reduced labor and overtime expenses

5-Improved staff productivity

6-Reduced utility and energy bills