

智能大厦科技

Facilities Management



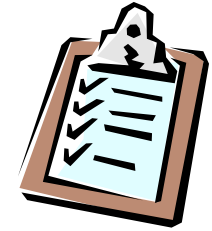
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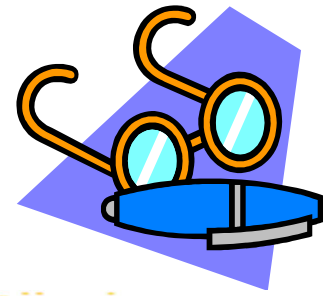
E-mail: cmhui@hku.hk

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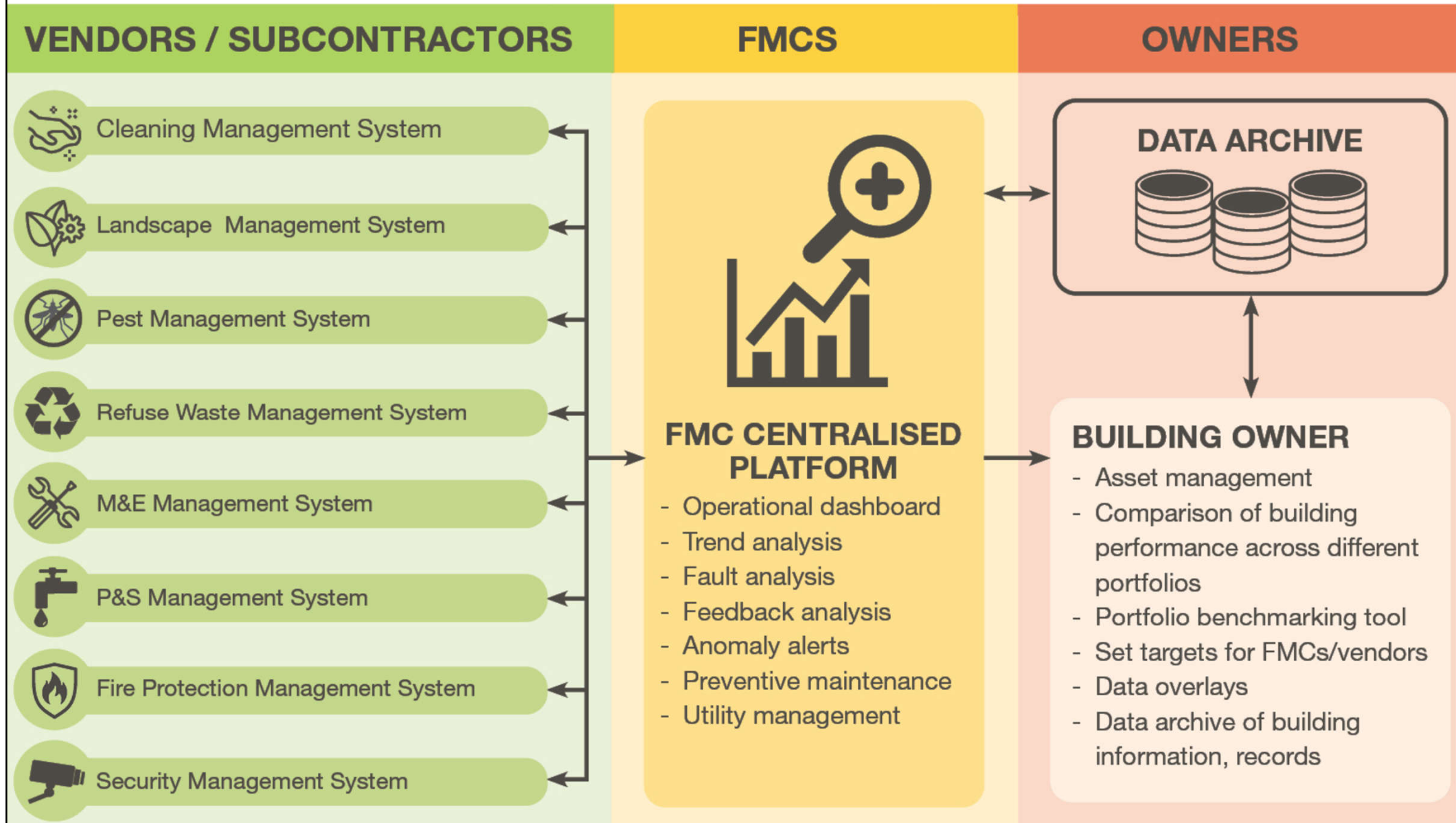
- Basic concepts
- Smart FM
- Key factors
- Smart space management

Basic concepts

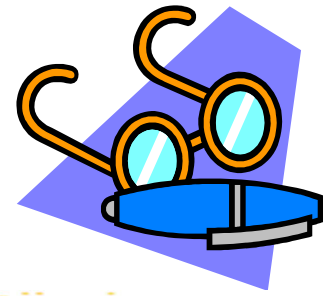


- Facilities Management (FM)
 - Management of physical assets of the building
 - Commercial, retail, residential & industrial properties
 - People oriented + Process driven
 - Encompass multiple disciplines to ensure functionality of the built environment by integrating people, place, process & technology
 - Manage costs & efficiencies
 - Manage spaces (e.g. for office, meeting) that can be used by individuals & groups to support a wide variety of different tasks (complete workplace management)

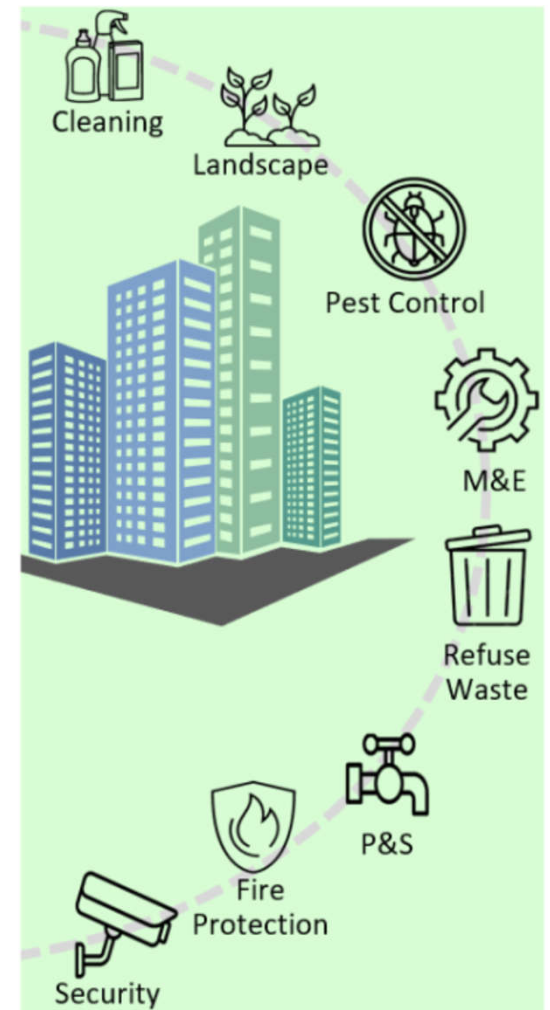
Multiple discipline systems of facilities management & relevant stakeholders including vendors/subcontractors, facilities management companies (FMCs) & building owners



Basic concepts



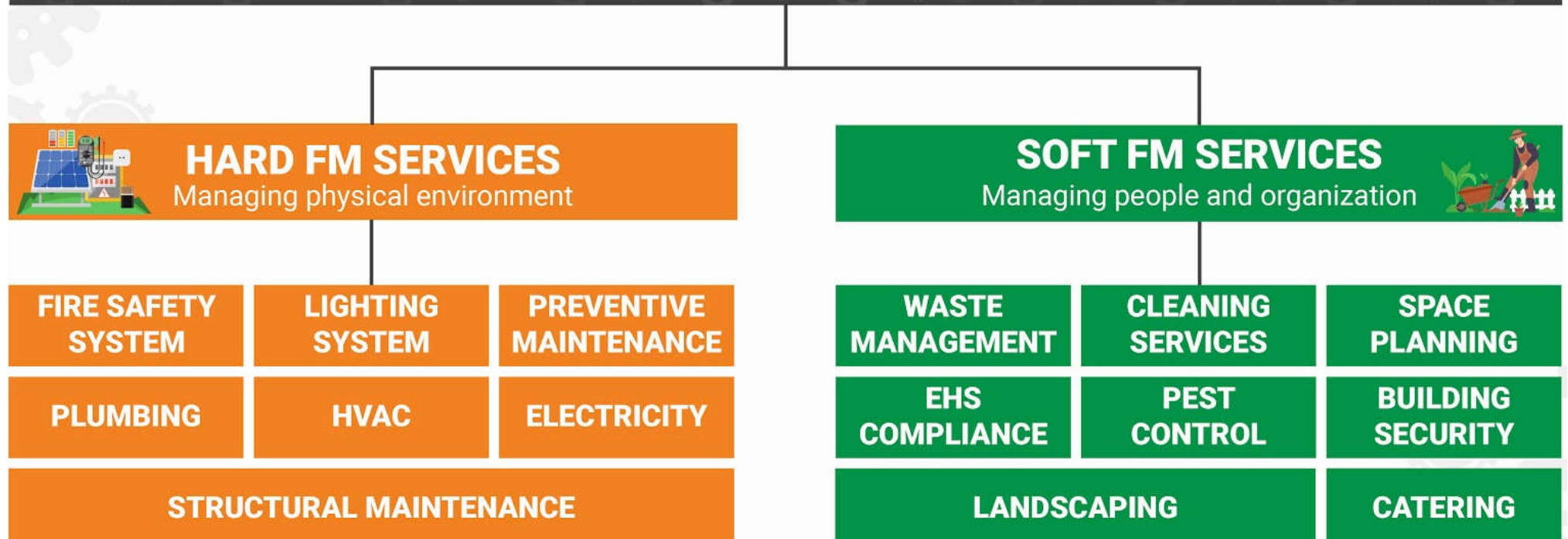
- Examples of facilities management tasks:
 - Meeting room booking
 - Visitor management
 - Cleaning service & pest control
 - Waste management
 - Security management
 - Asset maintenance & workflow
 - Vendor & subcontractor management
 - Request (helpdesk) management



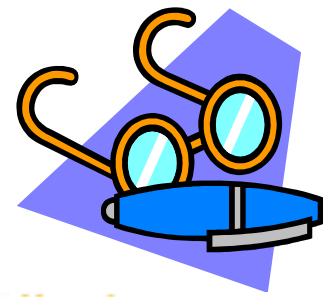
Scope & functions of facilities management (FM)



FACILITY MANAGEMENT

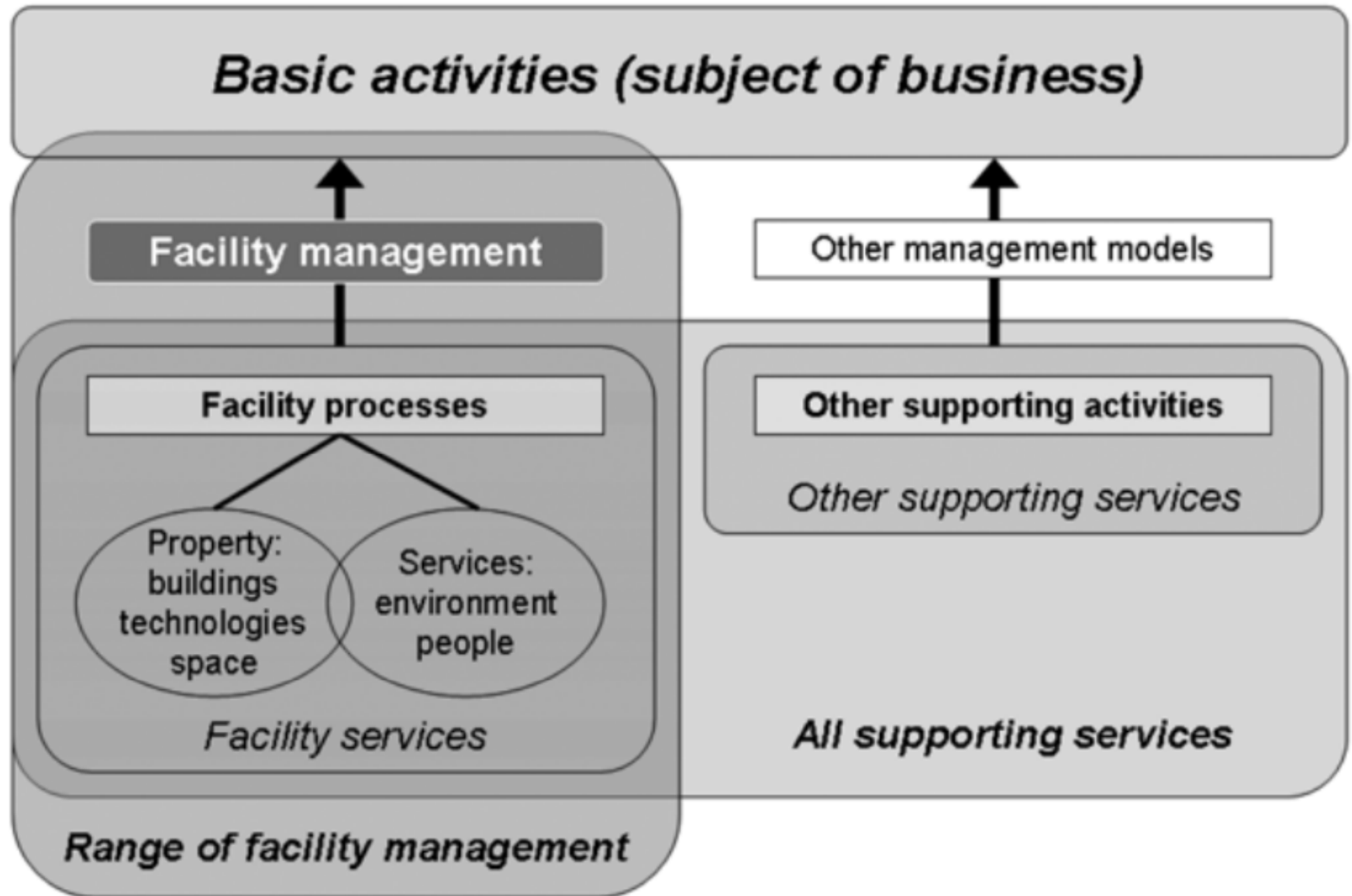


Basic concepts

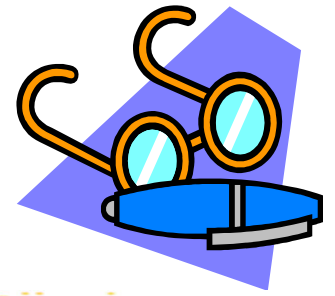


- Two areas of facilities management (FM):
 - 1) Space & Infrastructure (“hard services”)
 - Space management, space utilization, management & optimization of the workplace, technical management of buildings, energy management, waste management, indoor & outdoor cleaning
 - 2) People & Organizations (“soft services”)
 - Health, hygiene, safety & security, internal services (boarding, receptions, meeting rooms, secretarial services, etc.), ICT, internal logistics (archive services, mail service, transport services, car service, etc.)

Structure & activities of facility management & other supporting services

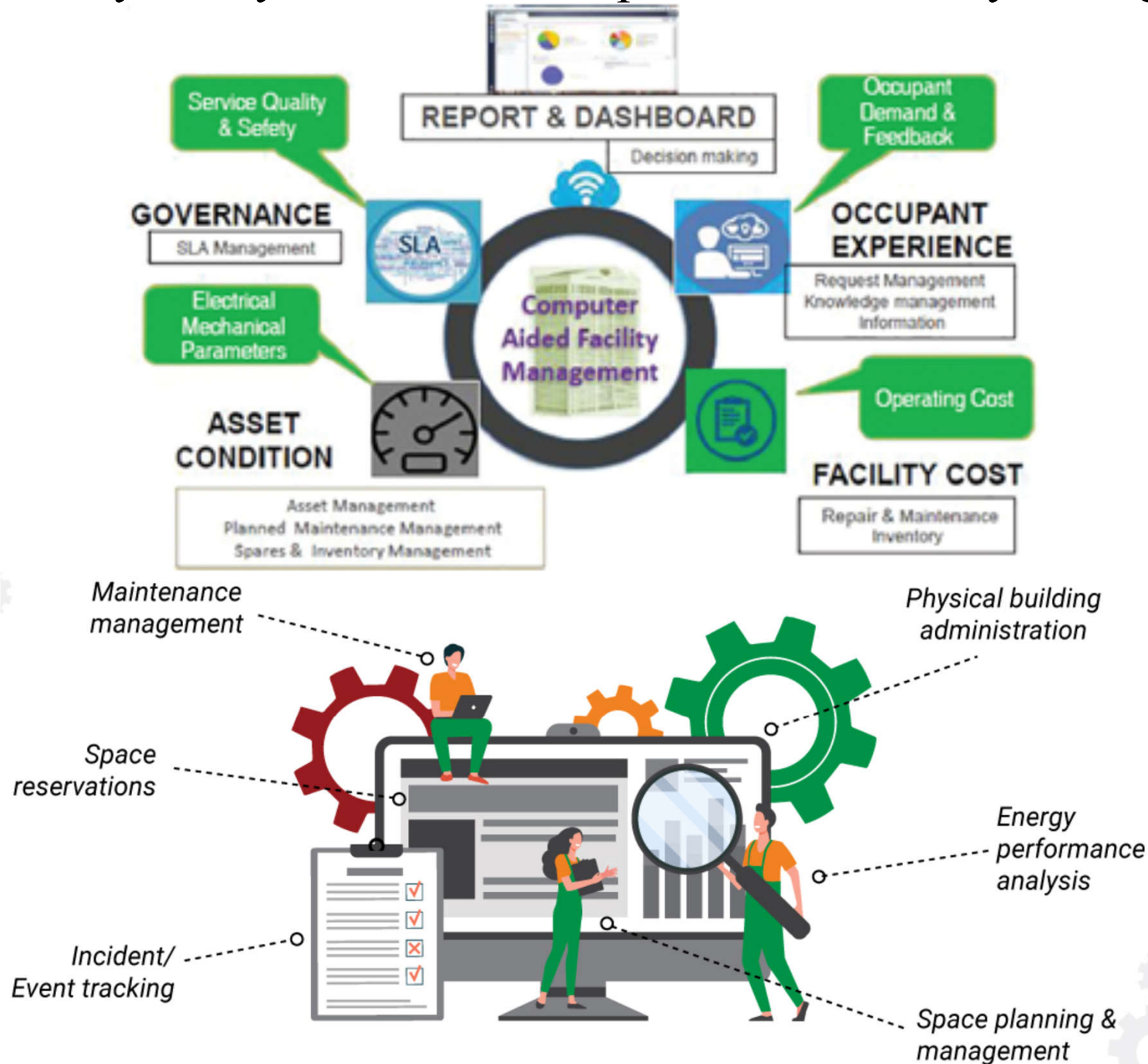


Basic concepts

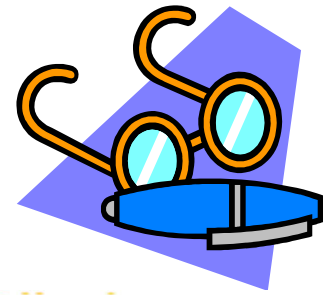


- Two software solutions/platforms for FM:
 - 1. Computer-Aided Facility Management (CAFM)
 - Space Management: track the occupancy & allocation of space
 - Move Management: plan, execute & track moves of equipment, people & furniture
 - Asset Management: track & maintain assets/equipment by scheduling usage & maintenance activities
 - Maintenance Management: manage & schedule maintenance activities, track the progress of work & generate reports

Functionality & key features of computer-aided facility management



Basic concepts

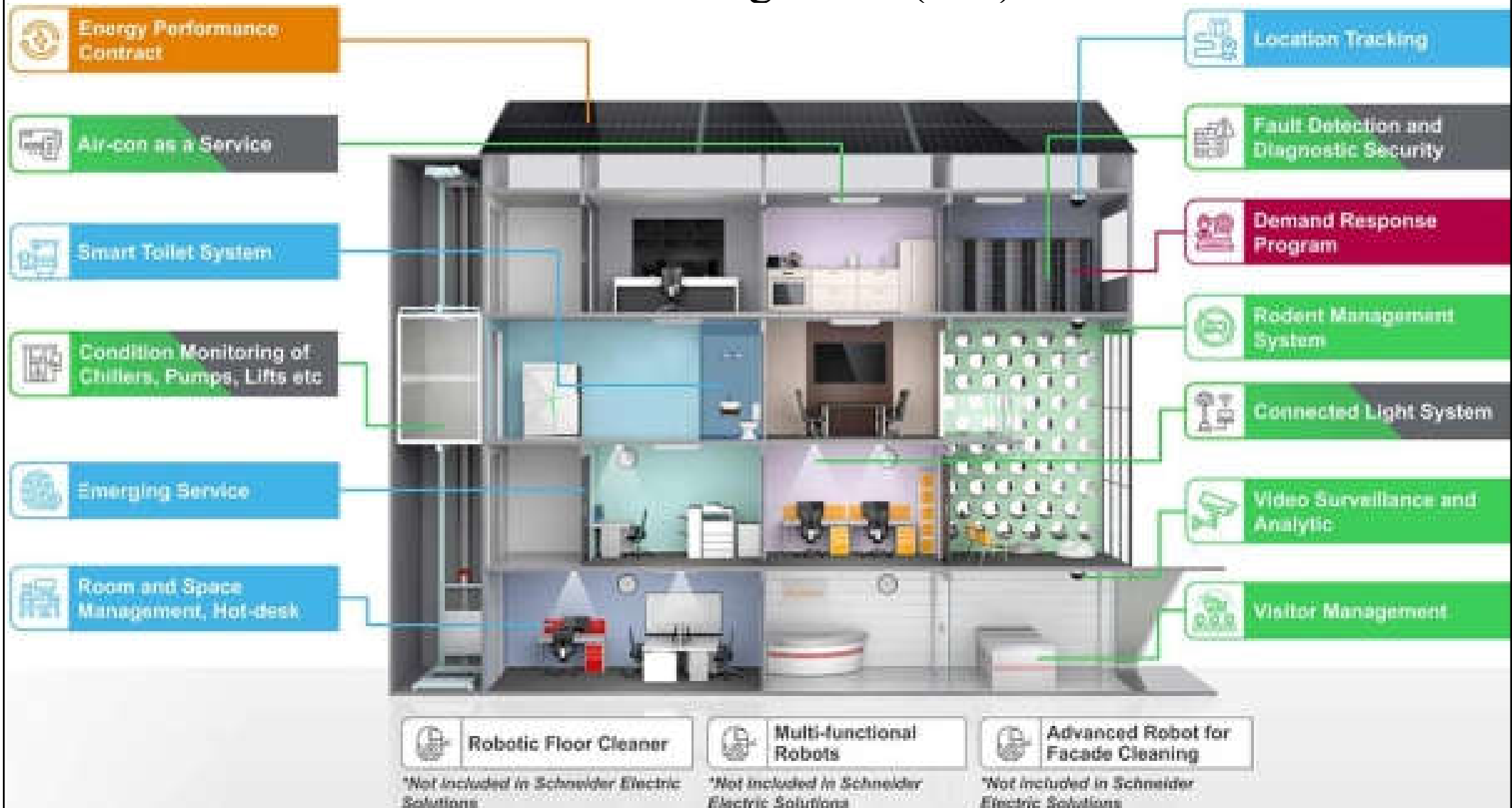


- Two software solutions/platforms for FM:
 - 2. Computerized Maintenance Management System (CMMS)
 - Work Order Management: create, schedule & track work orders related to maintenance activities.
 - Asset Management: track & maintain assets, schedule maintenance activities & track their usage
 - Inventory Management: manage spare parts & inventory related to maintenance activities
 - Reporting: generate reports related to maintenance activities, inventory & assets

An example of facilities management (FM) software interface



Smart facilities management (FM) services



People counting/
occupancy



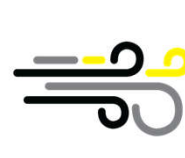
Door sensing



Water leakage



Temperature
control



Air quality
monitoring

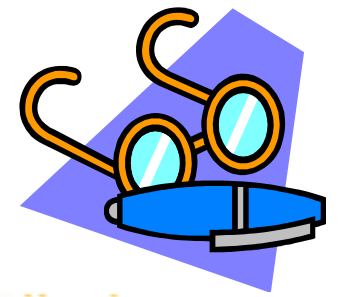


Smart parking



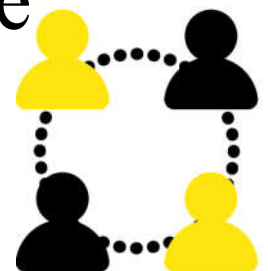
Smart restroom

Smart FM

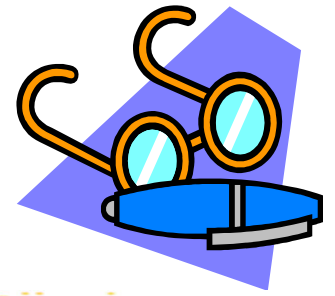


- Smart Facilities Management (FM) refers to the integration of systems, processes, technologies & personnel to enhance the management of a building's facilities
 - Coordination of space, infrastructure, people, & organization based on smart sensing, computational intelligence & networks
 - Enhance connection & collaboration to manage day-to-day work & increase productivity

智能物業管理



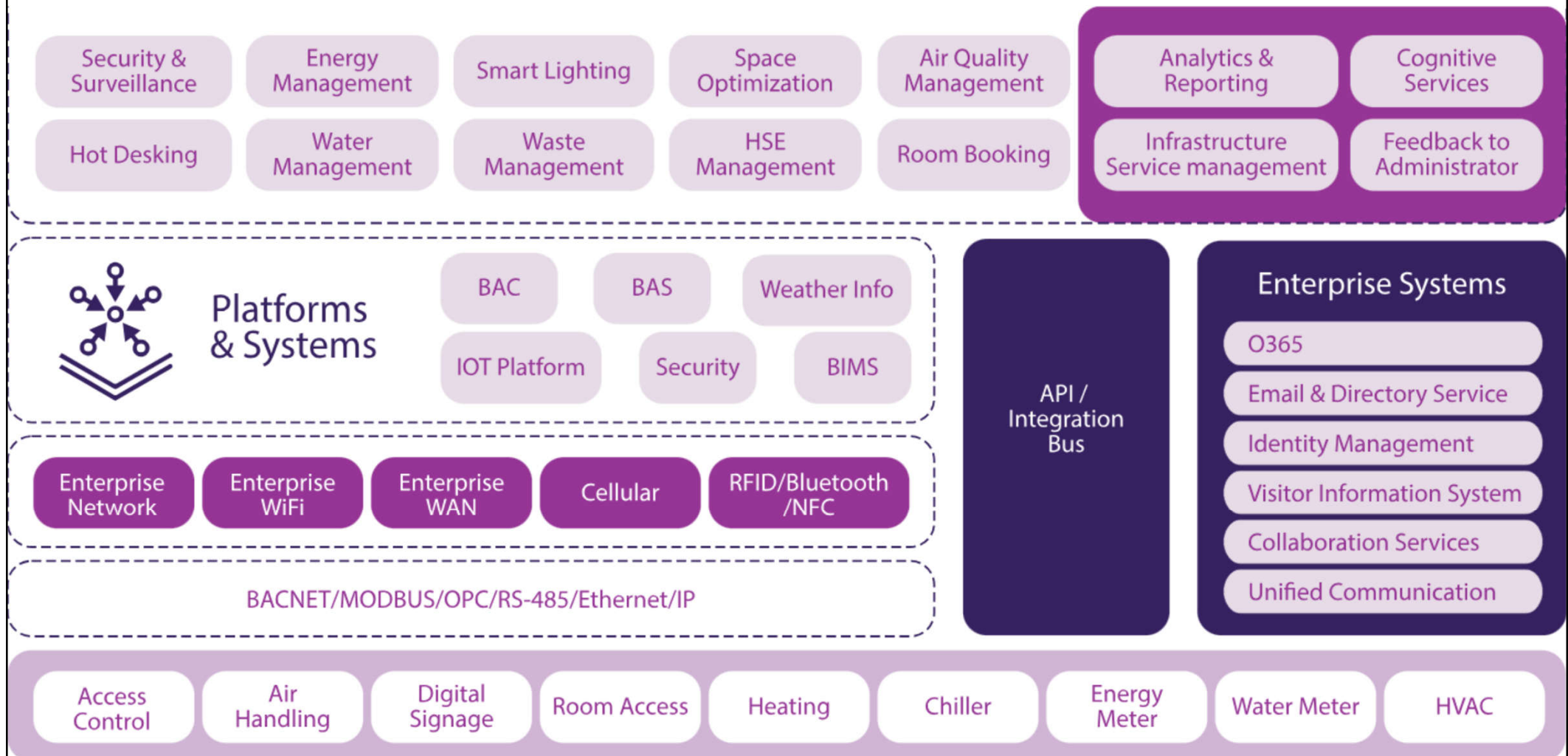
Smart FM



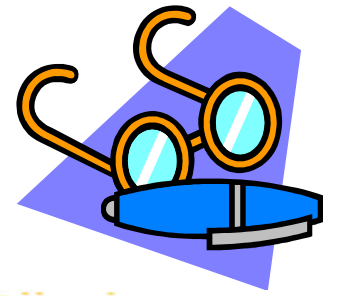
- Smart facilities management functions:
 - 1. Smart energy management
 - 2. Smart maintenance management
 - 3. Smart indoor occupant comfort management
 - 4. Smart space management
 - 5. Smart traffic management
 - 6. Smart security management
 - 7. Smart document code & transaction management



Major areas & functions of smart facilities management (SFM)



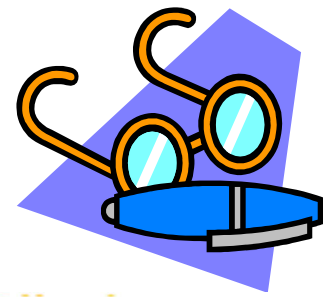
Smart FM



- With Smart FM, people can:
 - Access all facility status & data from a single dashboard/panel
 - Get notifications from sensors on building management tasks, e.g. when bathrooms need cleaning, or lights bulbs need changing
 - Achieve greater transparency on energy costs & savings breakdown
 - Perform preventive maintenance instead of reactive maintenance
 - Gather data & analytics to drive informed decisions



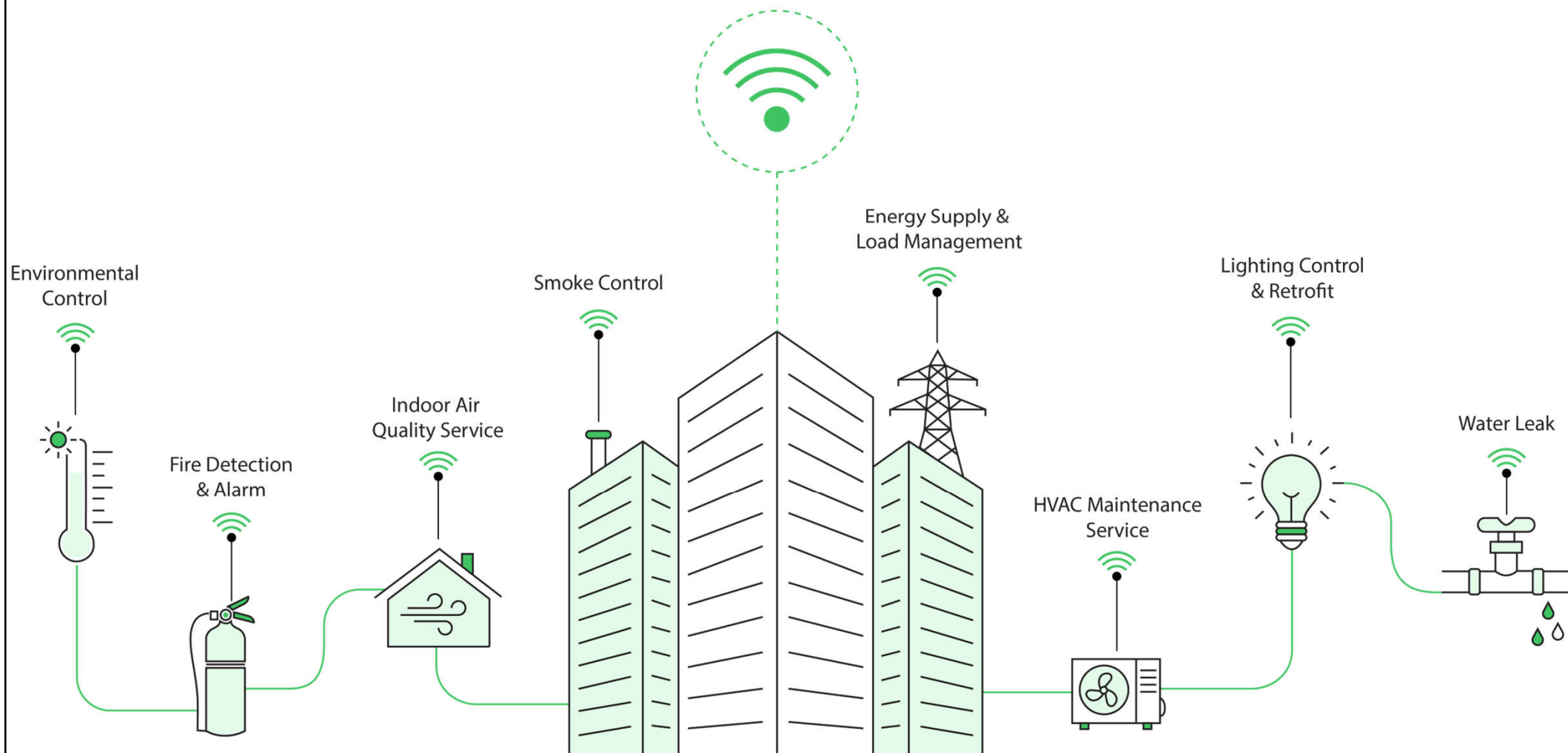
Smart FM



- Features of smart facilities management:
 - Interoperable control systems
 - IoT sensory devices (e.g. leakage detection)
 - Automated building systems diagnostics
 - Self-commissioning of building systems (sensors & control systems)
 - Effective management of device connectivity & network infrastructure
 - Optimum working & business environment



Features of smart facility monitoring solution

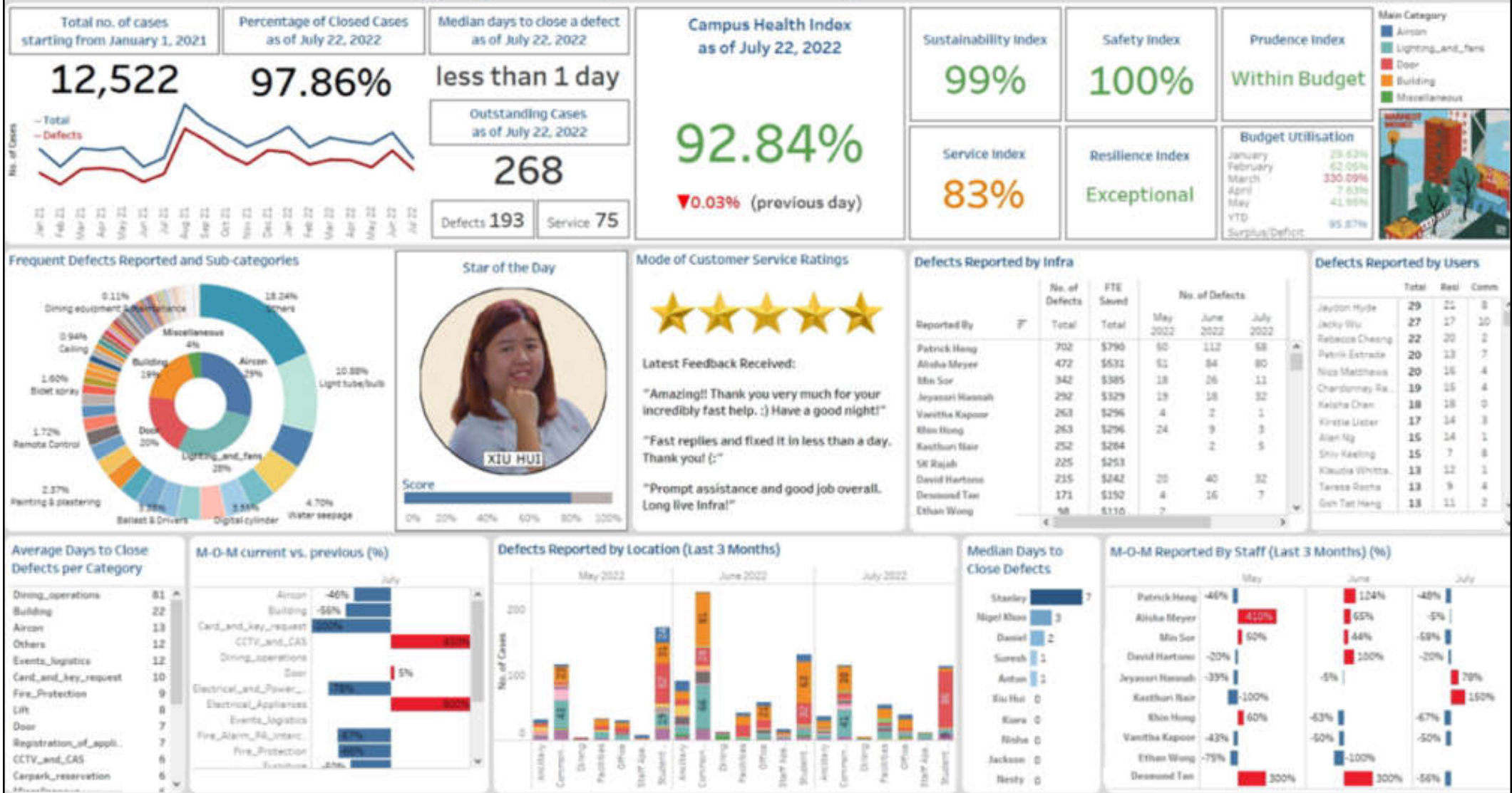


Example of smart facility monitoring solution on mobile phone

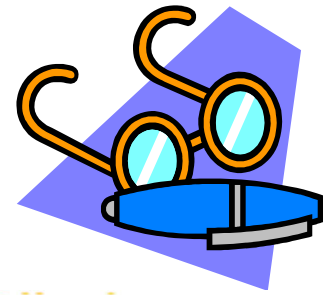


Smart facilities management dashboard

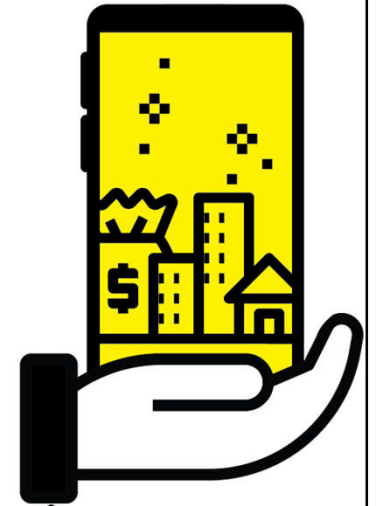
Yale-NUS Aggregated Campus Health and Integrated Performance Dashboard



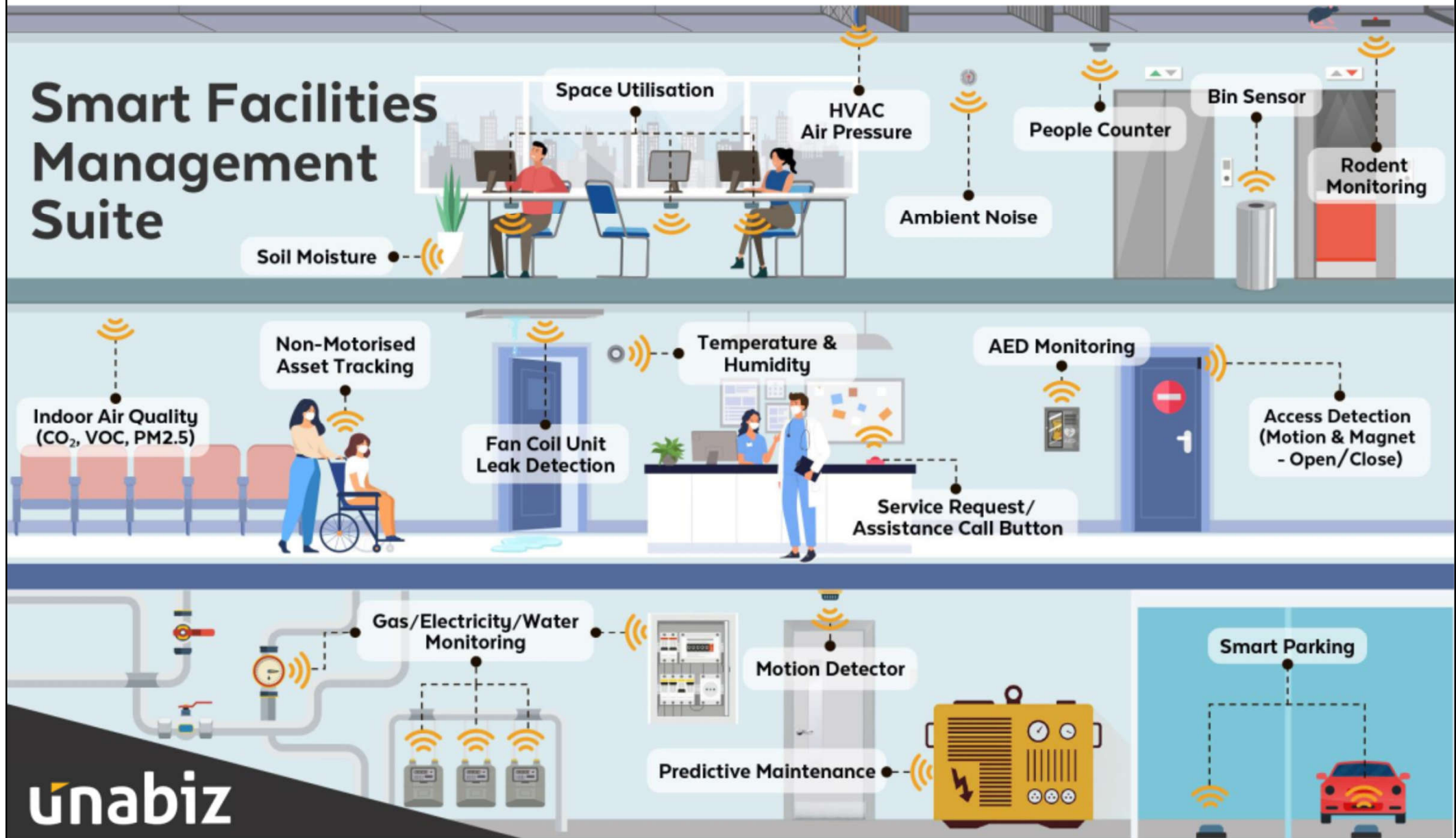
Smart FM



- Major benefits of smart FM:
 - Improve operational efficiency, facilitate workflow automation, resources access & predictive maintenance
 - Keep staff connected in work anywhere, anytime & link them together with media sharing
 - Enhance user experience (minimise downtime, enhance comfort, paperless forms & document)
 - Cost savings (reduce O&M cost, manpower cost)
 - Improve sustainability (optimize resources use)



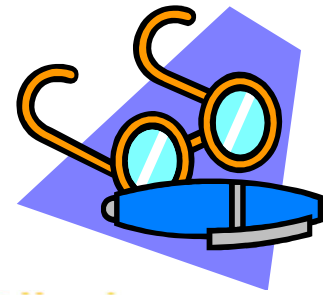
Smart facilities management suite



Smart/digital facilities management for office workplace



Smart FM



- Smart restroom/toilet

- Reduce queuing time for restroom
- Usage analysis for effective cleaning schedule
- Consumable level monitoring for timely replenishment of soap, toilet paper and hand towel
- Ambience monitoring e.g. air quality, restroom odour & wet floor
- Interactive customer survey to gather customer satisfaction index



Smart toilet system

L2

可使用 Available

0 3



空氣質素 Air Quality : 佳 Good

2022/1/01 09:00 am 星期三 Wed 31.8 °C 67.2 %

其他樓層
Other Floors

L1

可使用
Available

清潔中
Cleaning

使用中
In Use

L3

可使用
Available

暫無空缺
No vacancies

可使用
Available

可使用
Available

L4

可使用
Available

可使用
Available

可使用
Available

一樓男洗手間 L1 Men's Toilet

2022/7/20 10:57

星期三 Wed

可使用 Available

5

廁格
Cubicle(s)

31.8 °C 67.2 %

資料來源: 香港天文台
Source: Hong Kong Observatory



可使用
Available

鄰近洗手間 Toilet Nearby

二樓男洗手間

L2 Men's Toilet



4 分鐘
Minute(s)



1



導航 Navigation



People Counting



Ammonia Sensor



Consumable sensor



Alert System



Vacancy indication



Fall detection

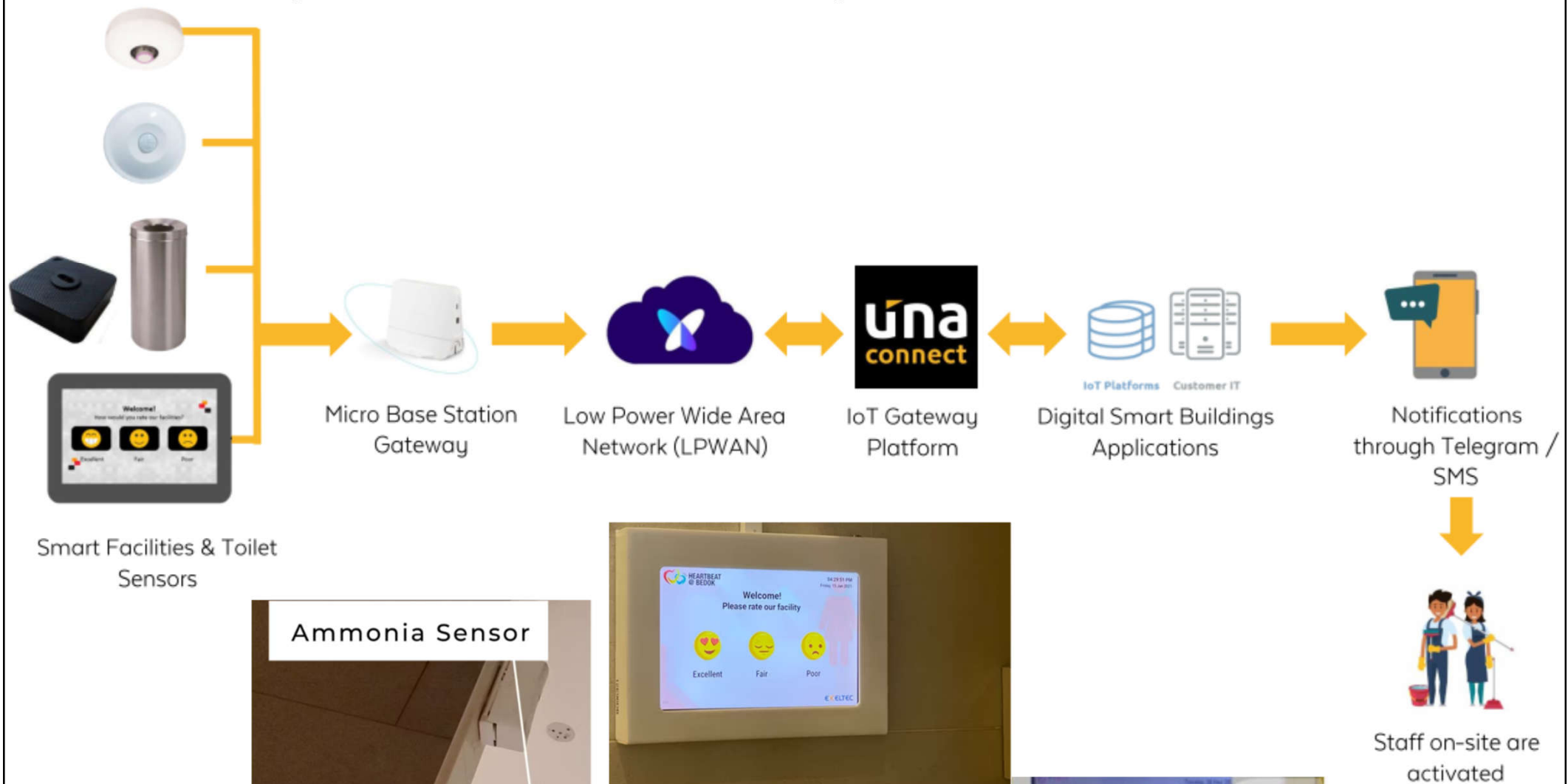


Gain Insights

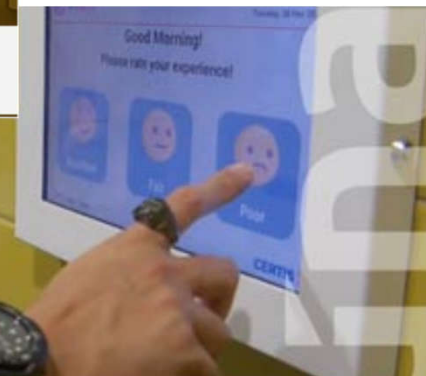
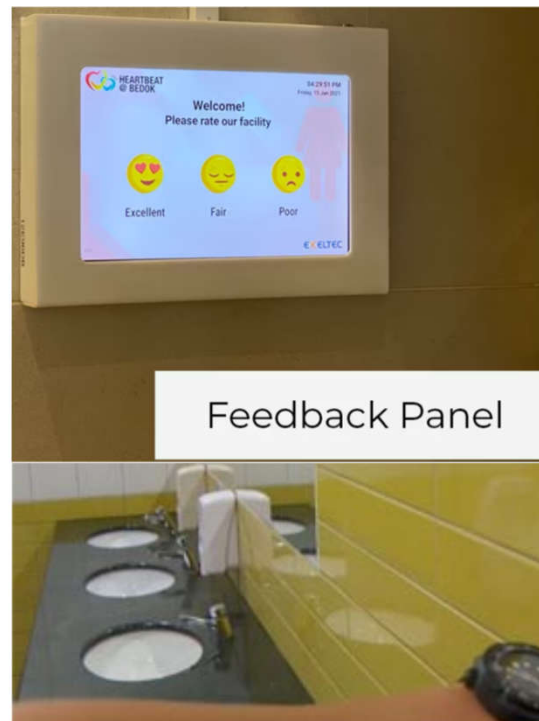
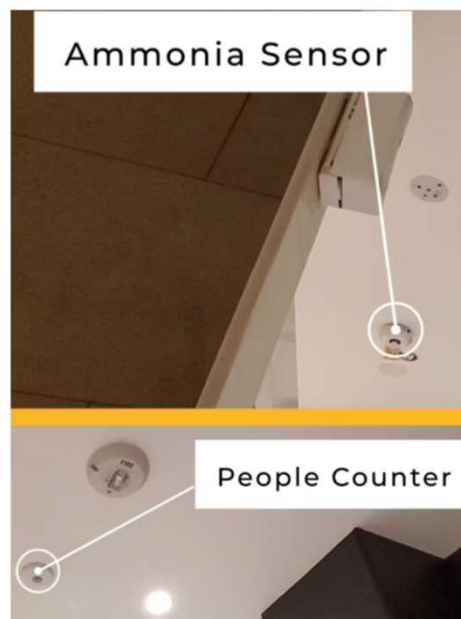
Smart toilet management



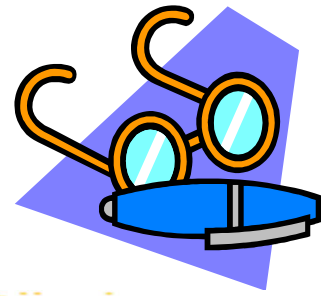
System architecture & components of smart toilet



Smart Facilities & Toilet Sensors

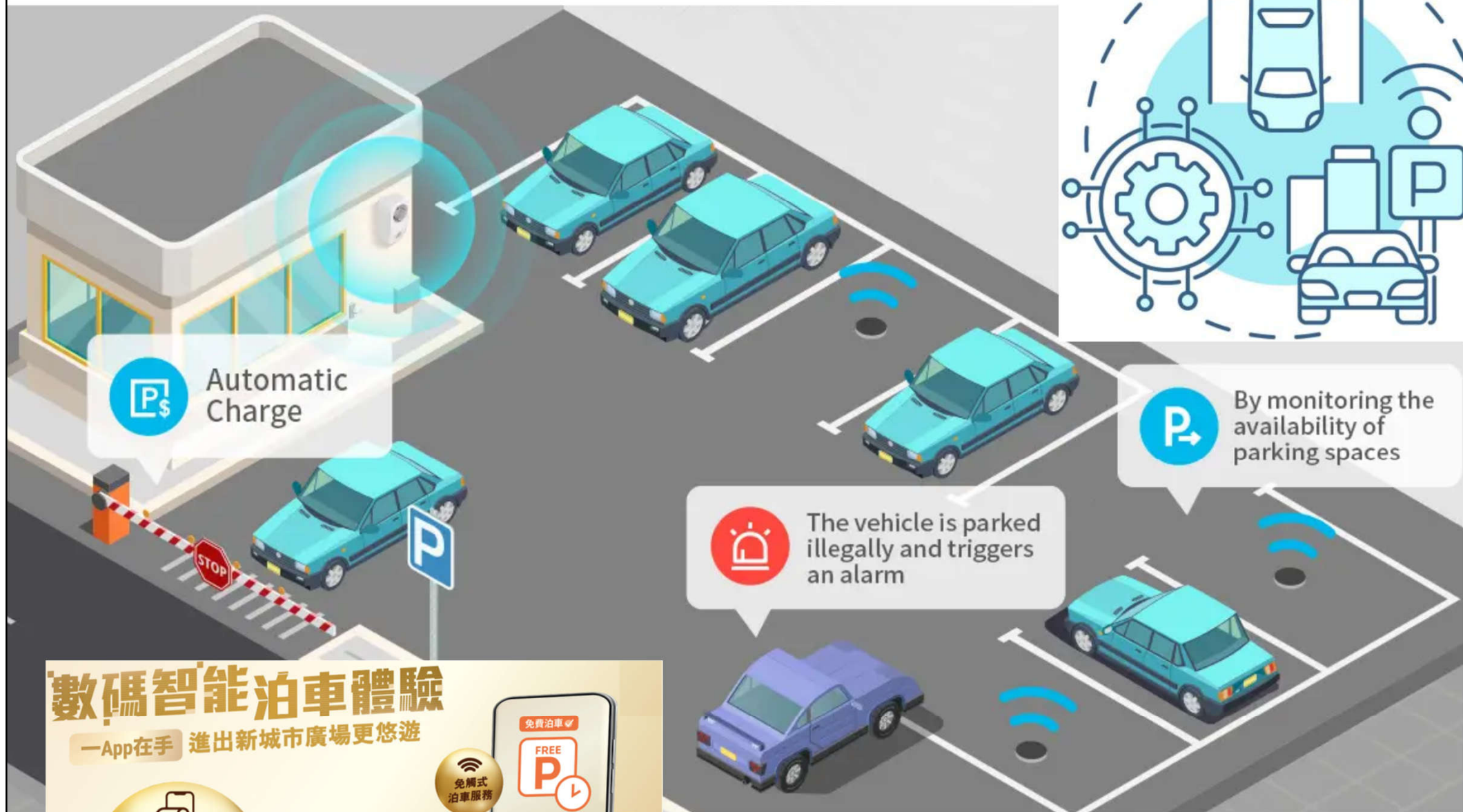


Smart FM



- Smart parking
 - Reservation service App to reduce queuing time
 - Touchless entry & mobile payment
 - Indoor navigation & find my car mobile App
 - Real-time data insights for better carpark management
 - Support workflow integration for efficient operation, cleaning, maintenance & customer services

Smart parking system



數碼智能泊車體驗

一App在手 進出新城市廣場更悠遊



於手機應用程式
上載即日消費單據
換領免費泊車
同時亦可用
The Point 積分換領



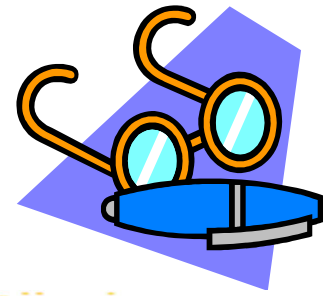
免費泊車
泊車服務



無感泊車
支付功能

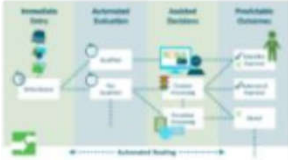















Key factors

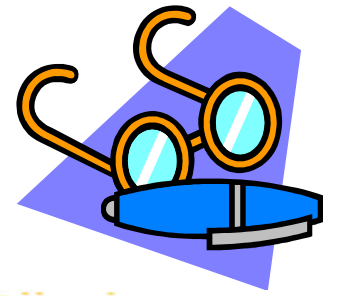


- Drivers of smart facilities management:
 - 1. Internet of Things (IoT) & radio frequency identification (RFID)
 - 2. High-speed, high bandwidth wireless networks
 - 3. Artificial Intelligence (AI) & data analytics
 - 4. Augmented & virtual reality (AR/VR) visualization + Digital twin (DT)
 - 5. Intelligent video & image analysis
 - 6. Drones (e.g. inspect building façade & rooftop)

A smart FM framework with multiple solutions identified

Type/ Scope	Description	Building Level FM Services				Clustering
		Energy	Security	M&E Functions	Environmental Services	
Type 1 Digitalised Workflow Automation	When triggered, by an incident, automatically initiates a process that track, log, and close the incident	 <p>Workflow Automation System</p>				<div>Towards Aggregation</div>  <p>Mixed Developments</p>  <p>Portfolio of Buildings</p>  <p>District Level</p>
Type 2 Optimisation within System	Use data analytics to <ul style="list-style-type: none"> - Optimize systems - Quantify FM efficiency - Perform Preventive/ Predictive maintenance 	 <p>EPC Remote Monitor BCA Portal</p>	 <p>Video Monitoring with Incident Detection</p>	 <p>Lift Monitoring</p>	 <p>Toilet Sensors, Compactor</p>	
		 <p>Connected Services for Chiller Optimization</p>	 <p>Security Kiosk and Occupants Engagement</p>	 <p>Failure Prediction</p>	 <p>Usage and Feedback data to optimize cleaning</p>	
Type 3 Integration Across Systems	Optimize resource deployment and utilisation across many systems	 <p>Co-sharing or Hot Desk Integrating Booking, Billing, Security, Space Management, Thermal Comfort</p>	 <p>Integration of systems for Demand/Occupant-based building control & optimisation</p>			

Key factors

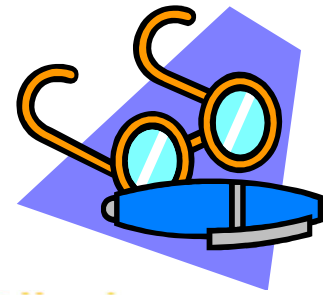


- How to apply smart facilities management?
 - Integrate digital technologies & smart automation into facility operations & maintenance to optimise efficiency & performance
 - Consider carefully staffing, budget, training, equipment, procurement (in-house or outsource)
- Technology application
 - Integrate technologies into business operations of the organisation to optimise efficiency & effectiveness of processes

Five steps for the adoption of smart facilities management

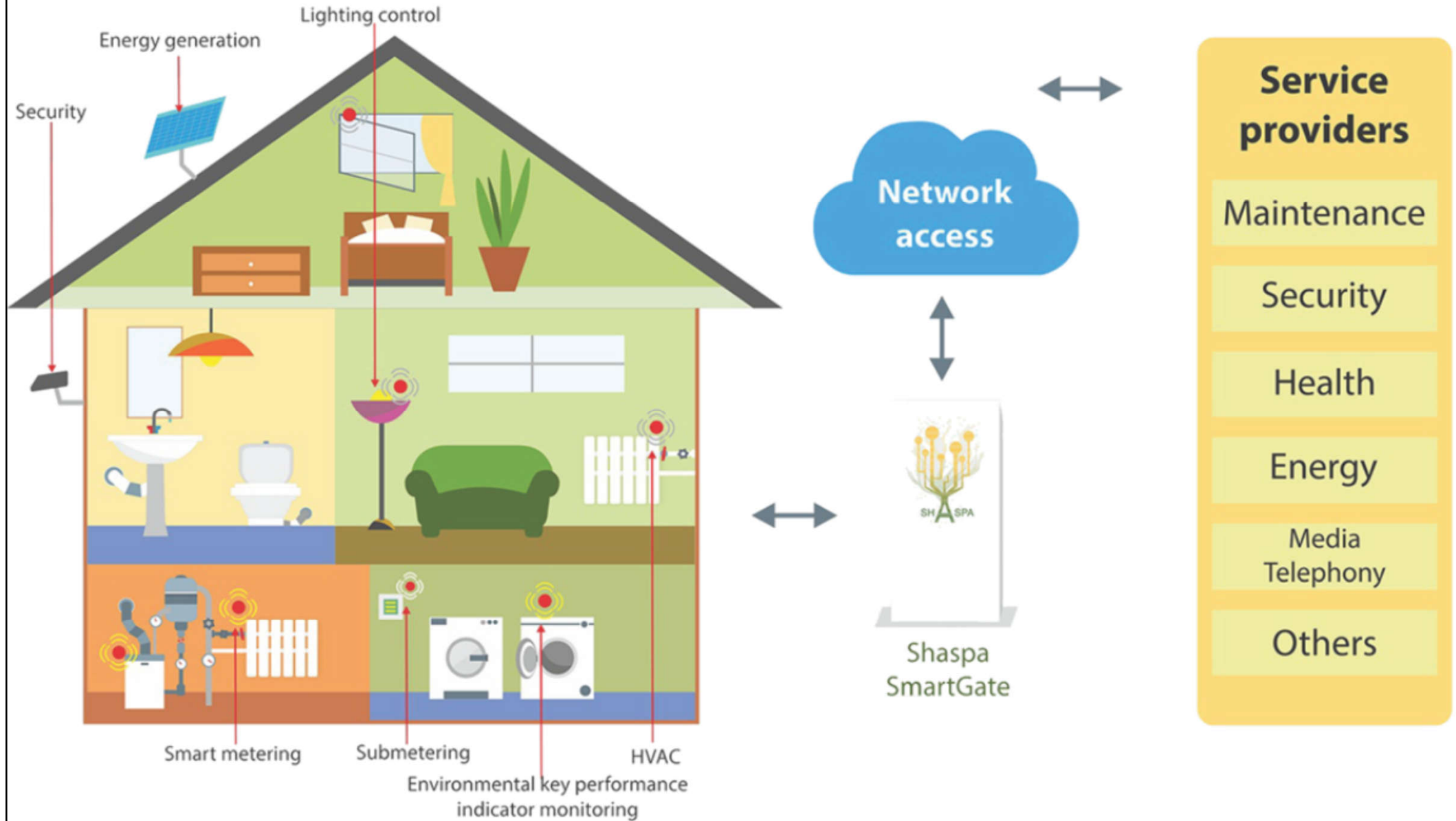


Key factors

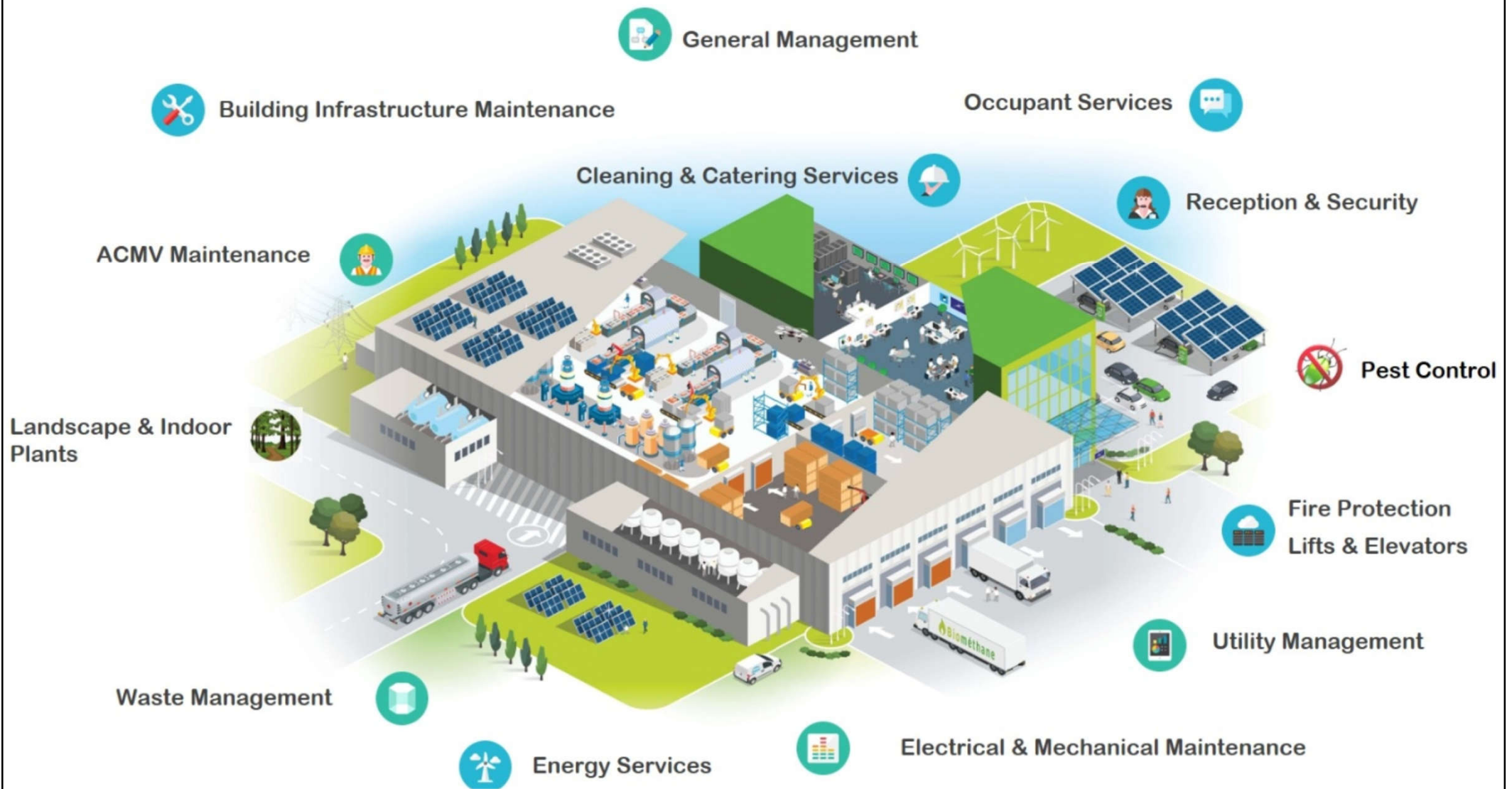


- Applications integration
 - Integrate data or functions from one application with that of another application
 - Involves development of an integration plan, programming & the identification & utilisation of appropriate middleware to optimise the connectivity & performance of disparate applications across target environments
- Manage facility operations & maintenance in an interactive & automated way

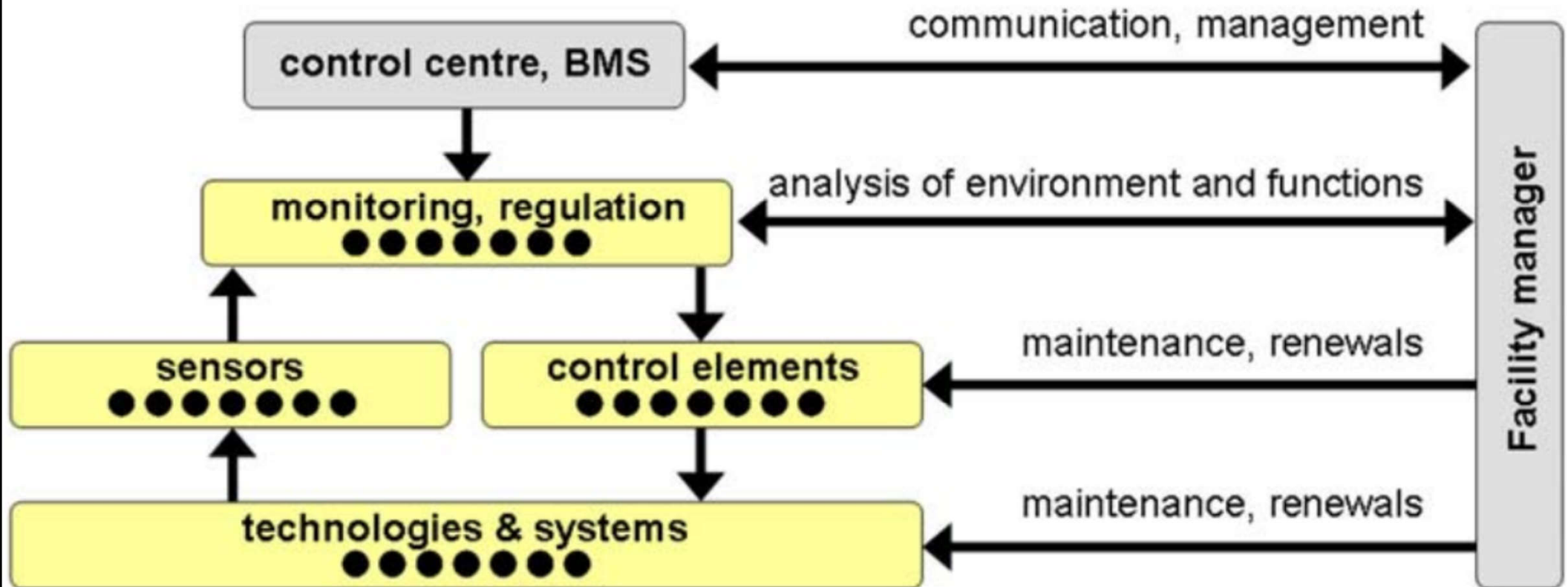
Integrated equipment & appliances for residential buildings



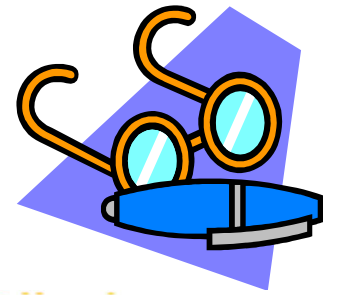
Integrated facilities management for industrial buildings



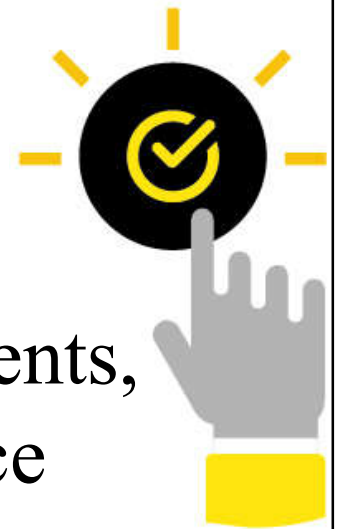
Function principle of building management system (BMS) in relation to performance of facility management



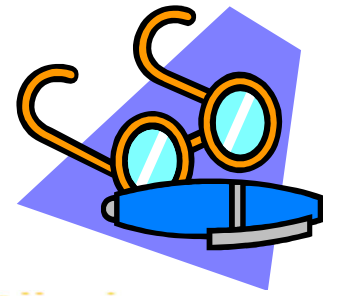
Key factors



- How to enhance operation efficiency & manpower management in smart FM?
 - Workflow automation tailored for FM
 - Easy management & control of task assignments, work orders, patrols & scheduled maintenance integrated in one platform
 - Utilize manpower resources & mitigate faults
 - Timely reporting of incidents, job dispatch, work progress, task completion & errors

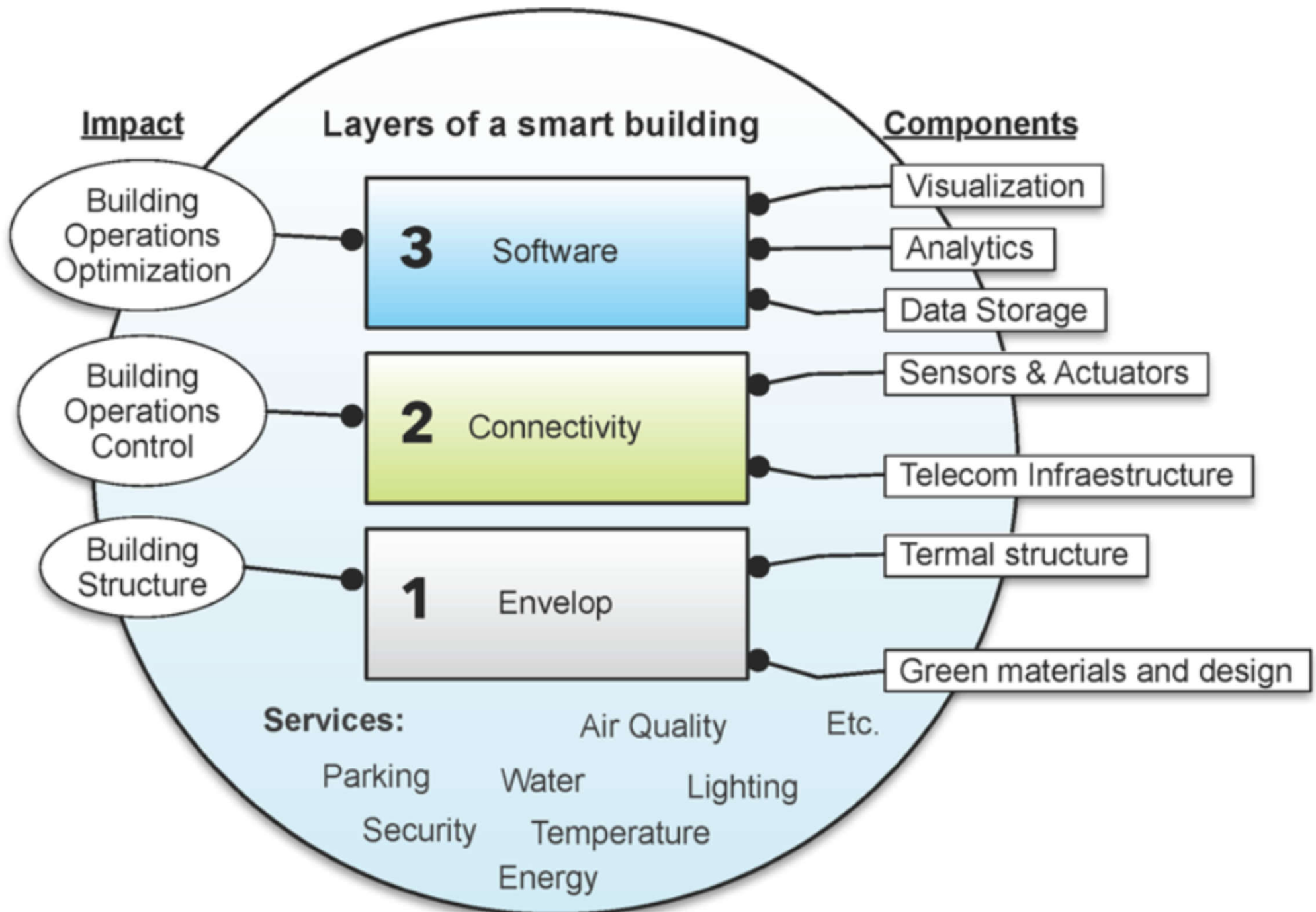


Key factors

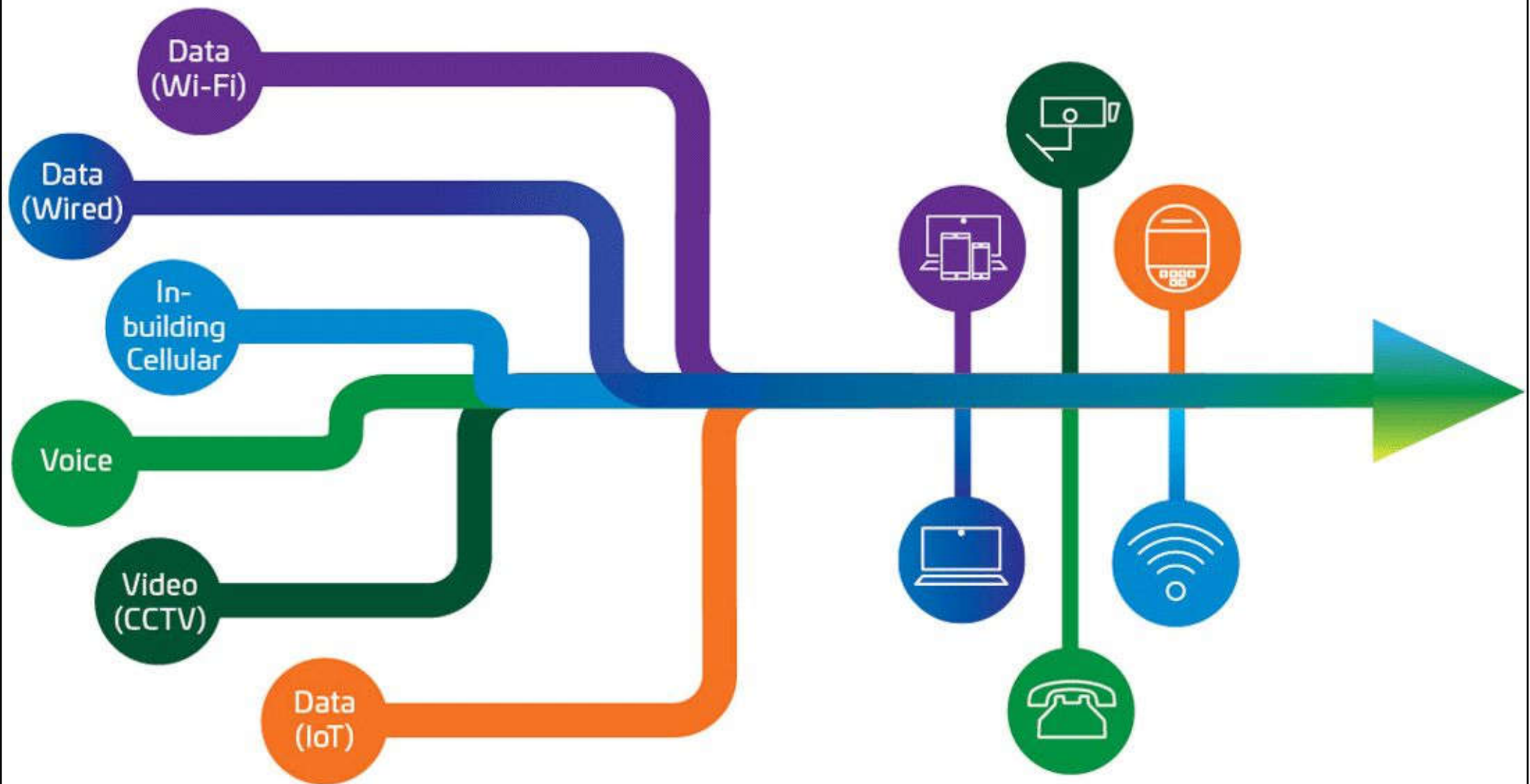


- Tips for creating a smart building
 - 1. Define & set clear goals
 - Clearly establish the objectives & desired outcomes
 - 2. Prioritize data security
 - Implement strong security measures to ensure safety
 - 3. Collaborate with stakeholders
 - Work with stakeholders & occupants effectively
 - 4. Embrace sustainability
 - Enhance energy efficiency & sustainability
 - 5. Build a reliable network infrastructure

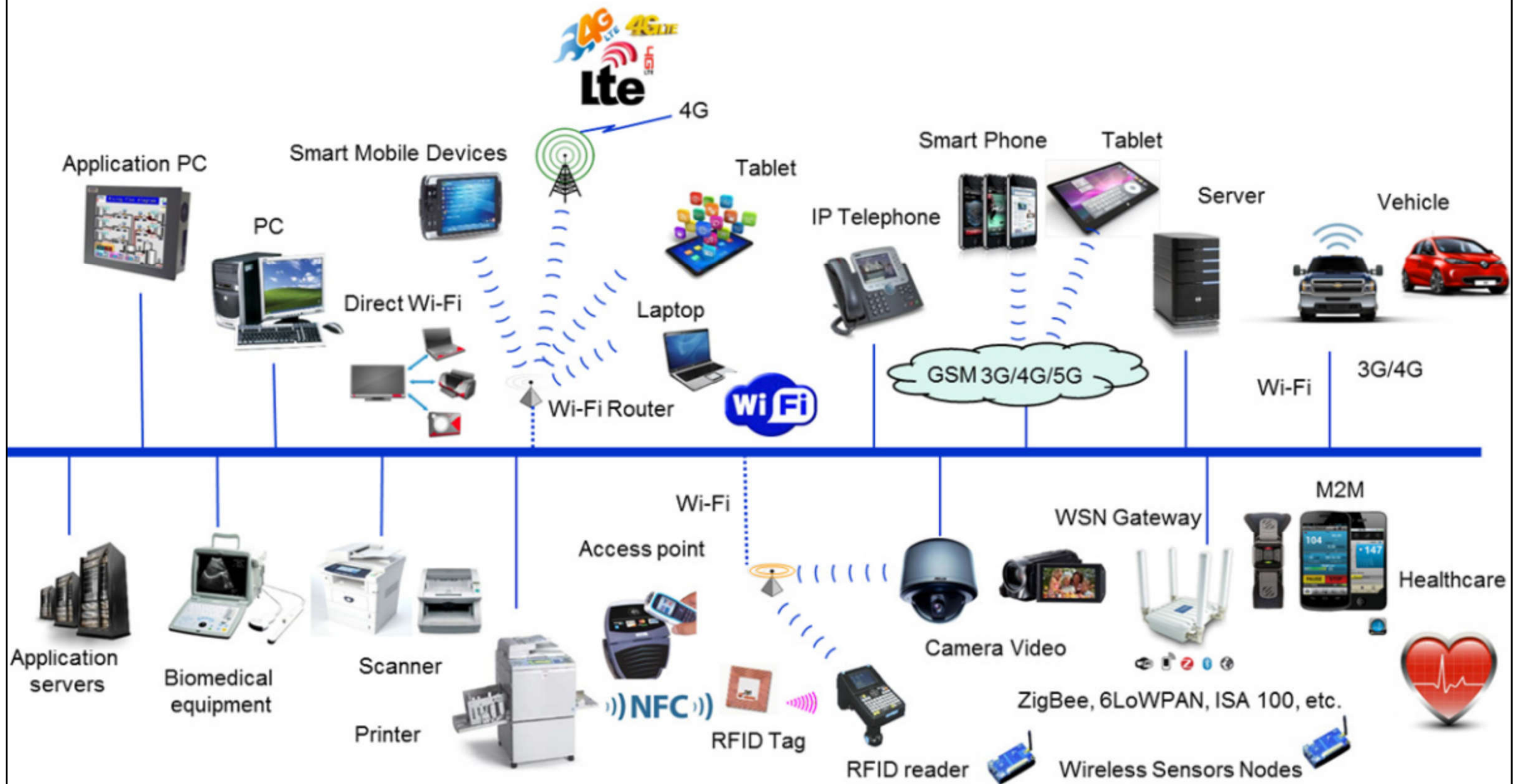
Three layers of a smart building



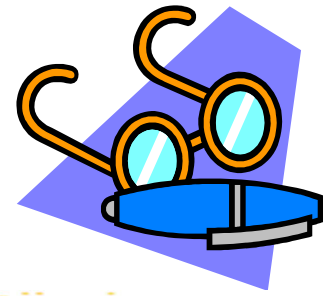
Converged networks inside the building



Network convergence using Internet Protocol (IP)

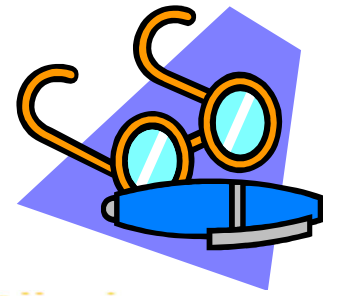


Key factors



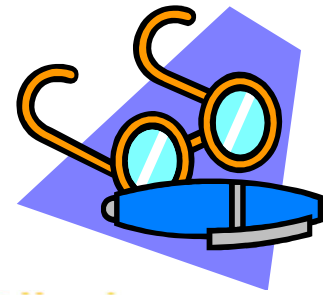
- Key considerations in managing data:
 - 1. Avoid data silos (fragmented standalone solutions) & ensure data interconnectivity
 - 2. Ensure interoperability & avoid smart solutions that are not portable but tied to specific vendor
 - 3. Balance cybersecurity & implementation efficiency
 - 4. Combination of workflow & information storage solutions to support information management process for the asset

Key factors



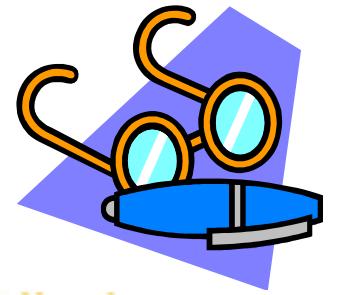
- Common features for FM data management:
 - Manage file & data (data standards & hierarchy)
 - User management (access right & services)
 - Dashboard, analytics & reporting
 - Operation & workflow management
 - Open protocols (ensure ease of interconnectivity)
 - Cloud-based environment (allow data & information to be efficiently accessed, shared & maintained from any location)

Key factors



- Examples of essential FM functions:
 - 1. Workflow tracking & service level delivery
 - Consolidation & analysis of data pertaining to works detected & carried out within a building or multiple buildings
 - 2. Fault detection & diagnostics (FDD)
 - Detecting deviations from normal or expected operation (faults) & diagnosing the type of problem & its location
 - 3. Condition-based maintenance
 - A predictive maintenance strategy where various elements of an operating asset are observed & measured over time to identify potential failure before it happens

Smart space management

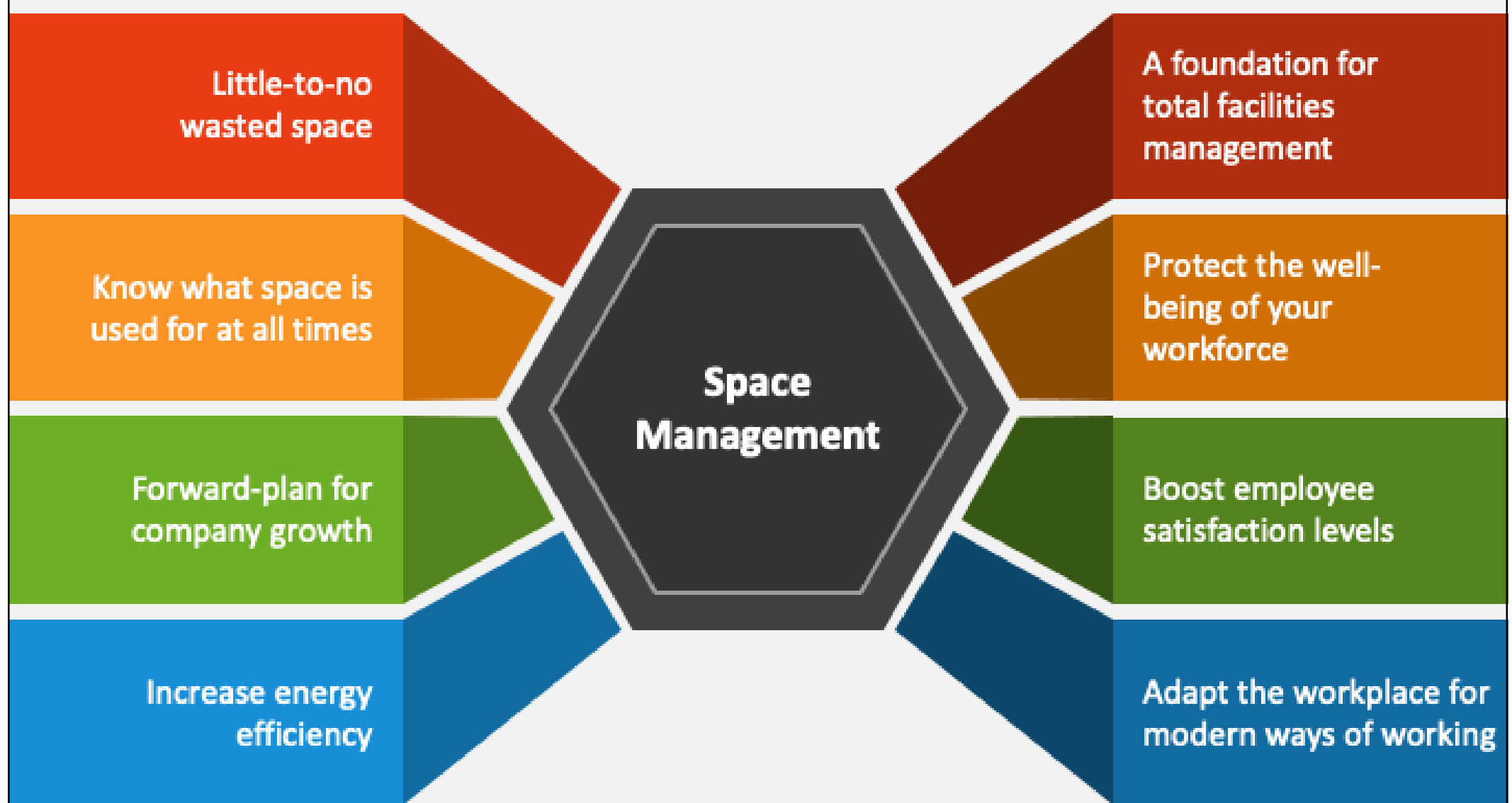


- Smart spaces (or connected spaces)
 - Workspaces within smart buildings that use technology & ambient intelligence to allow for monitoring & measurement of occupancy levels, available vacancies, use of amenities, etc.
 - Designed for optimal use & triggered by sensors & intelligent devices (e.g. smart watches, mobile devices & handheld badges) for the identification of office workers, their status & their relationship with office spaces

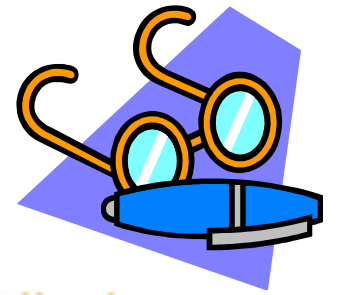
Objectives of space management

Objective	Explanation
Functionality	To ensure organization functionality is suitable with optimization of building space.
Consistency	To ensure space management is carried out consistently and systematically in achieving organizational objectives.
Efficiency	To ensure space being efficient, in good control, and bring maximum profits to the organization.
Flexibility	Even though space management requires control over space usage, the element of flexibility is not ignored, such as when there is an expansion of staff or staff reduction.
Cost	Effective space management, which has considered planning, execution, and monitoring elements, will decrease overall cost reduction and maintenance cost.

Benefits of space management

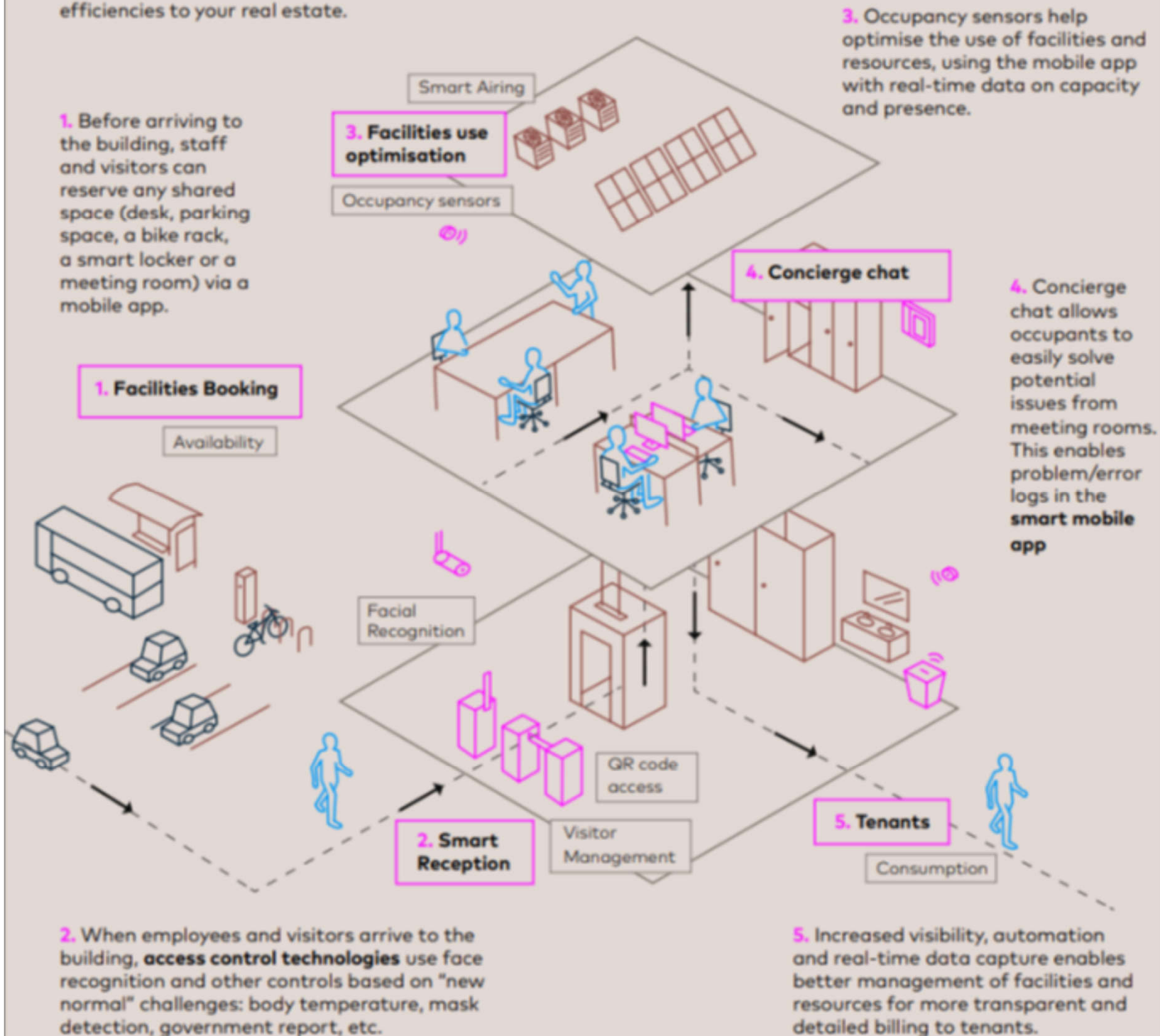


Smart space management



- New business models in office space usage, e.g. Space-as-a-Service (SaaS)
- Better utilization of spaces, as well as ensuring workers' well-being
- Productive workplace & engaging work environment
 - Improve functionality & efficiency of the space
- Provide flexibility & capabilities to quickly adapt to constantly evolving environments

Smart buildings can delight your building occupants, keep them safe, and bring financial and operational efficiencies to your real estate.

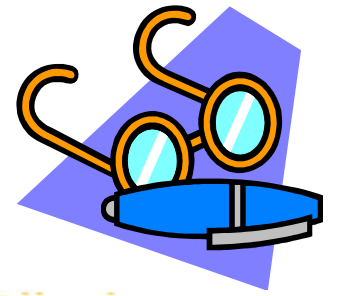


The smart space journey

Smart space applications for workspaces, retail, healthcare & manufacturing buildings

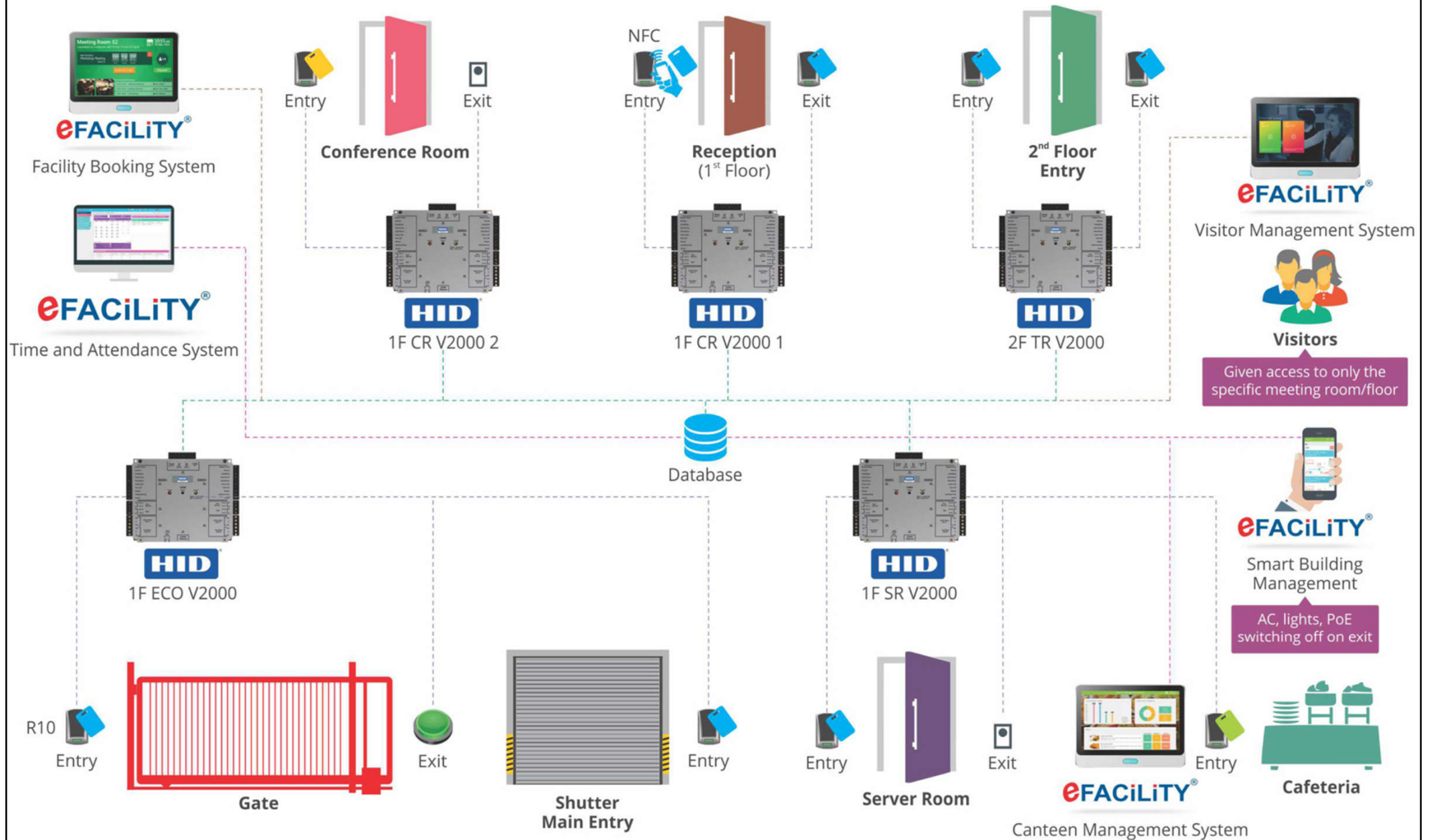


Smart space management

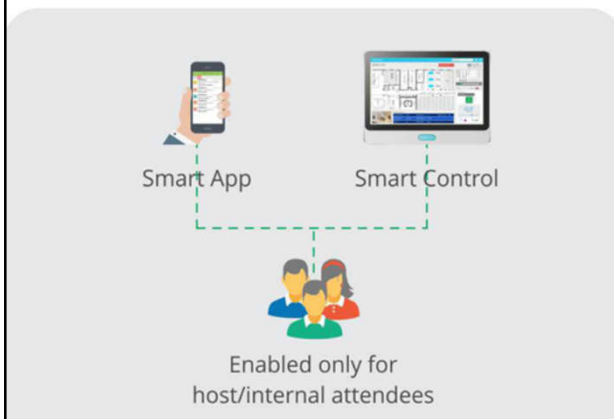
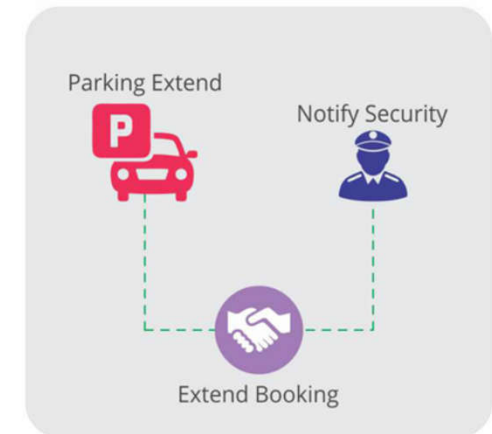
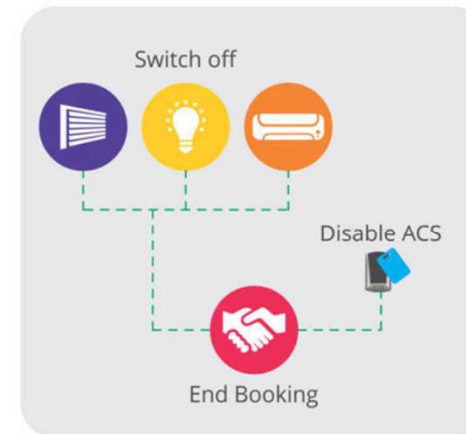
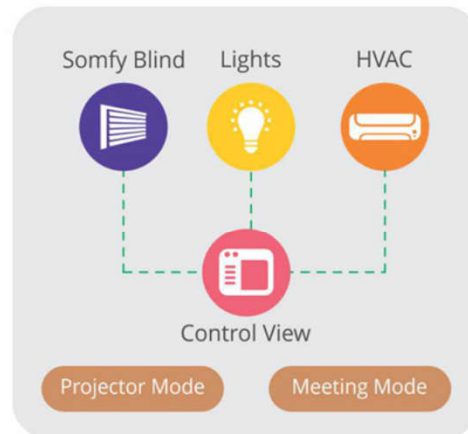
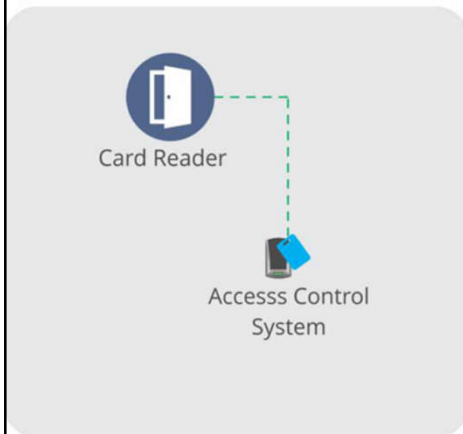
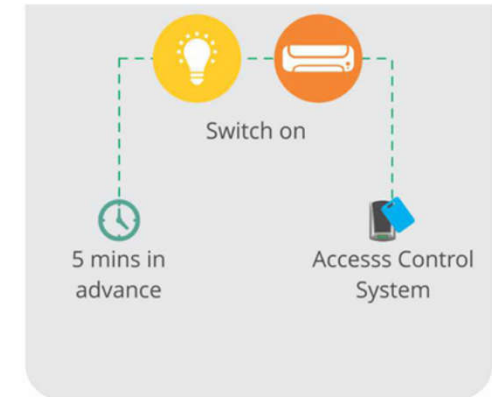
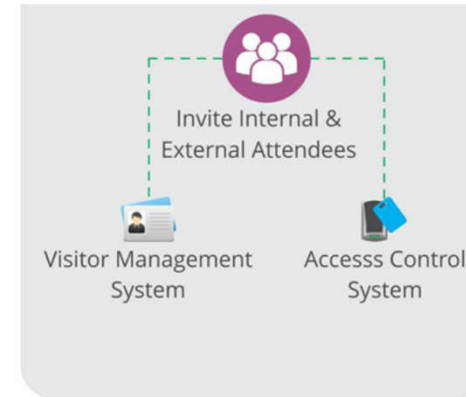
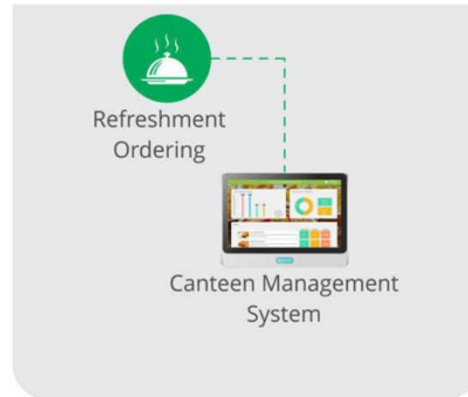
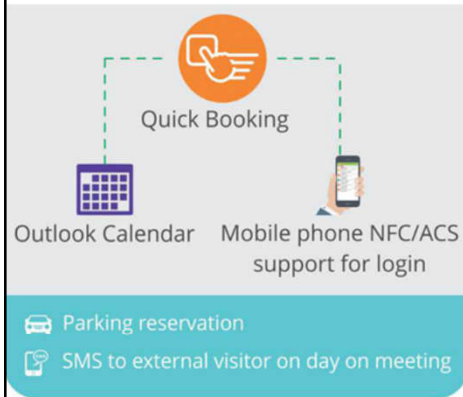


- Smart space components:
 - 1. Smart access control (e.g. facial recognition, contactless access, body temperature check)
 - 2. Facilities booking (with reports on usage)
 - 3. Spaces management (flexible schedule/services)
 - 4. Visitor management (register guest remotely)
 - 5. Occupancy monitoring (numbers & location)
 - 6. Smart HVAC (improve indoor air quality)
 - 7. Energy use monitor (facilitate O&M)

Access control integration of smart buildings



Facility booking system with conference room control functions



Integrated With:

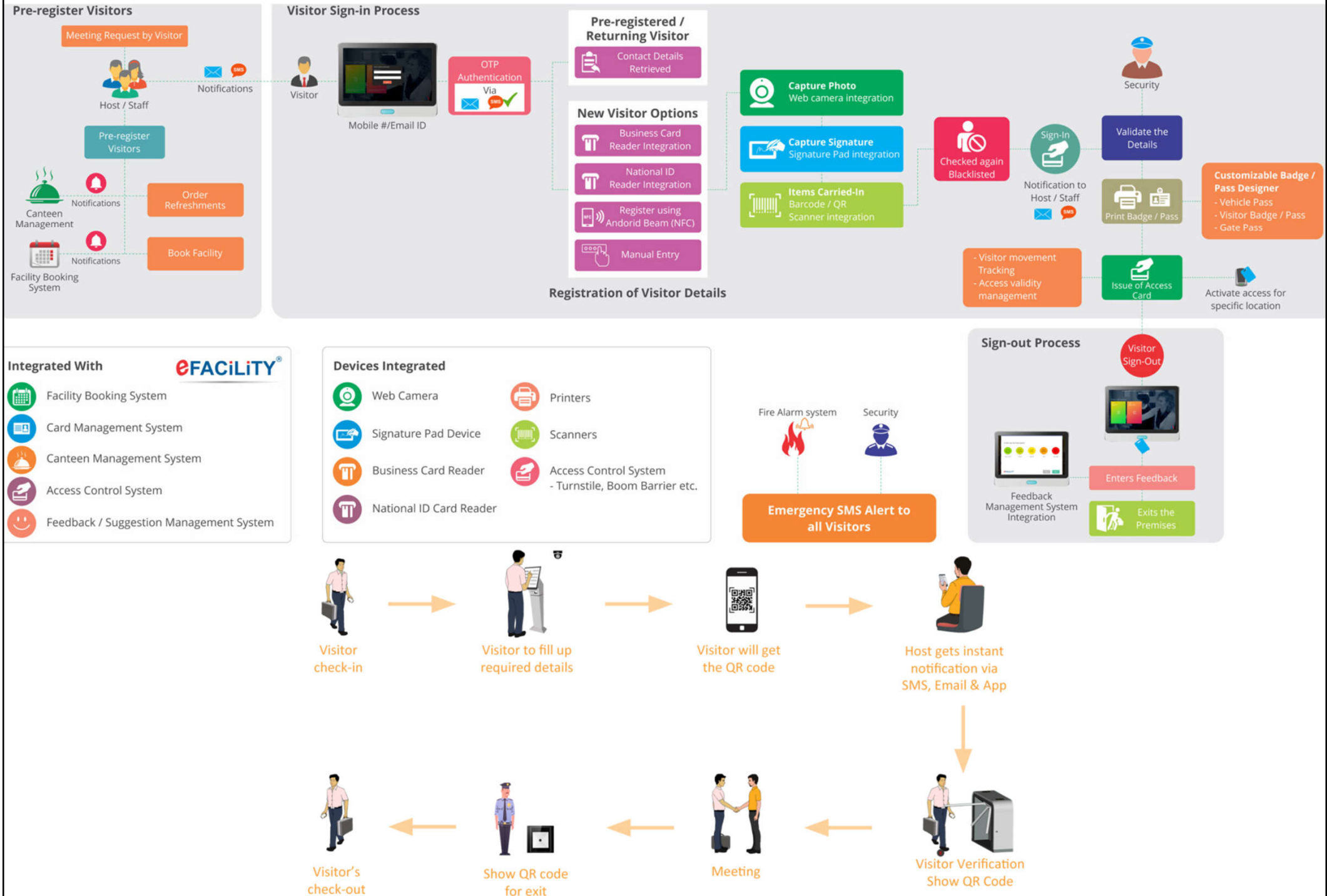
eFACILITY®

- Facility Booking System
- Building Automation System
- Smart Building App
- Canteen Management System
- Visitor Management System

Highlights:

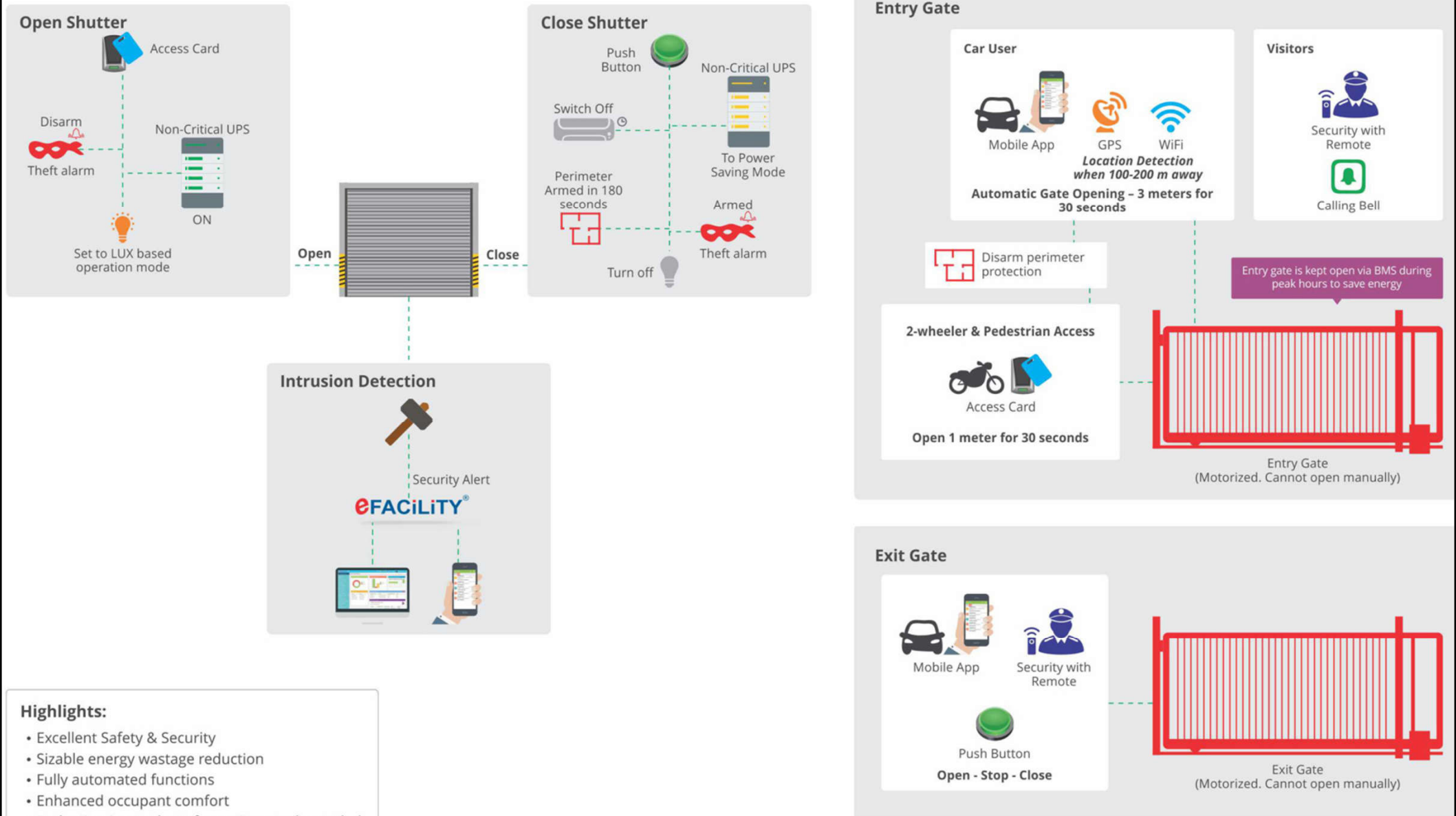
- Fully automated operations providing excellent user comfort
- Restricted access to boardrooms & conference rooms and improved overall security
- Reduces power wastage
- Everything at the touch of a button reducing dependence on manpower
- Integration with all relevant systems resulting in seamless operation

Visitor management system

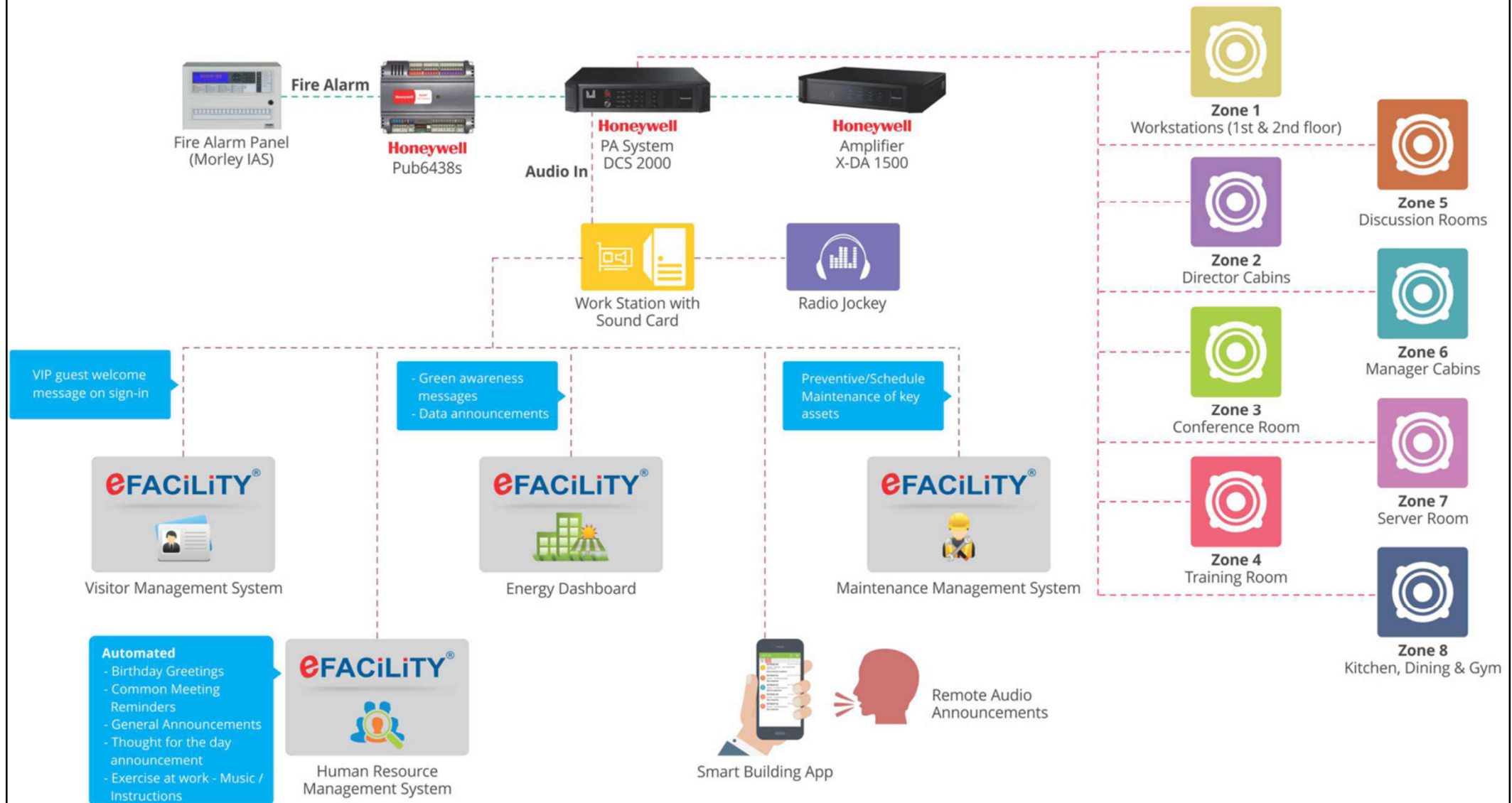


(Source: <https://www.greenestbuilding.com/smart-building/visitor-management/>)

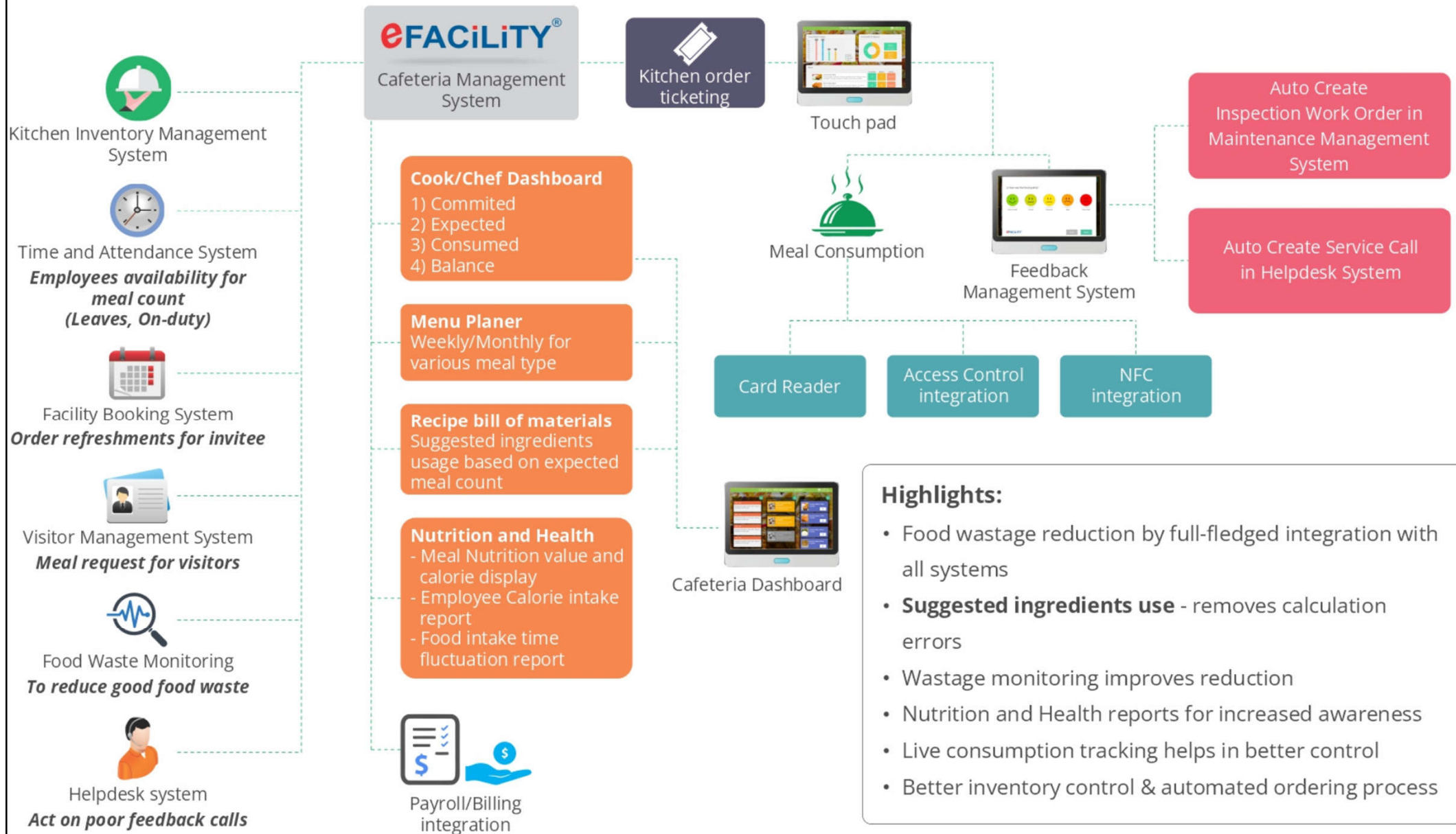
Automated gate & shutter system



Public address (PA) system integrated with fire alarm, visitor management, human resources management, energy dashboard & maintenance management



Cafeteria management system



Highlights:

- Food wastage reduction by full-fledged integration with all systems
- **Suggested ingredients use** - removes calculation errors
- Wastage monitoring improves reduction
- Nutrition and Health reports for increased awareness
- Live consumption tracking helps in better control
- Better inventory control & automated ordering process

Business cases for space management in smart buildings

Optimize Space Planning & Utilization



- Make strategic decisions on office layouts & amenities
- Optimal mix between open, co-working areas & individual zones to foster collaboration, innovation & productivity
- Effective allocation of office resources & flexible seating

Enhance Energy Efficiency



- Monitor occupancy & corresponding energy usage to streamline consumption & maximize efficiency
- Achieve HVAC energy conservation by tracking workspace utilization

Improve Employee Experience



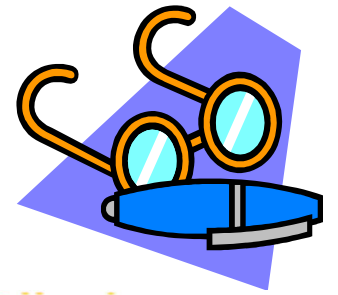
- Occupancy sensing to assist employee in day-to-day work to augment productivity & satisfaction
- Notify when a meeting room is booked & left empty, or whether the cafeteria is currently overcrowded

Streamline Maintenance Effort



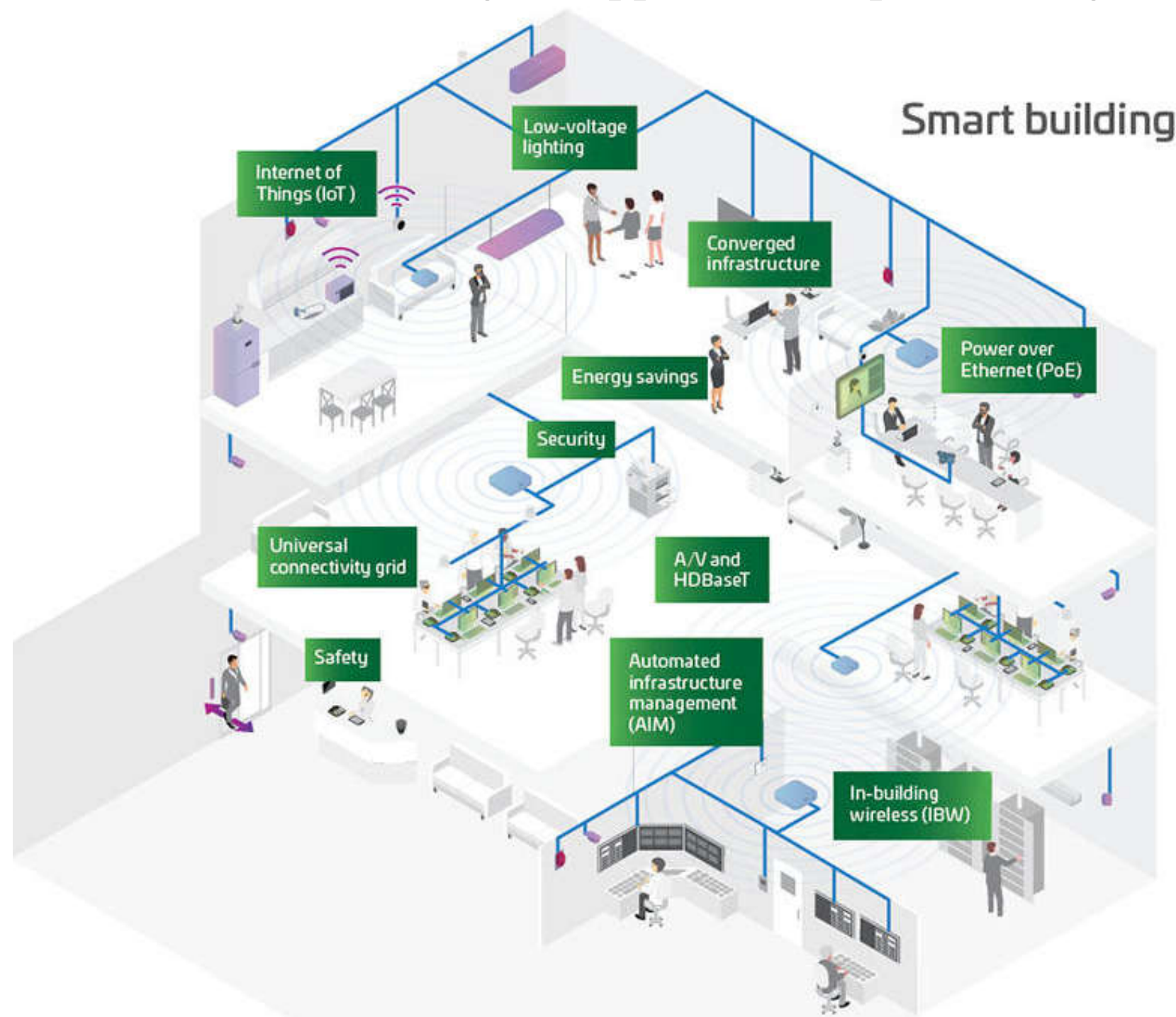
- Knowing the utilization patterns of different office zones allow facility managers to schedule demand-based cleaning activities
- By aligning priority & cleaning frequency with the traffic of each space, managers can ensure proper sanitation is maintained

Smart space management



- Typical features of smart spaces
 - Convergent network, single, unified IP over Ethernet physical network layer
 - Integrated, IP-based space management systems
 - Automated infrastructure management (AIM)
 - Future-ready infrastructure able to support Internet of Things (IoT) applications & devices
 - In-building cellular & wireless network coverage
 - Integrated power & connectivity systems
 - Power over Ethernet (PoE)

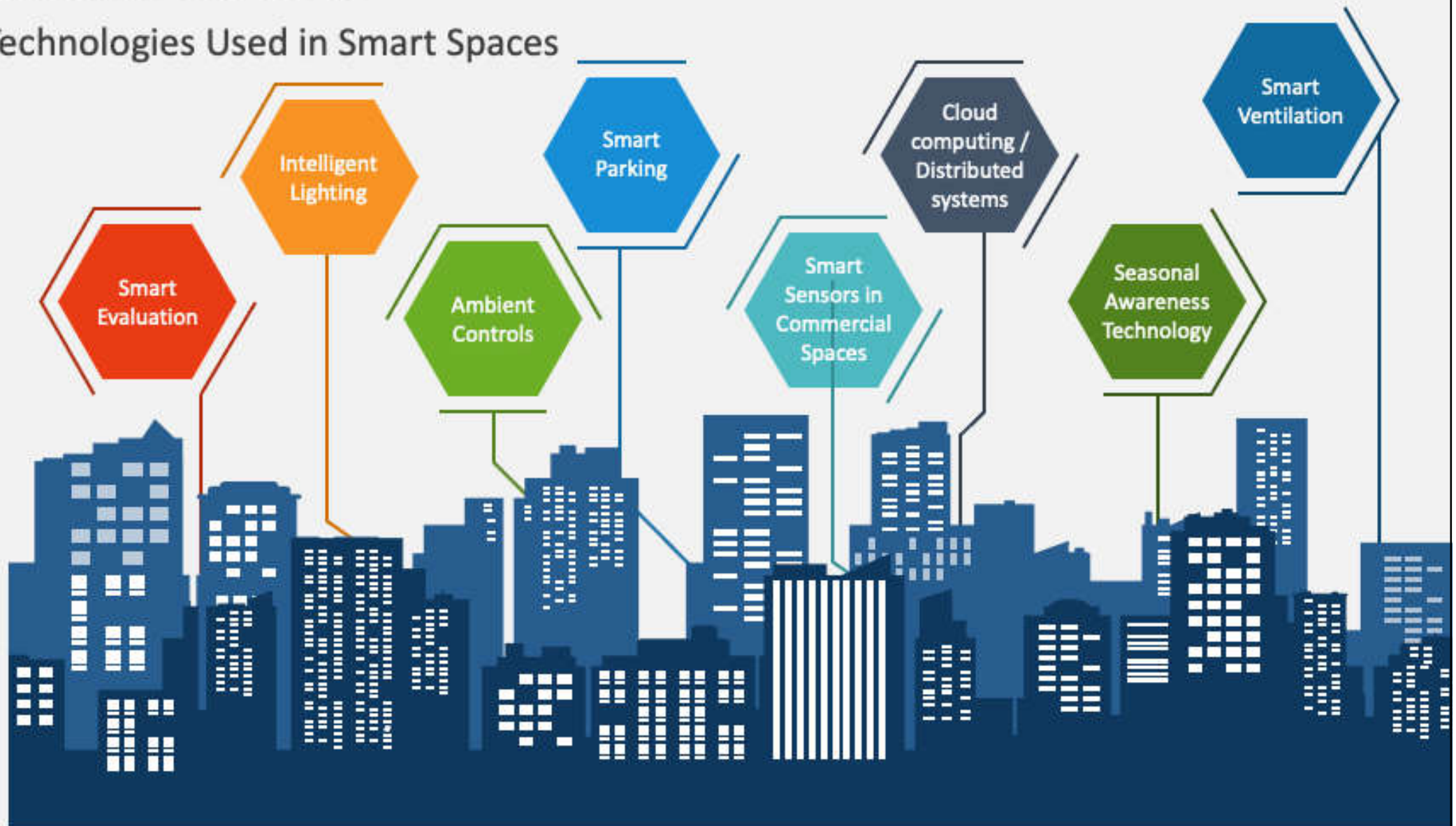
Features of smart building to support smart space management



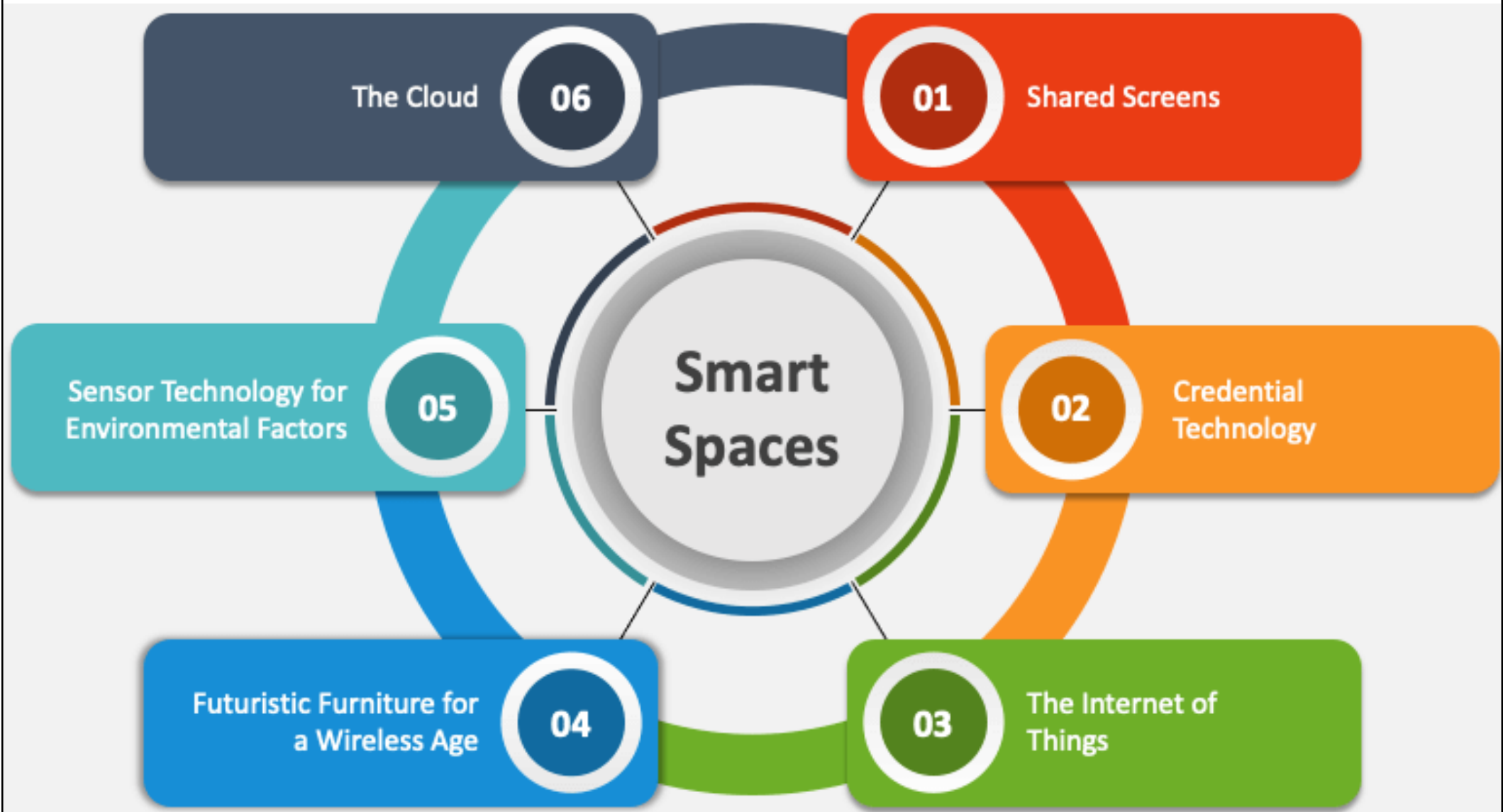
Technologies used in smart spaces

SMART SPACES

Technologies Used in Smart Spaces



How technologies will change the next gen workplaces?



Smart space evolution

	Isolated	Connected Systems	Coordinated Systems	Intelligent Environment
1 Openness	Closed	Open	Open	Open
2 Connectedness	Not Connected	Connected	Connected	Connected
3 Coordination	Not Coordinated	Integrated	Coordinated	Coordinated
4 Intelligence	Not Intelligent	Not Intelligent	Pockets of Artificial Intelligence	Broad Artificial Intelligence Use
5 Scope	Team	Department	Organization	Ecosystems



Further reading

- Complete Guide to Facilities Management
<https://limblecmms.com/blog/facilities-management/>
- How IoT Reinvents Space Management in Smart Buildings
<https://behrtech.com/blog/how-iot-reinvents-space-management-in-smart-buildings/>
- Smart Facilities Management (FM)
<https://www1.bca.gov.sg/buildsg/facilities-management-fm/smart-facilities-management-fm>
- Smart spaces: enhanced, connected urban environments of tomorrow
<https://www.commscope.com/insights/the-enterprise-source/smart-spaces-the-fact-file/>