Bosch.IO
Building

BOSCH
Invented for life

What does Bosch.IO stand for?

Bosch
A global network

402,800
Bosch associates make solutions that are “Invented for life”[1]

60
countries – 440 regional subsidiaries[1]

€ 3.7 bn
invested in software development & AI each year

30,000
Software engineers
1,000
AI experts

€ 5.6 bn
revenue in Energy and Building Technology

€ 17.8 bn
revenue in Consumer Goods

€ 47.6 bn
revenue in Mobility Solutions

€ 7.4 bn
revenue in Industrial Technology

1) As of 12.19; Preliminary, rounded figures based on internal accounting

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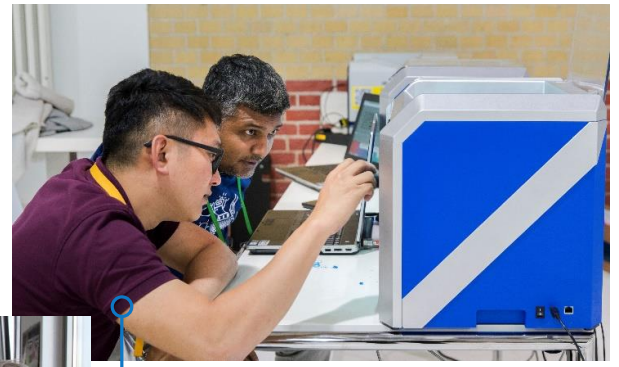
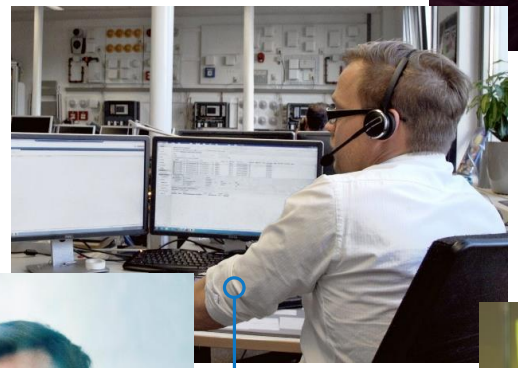
Bosch.IO
People, skills & set-up





Engineers and experts for connected products

Software developers

Experts for digital business models and UX

Project managers

900+

IoT, AI and digital experts

Software-, hardware- & domain-knowledge

Connectivity & digitalization

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Bosch.IO
A global team

Board of management

Aleksandar Mitrovic

Stefan Ferber

Yvonne Reckling

1) Berlin, Cologne, Feuerbach, Immenstaad, Ludwigsburg, Waiblingen, Weilimdorf

Bosch.IO
Driving forward the IoT for Bosch and our customers

280

Bosch plants worldwide are using Industry 4.0 solutions.

52m

IP-enabled devices were sold by Bosch in 2018.

> 5.1m

cars are connected over the air via the Bosch IoT Suite.

> 5.2m

buildings, homes, and stores are connected via the Bosch IoT Suite.

> 10m

sensors, devices, and machines are connected via the Bosch IoT Suite.

> 4m

MEMS sensors, a key IoT technology, are manufactured by Bosch every day.

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Bosch.IO
Our mission

AI-powered IoT solutions that **transform businesses**, **enhance efficiency**, and **tap new revenue streams**

Our **user-** and **business-centric approach** accelerates the adoption of the IoT & machine learning

Transforming networks into **connected IoT ecosystems**

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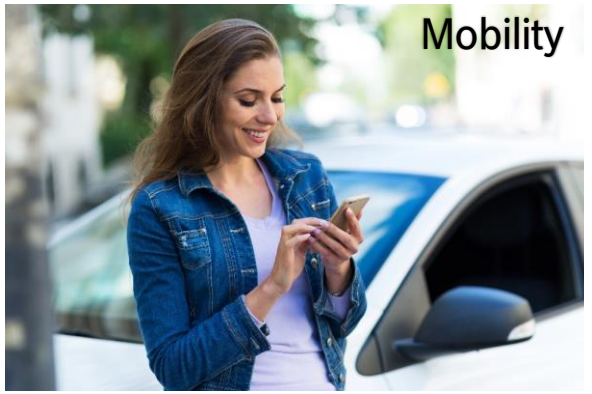
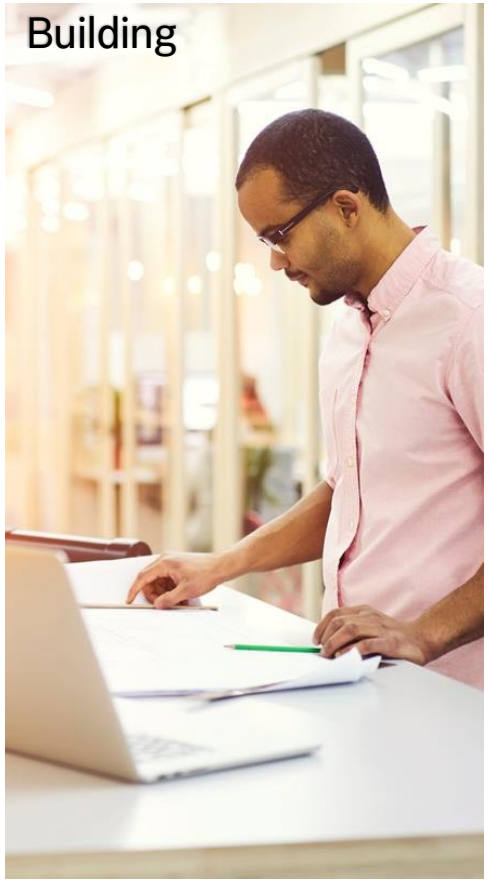
Bosch.IO
Industries & technology

Bosch IoT Cloud | Bosch IoT Suite | Artificial Intelligence





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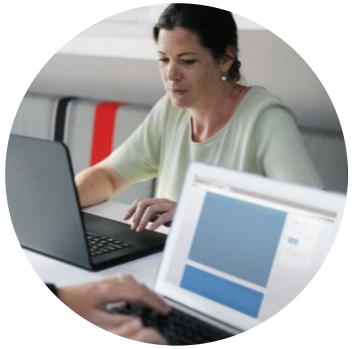
Today’s challenges in commercial buildings

Today‘s challenges…
Bringing together multiple stakeholders, each with specific needs

“I want to make my products more efficient, reduce service cost, and increase customer satisfaction.”	“I want to provide entirely new and more efficient services in the connected building.”	“In order to make decisions, I need to know the building’s status and how it is being used.”	“I want to get an overview of what I’m paying for and save money while improving operating efficiency.”	“I need equipment that makes my daily work easy and efficient.”
				
Device manufacturer	Service provider	Building owner	Tenant	User

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Today‘s challenges …
for building owners & tenants

- Full transparency of building usage
- Reaching maximal efficiency with minimal resources
- Inspiring working conditions with limited budget

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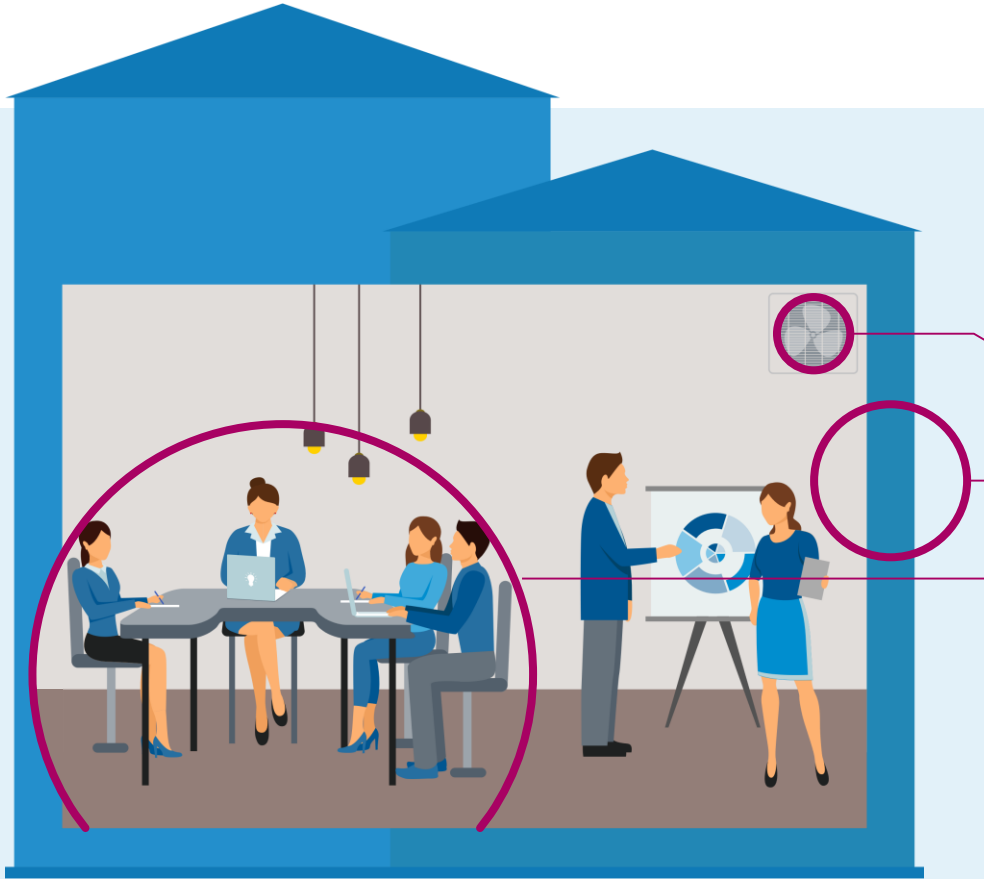
Today‘s challenges…
Building optimization: which levers are relevant?



The 3-30-300 rule describes the average order of magnitude between a company’s costs (*all per square foot, per year*)

- $3 for utilities
- $30 for rent
- $300 for payroll

A holistic optimization approach should aim at cost savings (energy, space) as well as increases in satisfaction and productivity of employees.

Reference projects

Bosch.IO Building
Some reference projects

Bosch IoT Campus in Berlin, Germany

Connected Campus in Singapore

Bosch Campus in Schwieberdingen, Germany

Bosch Campus in Abstatt, Germany

Bosch.IO Building
Space Monitoring in Abstatt

Robert Bosch GmbH
Abstatt offices

Space Monitoring for:

1,000 work places

150 focus- , meeting- and other rooms

Results:

Approx. 50 additional employees on the same site without impact on comfort

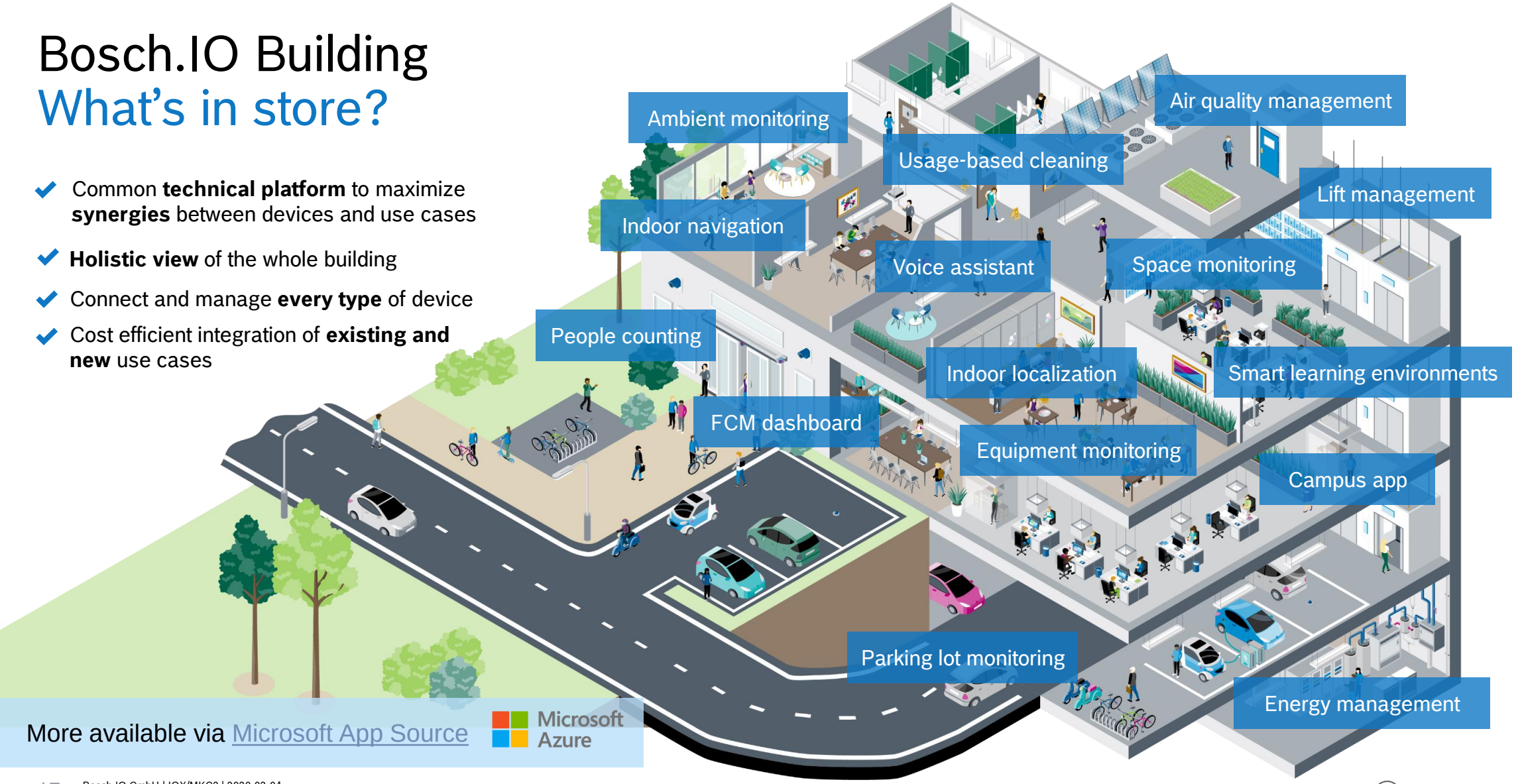
Savings potential of approx. 300,000 €

Required investment: around 35,000 € per year

Use case driven approach

Bosch.IO Building
What's in store?

- Common **technical platform** to maximize **synergies** between devices and use cases
- **Holistic view** of the whole building
- Connect and manage **every type** of device
- Cost efficient integration of **existing and new** use cases



More available via Microsoft App Source

Microsoft Azure

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Bosch.IO Building
Our offering for connected buildings

Standard use cases

- Implementation of ready-to-use solutions based on Bosch.IO Building use case catalog

Global partner ecosystem

- Implementation of digital services provided by partners
- Integrating device data into employee / visitor apps

Customized projects

- Development of new / customized solutions
- Integration of existing systems and 3rd party solutions

Bosch.IO Building
Space Monitoring

Increase # of office users up to 5 %
Savings per additional work place up to 6,000€ p.a.

Problem:

- Increasing space demand in offices facing limited availability
- Lack of room usage data and desk occupancy data

Solution:

- End-to-end IoT solution to monitor desk and room occupancy of multiple floors in one or more buildings
- Easy retrofitting with sensors and integration of additional data sources

Benefits:

- Optimize your meeting rooms, personnel, equipment, and other capacities to meet actual demand
- Gain actionable insights into how you can further improve the use of your building's capacities

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Bosch.IO Building
Space Monitoring

Room

Know the exact usage of your rooms

Improve the use of your building's capacities based on the user needs

Desk

Know the occupation of your workspaces precisely all the way down to single desk level

People Counting

Anonymously monitor people flow

Identify peaks and lows e.g. in canteen queues

Space Monitoring
Technical concept & impressions

Space Monitoring

CLOUD

Connected Building Services (SaaS)

- Building Data Pipelines
- Building Data Lake
- Building Analytics
- Equipment Time Series

Platforms as a Service

Microsoft Azure

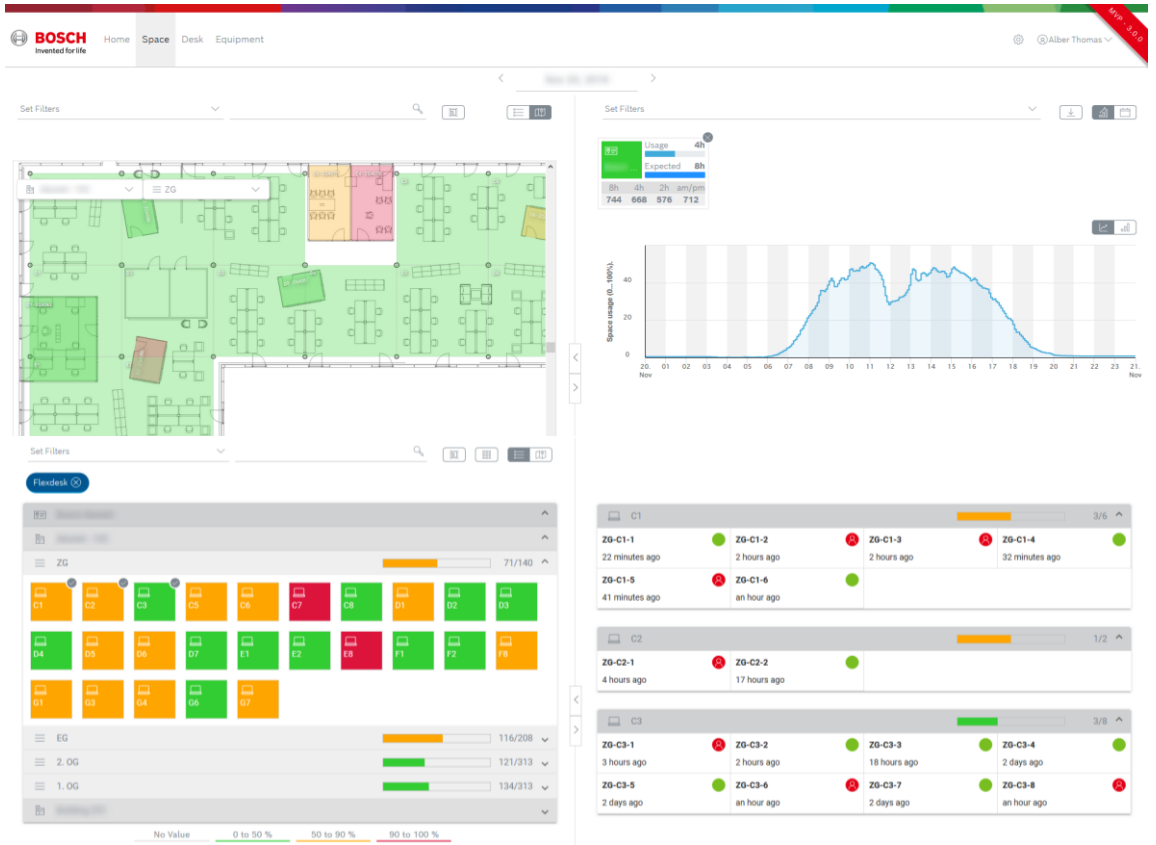
Bosch IoT Suite

BUILDING

Connectivity gateways & edge controllers

IoT devices

© Yanzi



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Bosch.IO Building Ecosystem

Usage based cleaning

Service provided by GREENBIRD

Cost optimization
Increased service quality
Transparency of service

Problem:

- Lack of transparency about actual building usage and cleaning demands
- Cost intensive service providers with limited control mechanisms

Solution:

- Intelligent data analytics for the creation of optimized cleaning schedules
- Digital tools (tablet) for intuitive and quick work
- Usage of already existing data sources, systems or sensor retrofit

Benefits:

- Improve cleaning quality and customer satisfaction by more precise cleaning schedules

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Bosch.IO Building
Ambient monitoring

Visibility of environmental parameters
Overall productivity increase up to 10%

Problem:

- Air quality rated number one criterium for workplace quality
- Inefficient, cost-intensive building operation

Solution:

- End-to-end IoT solution to monitor environmental parameters: temperature, CO_2, humidity, VOC, noise
- Dashboard with visualization
- Easy retrofitting and integration of sensor data

Benefits:

- Get real-time reports on indoor air quality and analyze historic trends
- Reduce energy consumption via manual adjustments at the ventilation
- Prevent mold with proactive maintenance

Ambient Monitoring
Technical concept & impressions

Ambient Monitoring

CLOUD

Connected Building Services (SaaS)

- Building Data Pipelines
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Platforms as a Service

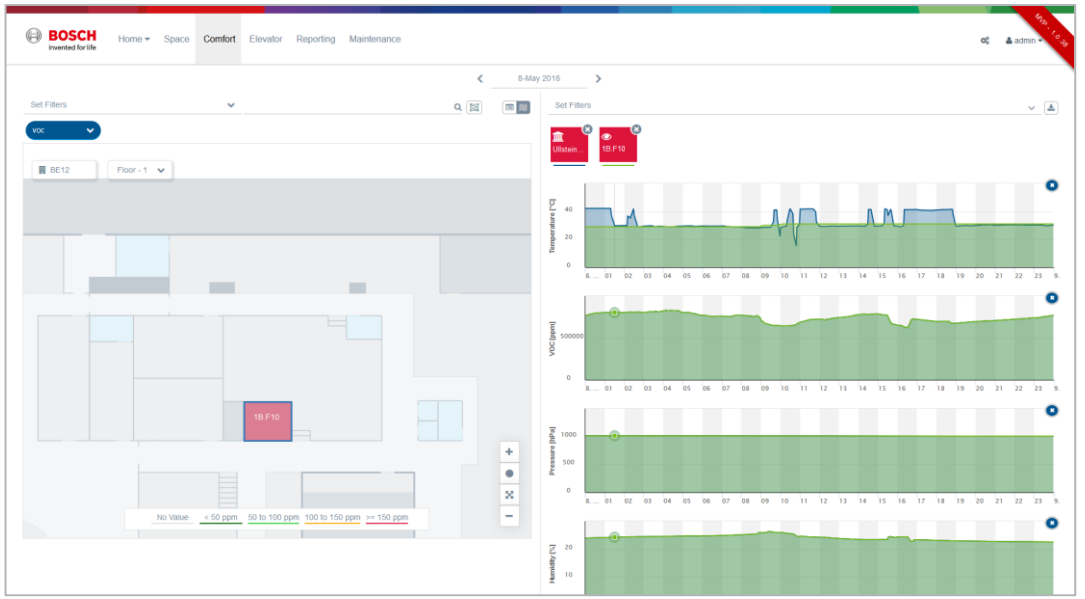
Microsoft Azure

Bosch IoT Suite

BUILDING

Connectivity Gateways & Edge Controllers

IoT Devices



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Bosch.IO Building
Air quality management

Service provided by qlair

Overall productivity increase up to 10%
Energy savings up to 20%*

Problem:

- Air quality rated number one criterium for workplace quality
- Inefficient, cost-intensive building operation

Solution:

- End-to-end IoT solution to monitor environmental parameters: temperature, CO_2, humidity, VOC, noise
- App and Dashboard with visualization and event recognition, monthly reports

Benefits:

- Get real-time reports on indoor air quality and filter status, receive pollution alerts
- Reduce energy consumption via demand driven ventilation
- Prevent mold with proactive maintenance

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* Related to air handling units.

Bosch.IO Building
Parking Lot Monitoring

Problem:

- High search time for free parking spots in car parks
- No information about parking lot usage

Solution:

- End-to-end IoT solution to monitor parking lot usage and live availability
- Combination of different sensor gives maximum flexibility during construction and retrofit (cameras, floor sensors, ceiling and wired sensors)

Benefits:

- Get insights on parking behavior (eg. Identify hot spots, peaks)
- Combine with other hardware solutions (such as displays) to facilitate navigation

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Parking Lot Monitoring
Technical concept & impressions

Parking Lot Monitoring

CLOUD

Connected Building Services (SaaS)

- Building Data Pipelines
- Building Data Lake
- Building Analytics
- Equipment Time Series

Platforms as a Service

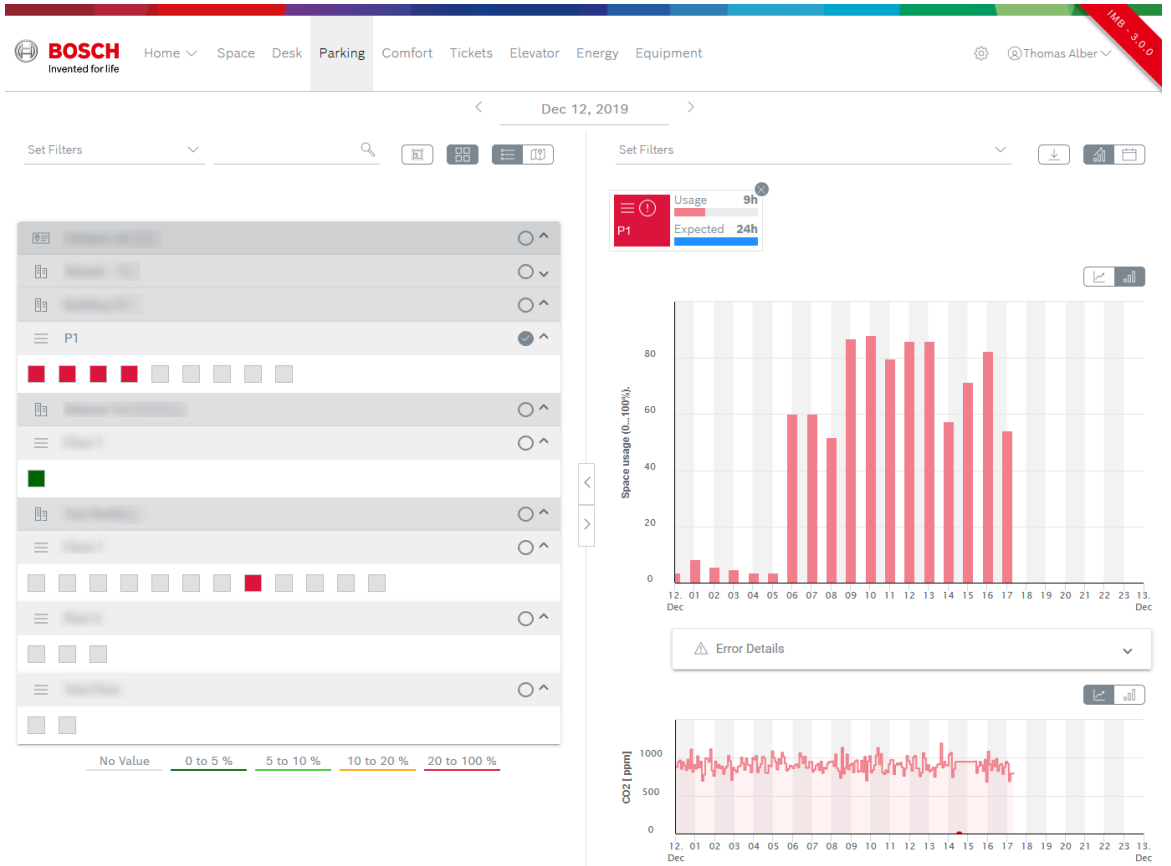
Microsoft Azure

Bosch IoT Suite

BUILDING

Connectivity gateways & edge controllers

IoT devices



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Bosch.IO Building
Lift Manager

Reduced lift downtimes up to 50%
Decrease of maintenance cost up to 30%

Problem:

- Lack of centralized maintenance tracking & recording
- Lack of data transparency
- Lack of sufficient # of skilled workers

Solution:

- End-to-end IoT solution to manage lift operation and maintenance (in partnership with TÜV Süd)
- Easy retrofitting of lifts with Bosch multi-sensor devices

Benefits:

- Monitor the lift status based on real-time anomaly detection
- Optimize maintenance planning due to predictive analytics and performance comparisons

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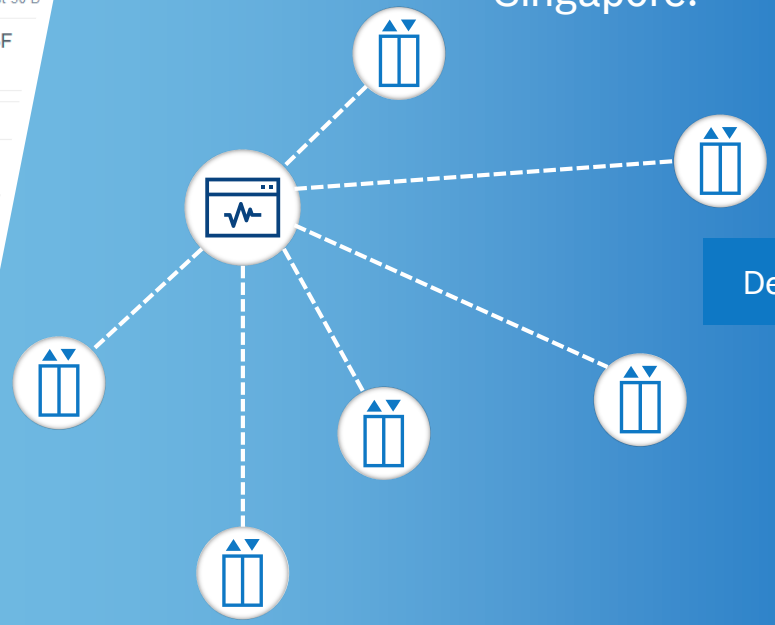
Bosch.IO Building
Lift Manager - Example

Reference Business Park
Singapore

117 lifts

connected across several buildings in a high technology business park in Singapore.



Demo available!

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Bosch.IO Building
Equipment Monitoring / Light Monitoring

Problem:

- Luminaires are spread across several buildings and locations within a campus
- Lack of data on the equipment functional status and energy consumption
- Negative user experience and maintenance

Solution:

- IoT solution to monitor status of equipment using e.g. existing light management solution or Bosch connectivity offerings
- Equipment status data combined with topology information

Benefits:

- Transparency on equipment availability and energy consumption
- Efficient maintenance runs based on real maintenance needs and on position information

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Equipment Monitoring
Technical concept & impressions

Equipment Monitoring

CLOUD

Connected Building Services (SaaS)

- Building Data Pipelines
- Building Data Lake
- Building Analytics
- Equipment Time Series

Platforms as a Service

Microsoft Azure

Bosch IoT Suite

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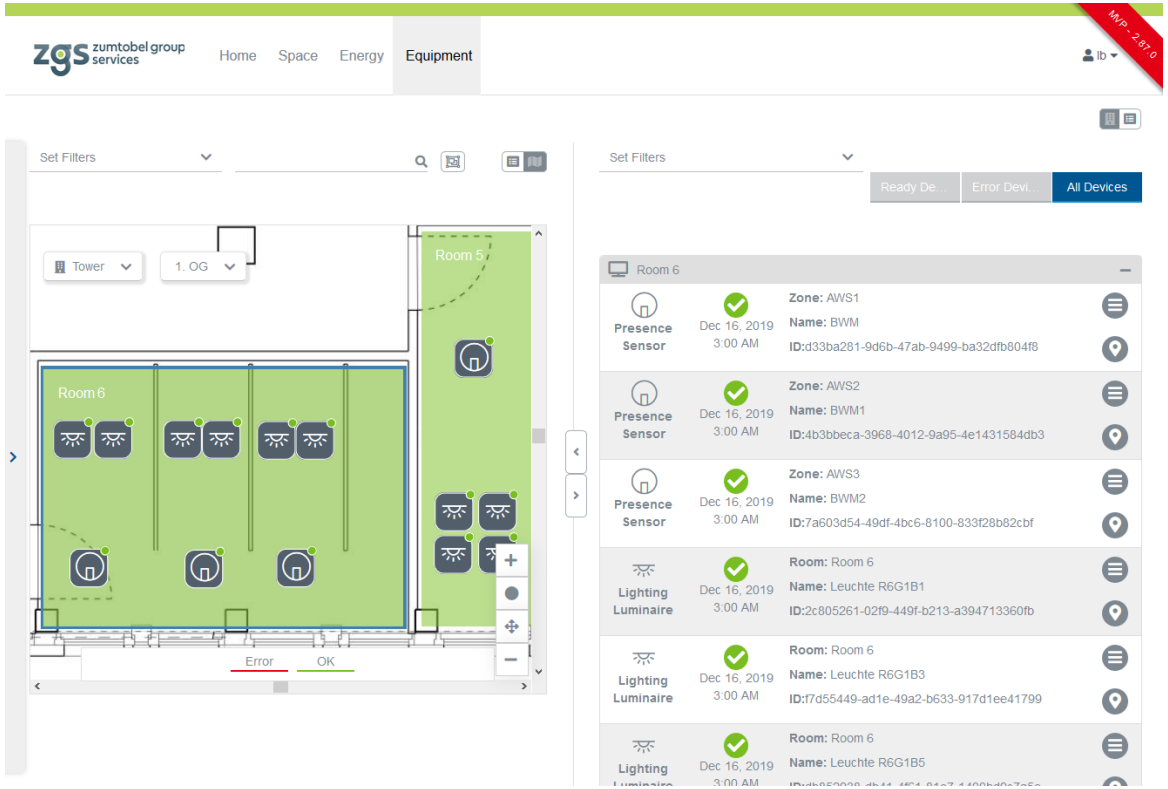
Light Management System

IoT Devices



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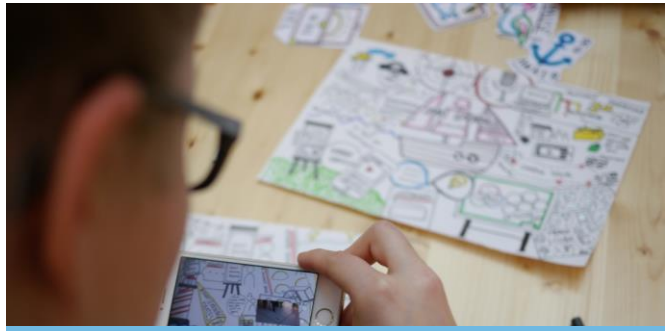
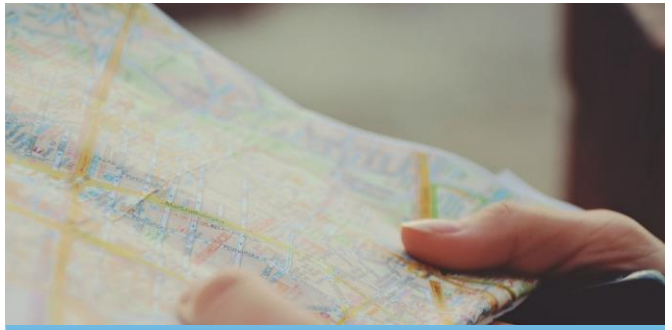
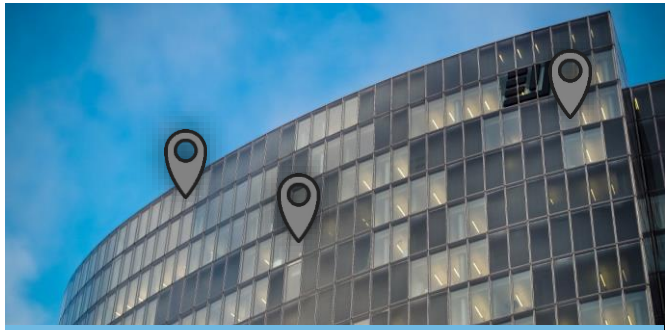
IoT use cases for connected buildings
What else can we offer?



Smart learning environment

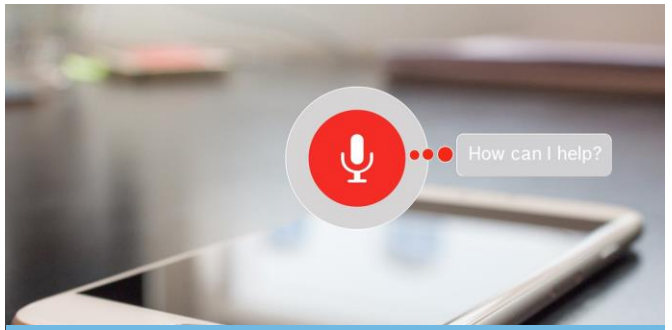


Indoor navigation

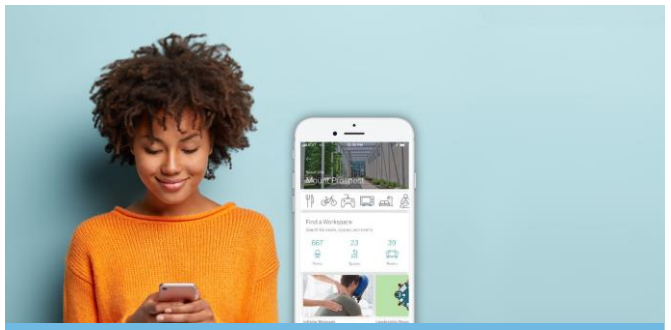


Indoor localization

Asset & energy monitoring



Digital-/Voice assistant



Mobile app/Campus app

Bosch.IO Building
Smart Learning Environments

Problem:

- How to bring a digital transformation to life
- Creating innovative new work concepts while tapping the potential of digital technologies

Solution:

- Support companies' efforts to design new work experiences
- Co-creating innovative and participative formats for people to experience digital technologies with a real-world touch

Benefits:

- Fosters an interdisciplinary exchange of ideas among the workforce
- Encourage staff to explore the potential of new technologies at their workplace
- Have a formative role in shaping digital transformation

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Bosch.IO Building
Smart Learning Environments – Onboarding Experience

Problem:

- Ability to attract qualified candidates and retain employees over the long term
- Positioning with an outstanding employer branding

Solution:

- Designing a holistic, systematic onboarding journey centered on employees' individual needs
- Seamlessly integrating innovative technologies into the work environment
- Prototyping augmented-reality and 3D applications to support self-directed, interactive onboarding

Benefits:

- Improving talent acquisition and retention
- Fostering the corporate culture as a whole

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Bosch.IO Building
Mobile App/Campus App

Problem:

- Missing communication channel between owner and campus user
- Missing mobile access to services from anywhere

Solution:

- Mobile app with relevant content and use cases
- Implemented use cases can be integrated in an existing employee app or offered via partner app

Benefits:

- Increase user satisfaction by creating a easy to use way of accessing services
- Know the best time to grab lunch, view upcoming events, book a meeting room…

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Bosch.IO Building
Digital-/Voice Assistant

Problem:

- Missing natural interaction opportunities for users with digital services

Solution:

- Algorithm to provide a digital assistant via text or a voice assistant via speech
- Covering Automatic Speech Recognition (ASR), Natural Language Understanding (NLU), Dialog Management (DM) and Text to Speech (TTS)

Benefits:

- Provide natural engagement channels for digital services
- Hybrid deployment model with full privacy control

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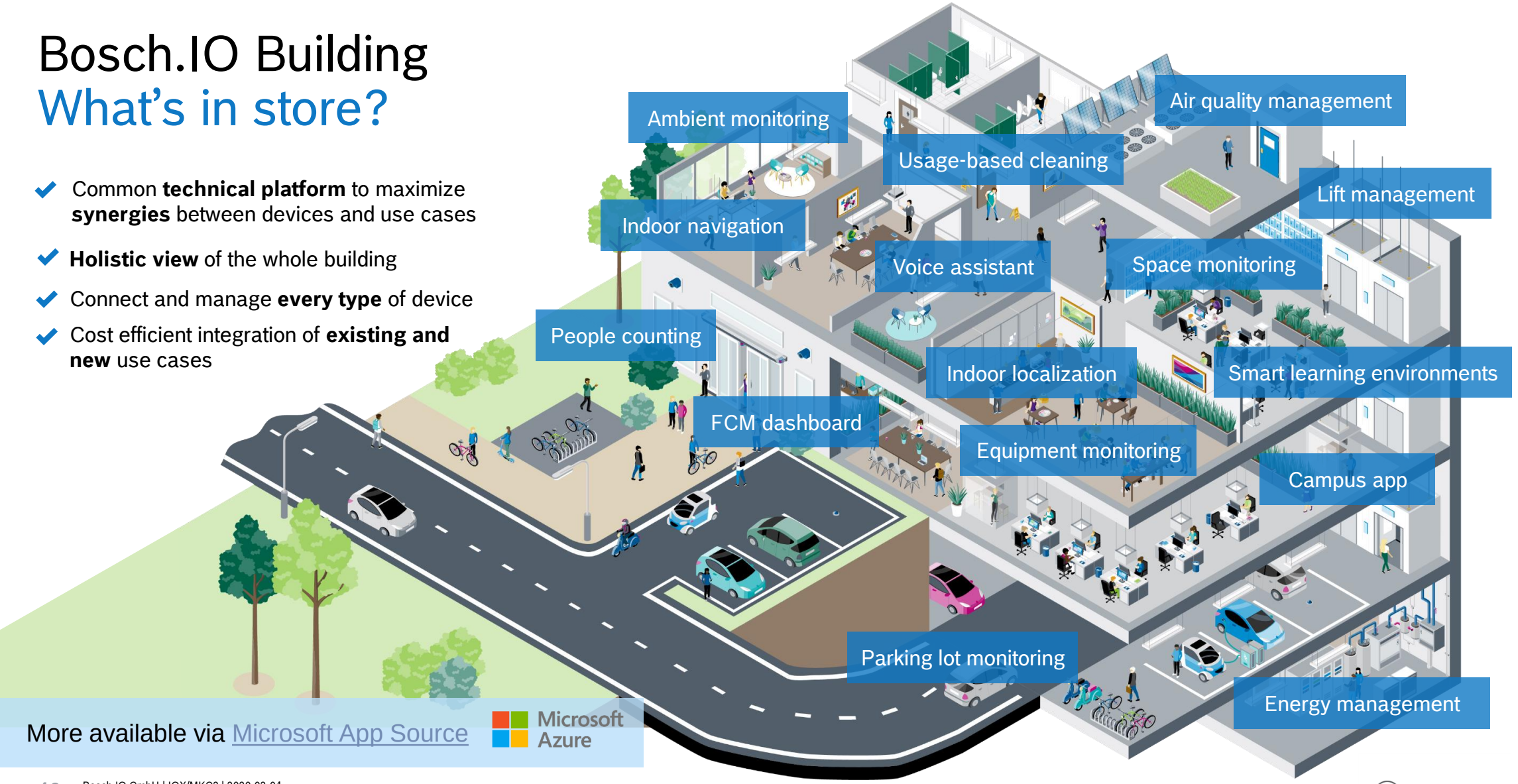
How to solve these challenges?

Bosch.IO Building
What's in store?

- Common **technical platform** to maximize **synergies** between devices and use cases
- **Holistic view** of the whole building
- Connect and manage **every type** of device
- Cost efficient integration of **existing and new** use cases



More available via Microsoft App Source

Microsoft Azure

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Solution Architecture Landscape

Bosch.IO Building use cases

- **Space Monitoring** — Room | Desk | Ambient | People Counting
- **Parking Lot Monitoring**
- **Lift Manager**
- **Equipment Monitoring**
- ...

Individual customer projects

- **Customer Projects**
- ...

3rd party ecosystem use cases

- **Air Quality Management**
- **Usage-based cleaning**
- **Indoor Navigation**
- ...

CLOUD

Connected Building Services
Software as a Service

- Building Data Pipelines
- Building Data Lake
- Building Analytics
- Equipment Time Series
- Building Cockpit
- Building Digital Twin

- 3rd party services
- Custom developed services

Platforms as a Service

- Bosch IoT Suite
- Microsoft Azure

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Connectivity gateways & edge controllers

IoT devices

Existing building systems

Building models

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Bosch.IO Building
Features and benefits

- Fast and easy installation in new and existing buildings (greenfield / brownfield)
- Increased operational transparency for your building and building equipment
- Common data lake for all building subsystems
- Open APIs for easy integration with BMS, building models, and 3rd party solutions

How to get started?

Bosch.IO Building
How to start your connected building project

Analyze the initial situation depending on your use case

#parking lots, #entrances, #desks, #rooms, building size

Define the required hardware

Selection of suitable sensors, gateways & repeaters

Installation

Installing new hardware, connecting to existing hardware and building systems

Onboarding in Connected Building Services

Integration in existing building model or setup of new building model

THANK YOU

Your contact:

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Read the blog post

https://bit.ly/2D7azLD

BOSCH SINGAPORE CAMPUS – SMART BUILDING CONCEPT TURNED REALITY

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Bosch Singapore connected campus
Challenges we addressed

Improve occupant comfort
for better productivity and well-being

Increase building safety and security
to provide a safer working environment

Create more transparency
into building operations

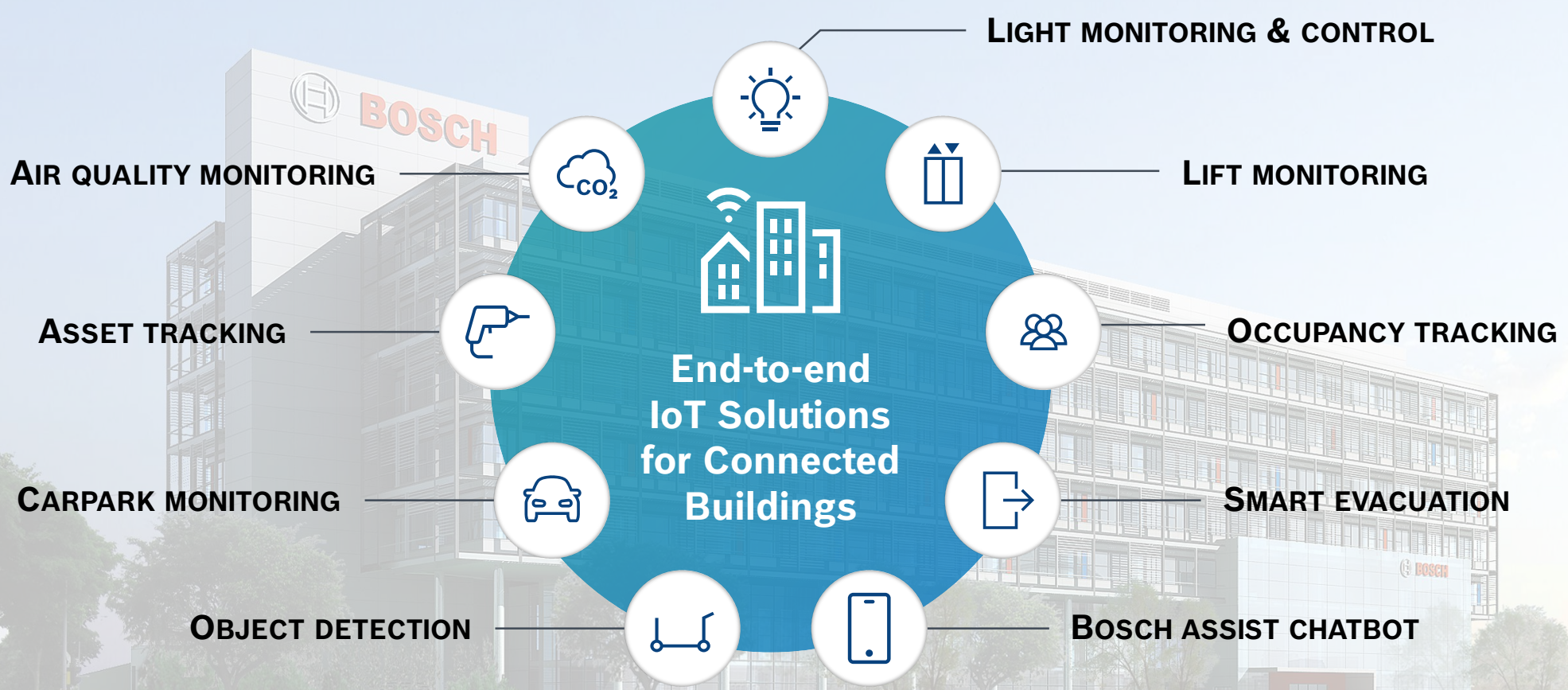
Optimize energy consumption
to reduce operating expenses

Optimize campus space utilization
based on usage data and trends

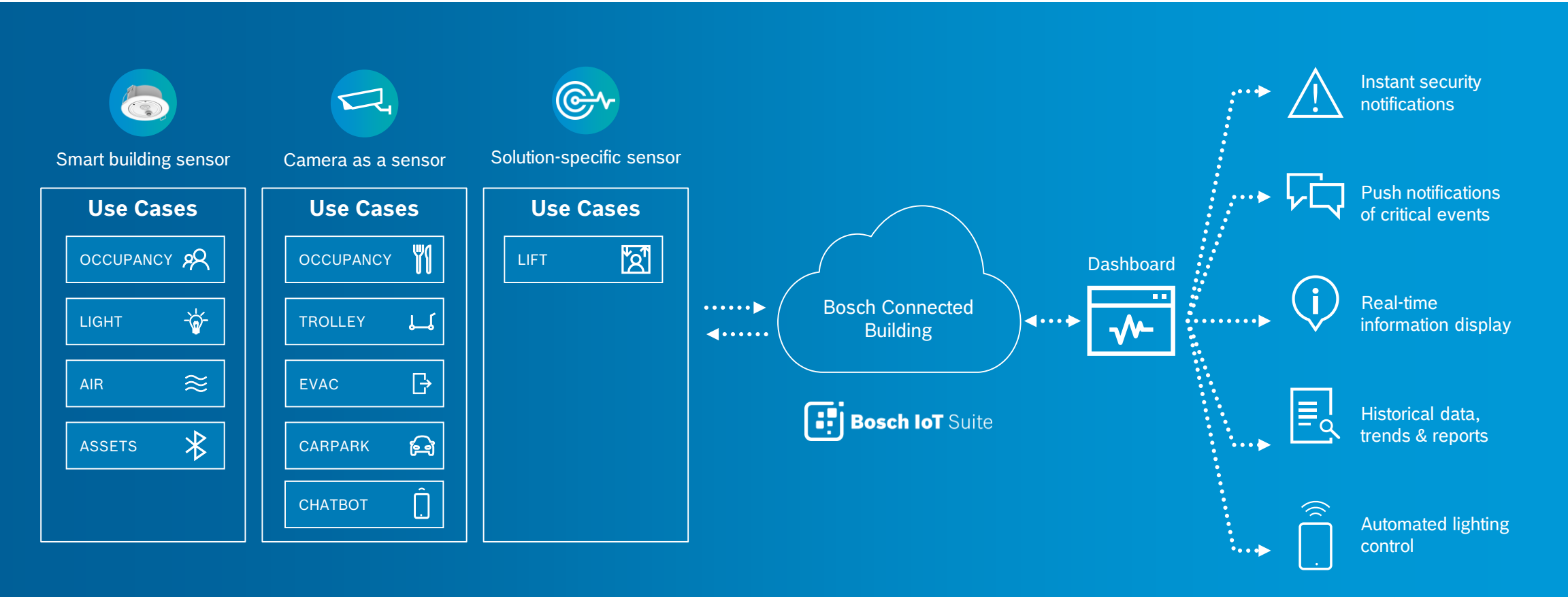
Keep track of valuable assets
to optimize the asset pool according to demand and minimize losses

Provide real-time information
on availability of shared facilities to minimize waiting times and optimize staffing

Smart building use cases implemented at the Bosch Singapore campus



Bosch Singapore connected campus
System architecture



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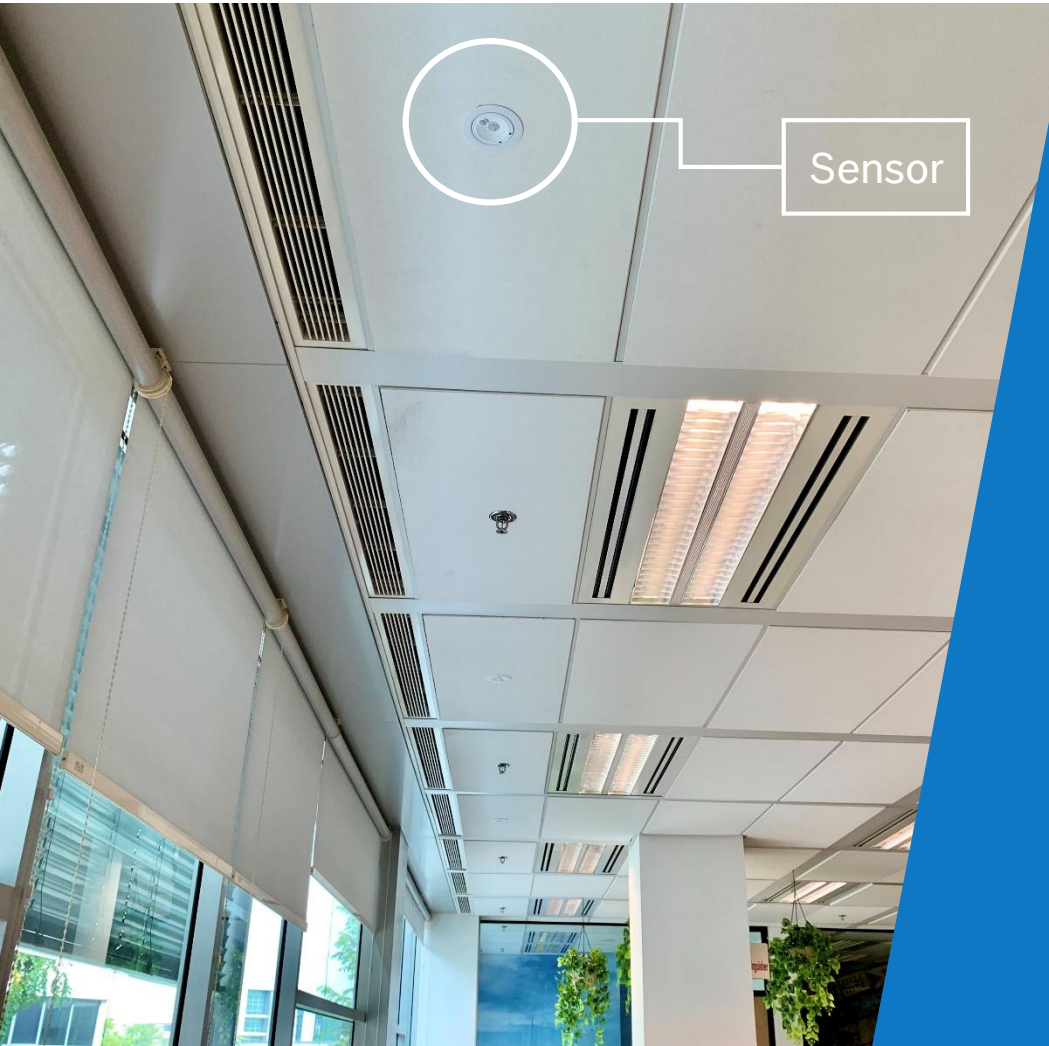
Bosch Singapore connected campus

Use case: Daylight harvesting & light scheduling

Co-working | Educational | Commercial



Smart building sensor

Overview

- Weekdays: lights autonomously dim or brighten depending on daylight > daylight harvesting mode
- Evenings: lights switch to presence detection mode triggered by motion & sound
- Meeting room lights: always in presence detection mode
- Weekends: presence detection mode

Benefits

- Increased comfort for building occupants
- Minimization of energy consumption in temporarily unoccupied areas
- Optimization of energy consumption across the building

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Bosch Singapore connected campus
Use case: Air quality monitoring

Hotels | Healthcare | Educational | Commercial

Smart building sensor

Overview

- Tracking of vital air quality parameters:
  - Temperature
  - Humidity
  - CO_2
  - TVOC
- Air quality status displayed on the Connected Building dashboard across the floor plan
- Notifications if the indices exceed a healthy range

Benefits

- Improved well-being and productivity of building occupants
- Reduced energy consumption with the demand-driven HVAC usage
- Mold and mildew elimination thanks to optimized air parameters

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Bosch Singapore connected campus

Use case: Asset tracking

Co-working | Plants & workshops | Hotels | Healthcare | Educational | Retail

Smart building sensor

Overview

- Bluetooth beacons to pinpoint asset location:
  - battery life up to 5 years
  - various forms and sizes
- Real-time asset location on the floorplan
- Historical asset utilization data
- Push notifications if assets leave a designated zone

Benefits

- Easy tracing and recovery of assets
- Increased productivity and reduced labour waste
- Asset pool optimization
- Improved asset life cycle management
- Reduced expenses thanks to minimization of asset damage and loss

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Bosch Singapore connected campus
Use case: Lift monitoring

Healthcare Educational Commercial Residential

Solution-specific sensor

Overview

- Lift Manager: monitors the status of lifts & maintenance activities
- A single dashboard tracks physical condition, utilization, and ride comfort of all lifts regardless of brand
- Anomaly alerts and critical event notifications
- Predictive analytics forecasts a breakdown and recommends a maintenance activity to prevent it
- Lift technicians informed of a malfunction cause in advance

Benefits

- Lift operational and maintenance transparency
- Minimization of lift downtime
- Increased safety of rides
- Cost savings thanks to predictive maintenance

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Bosch Singapore connected campus
Use case: Occupancy tracking

Co-working | Retail | Educational | Commercial

Smart building sensor | Camera as a sensor

Overview

- People flow in real time on the floor plan
- Detailed occupancy reports and room usage trends
- Real-time presence detection in restricted zones
- Real-time occupancy status of shared facilities (e.g. gym, canteen) for building occupants via the Bosch Assist chatbot

Benefits

- Improved space management due to identification of poorly used or frequently overcrowded areas
- Cost savings thanks to reduction in vacant space
- Data-driven decision making on office expansion or reduction
- Enhanced security
- Improved productivity and reduced waiting time

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Bosch Singapore connected campus

Use case: Carpark monitoring & alerts

Healthcare Retail Commercial

Camera as a sensor

Overview

- A single Bosch CCTV camera is used (object counting, edge analytics capabilities)
- Connected Building dashboard: real-time carpark occupancy status, trends, and historical reports
- Monitoring of the no-parking zone:
    1. The camera is trained to detect a long-parked car
    2. BoschAssist chatbot notifies a security guard
    3. Public address system can notify the driver

Benefits

- Optimized parking space utilization
- Extra parking slots can be made available if the main car park is full
- Increased safety thanks to prevention of parking in restricted areas

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Bosch Singapore connected campus

Use case: Smart evacuation

Co-working | Hotels | Retail | Healthcare | Educational | Commercial

Smart building sensor

Camera as a sensor

Overview

- The Connected Building system determines who is inside when an emergency occurs
- Avoiding a stampede during evacuation: the Bosch fire alarm and the public address systems disseminate targeted announcements to different floors
- Bosch cameras monitor crowd formations and help guide people out through alternative exits if required

Benefits

- Shortened evacuation time and a streamlined process can save lives
- Safer working environment

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Bosch Singapore connected campus
Use case: Object detection

Co-working | Retail | Healthcare | Educational | Commercial

Camera as a sensor

Overview

- If the Bosch CCTV camera spots a cargo trolley in the passenger lift lobby, it triggers the public address system to play an automated warning message
- Based on the ability of Bosch cameras to be trained to spot particular objects
- Can be applied to other areas, depending on your specific needs

Benefits

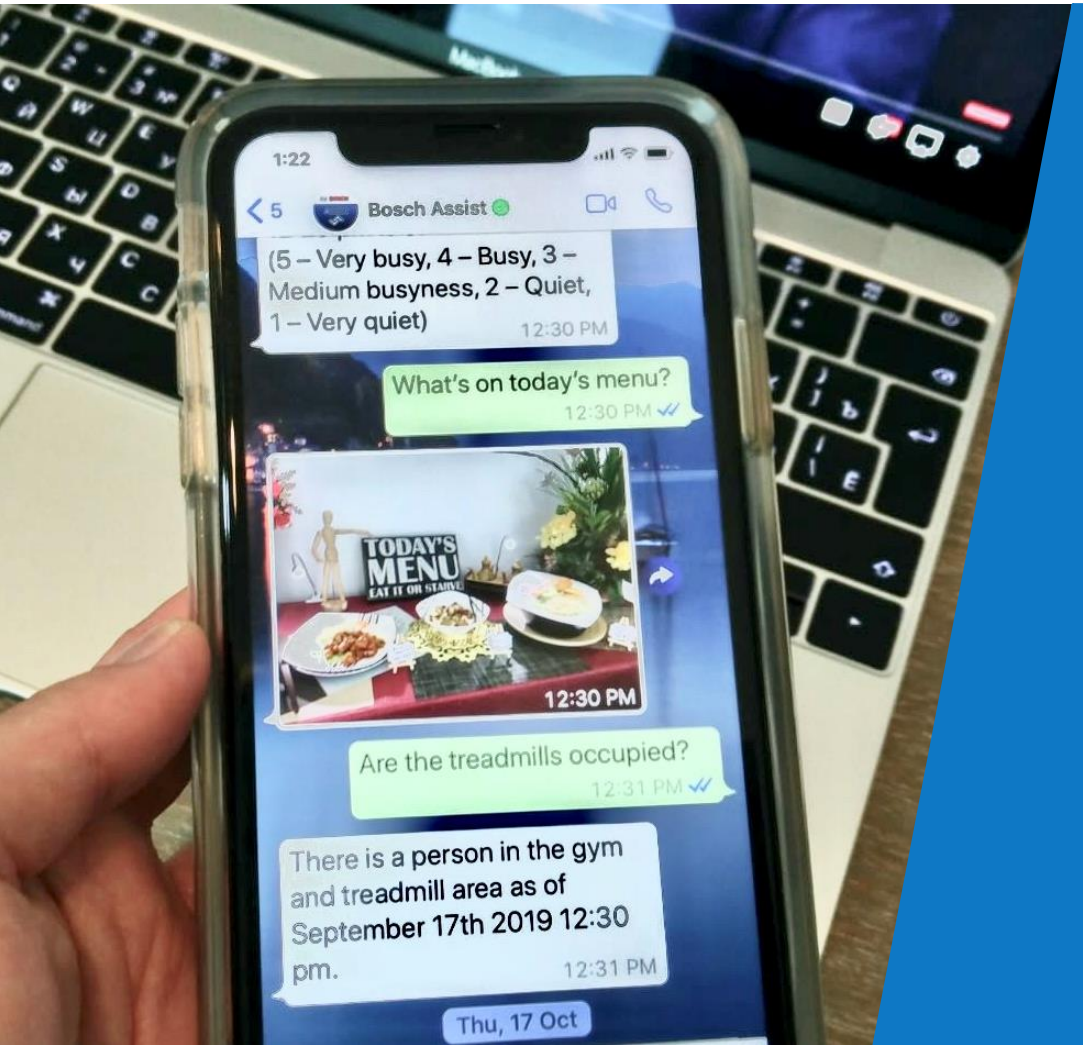
- Increased safety and comfort, especially during morning and evening peak hours

BOSCH

Bosch Singapore connected campus

Use case: The Bosch Assist chatbot

Hotels | Co-working | Healthcare | Educational | Commercial



Camera as a sensor

Overview

- All building occupants can easily interact with their smart building via texting:
  - to check on the canteen and gym occupancy in real time, see today's menu, etc.
  - to report issues (e.g. broken equipment)

Benefits

- Increased comfort for building occupants
- Reduced waiting time for shared facilities
- Streamlined issue reporting

How it works: watch the video

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What's next?

Next steps

Integration with BMS and HVAC systems for automated control of key building functions based on collected data

Vision

Truly intelligent buildings, capable of adjusting to the ever-changing needs of their inhabitants, making life more comfortable, sustainable, and productive