

EmiratesGBC Technical Workshop

DIGITALIZATION IN THE BUILDING INDUSTRY

Digital Twin & Smart Offices

<u>Facilitators</u>	<u>Company</u>	<u>Date</u>
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Challenges of the construction industry

-Global Trends

Planning and construction phases – stakeholder challenges



“Inability to visualize the final product in the design phase leads to design changes in the construction phase, causing delays, added risk and extra cost.”

“Less prefabrication, more on-site work leads to higher costs and lower quality.”

Owners



“Manual quantity estimation is a time-consuming process with low accuracy and high risk.”

“The effects of design changes on the budget are not easily reflected.”

Planners



“Current tools and workflows don’t support coordinated work, which increases the cost and time of the project and decreases the quality.”

Contractors

Construction projects are faced with numerous challenges



- **Unbudgeted costs**

Unreliable schedule

Insufficient quality

Environmental impact during construction

Accidents on construction sites

Planning errors

Inaccurate, incomplete plans

Lack of cooperation

Difficulty of interdisciplinary realization



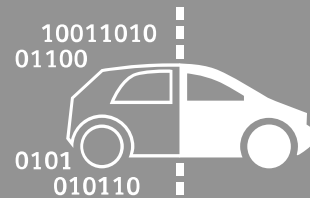
Digitalization is affecting all industries



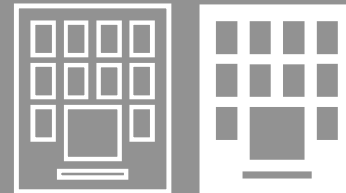
Predictive maintenance



Digital prototyping



Digital twin



Today, it is easier to turn data into value than it was only a few years ago

By 2020
there will be approximately

7 billion

connected devices
in buildings globally

Decreasing data collection costs –

\$500

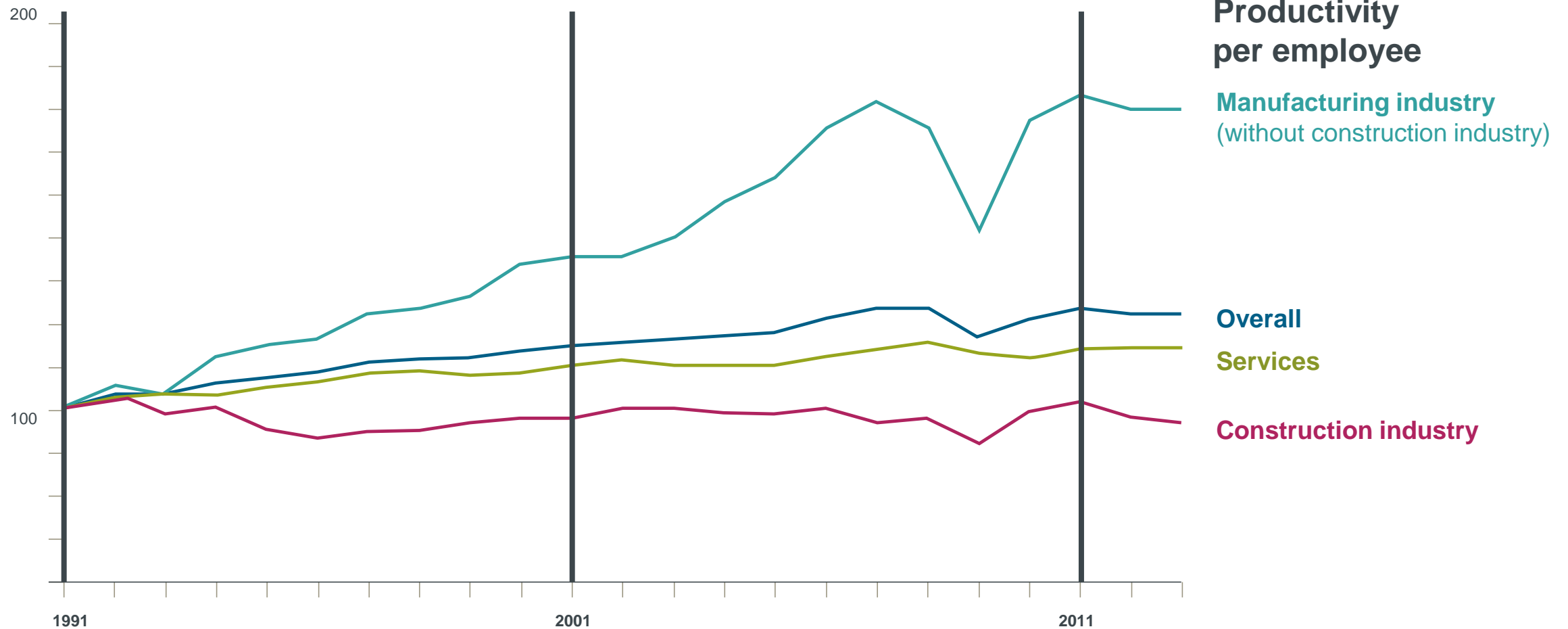
per 1 m
transistors
in 1990

\$0.05

per 1 m
transistors
in 2012

Standardization of
protocols

The manufacturing industry faced similar challenges – how did it improve?



BIM gives you more insight – and makes planning, building and operating your buildings easier



Earlier conflict and error detection



Up to **10%** savings in budget due to collision management

Improve budget reliability



Up to **40%** decrease in non-budgeted change orders

Fewer accidents on job sites



Faster project delivery



Project timeline shorted by up to **7%**

Basis for lifecycle cost optimization



Operation costs lowered by up to **9%**

Higher building quality



Up to **3.5%** more efficient occupancy

External Market Realities

driving the adoption of BIM

30%

of projects do not meet original program or budget



92%

of planners confirm that not all information is available when plans are made



37%

of materials used in construction become waste



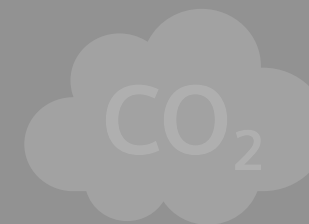
10%

of the cost of a project is typically due to change orders



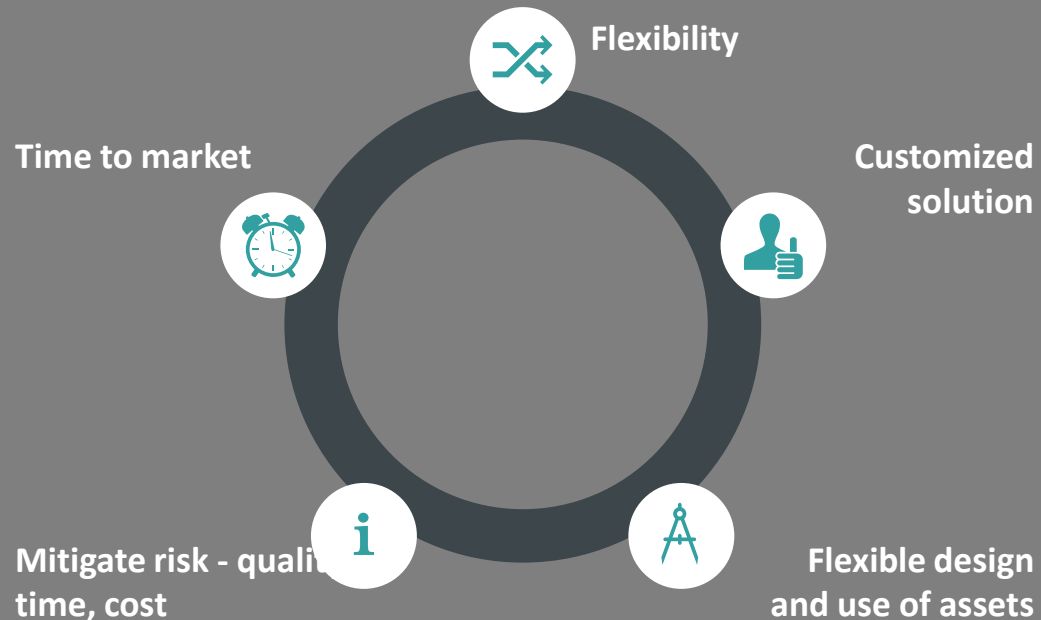
38%

of carbon emissions are from buildings, not cars



The digital transformation of the building lifecycle – totally new business models and ecosystems arise

Market/customer demands are changing ...



... new business models/ecosystems arise



From mechanical components to smart and integrated systems



From firmly defined products to customized solutions



From traditional materials and methods to new construction processes



From internet connectivity to Internet of Things and Web of Systems

Buildings are talking and generating data with every interaction

Enhancing building lifecycle performance through
the power of digitalization
enabled by BIM
creates a greater competitive advantage

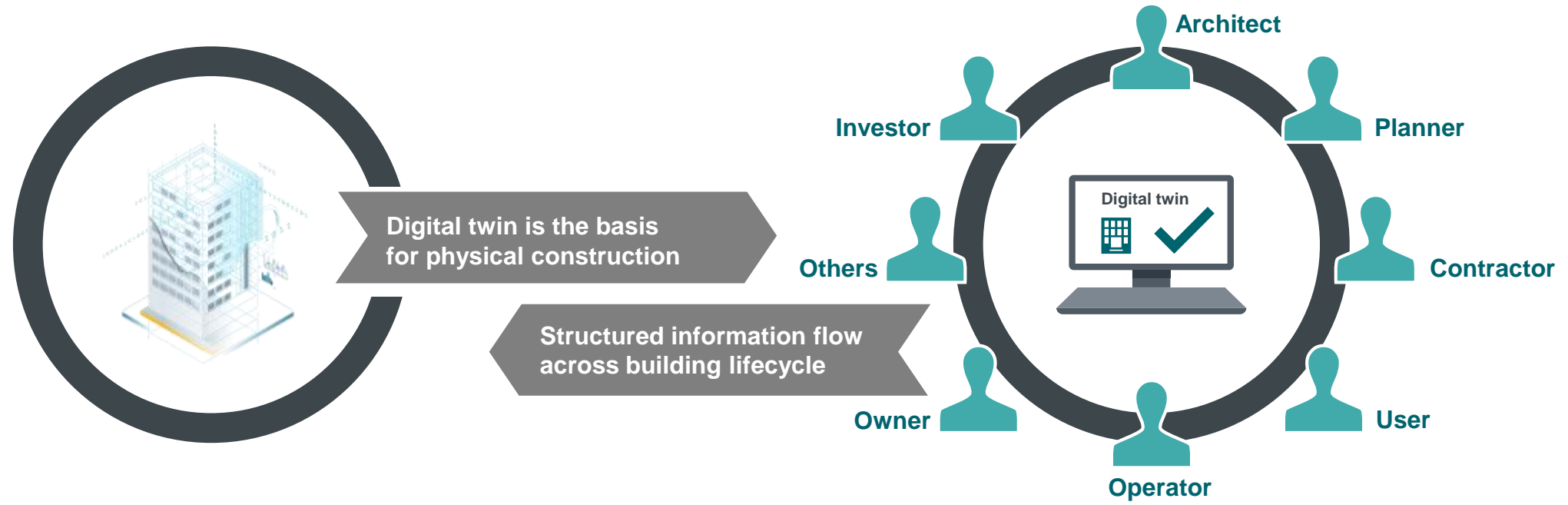
Enhancing building performance through the power of data

What is BIM?

What is BIM?

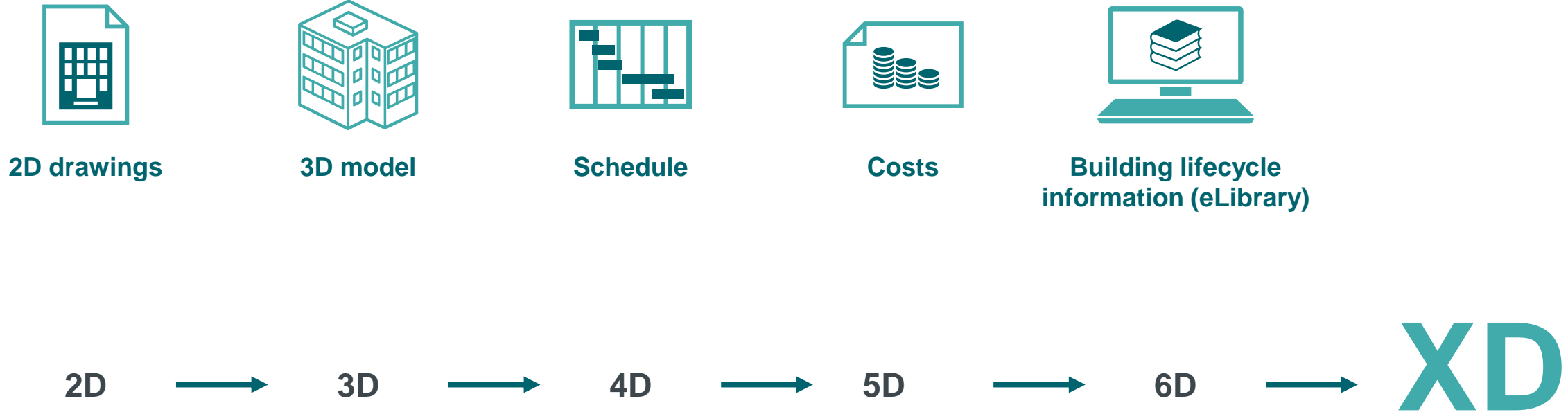
New way of working –

BIM is a process to encourage sharing of common data, process optimization and collaboration

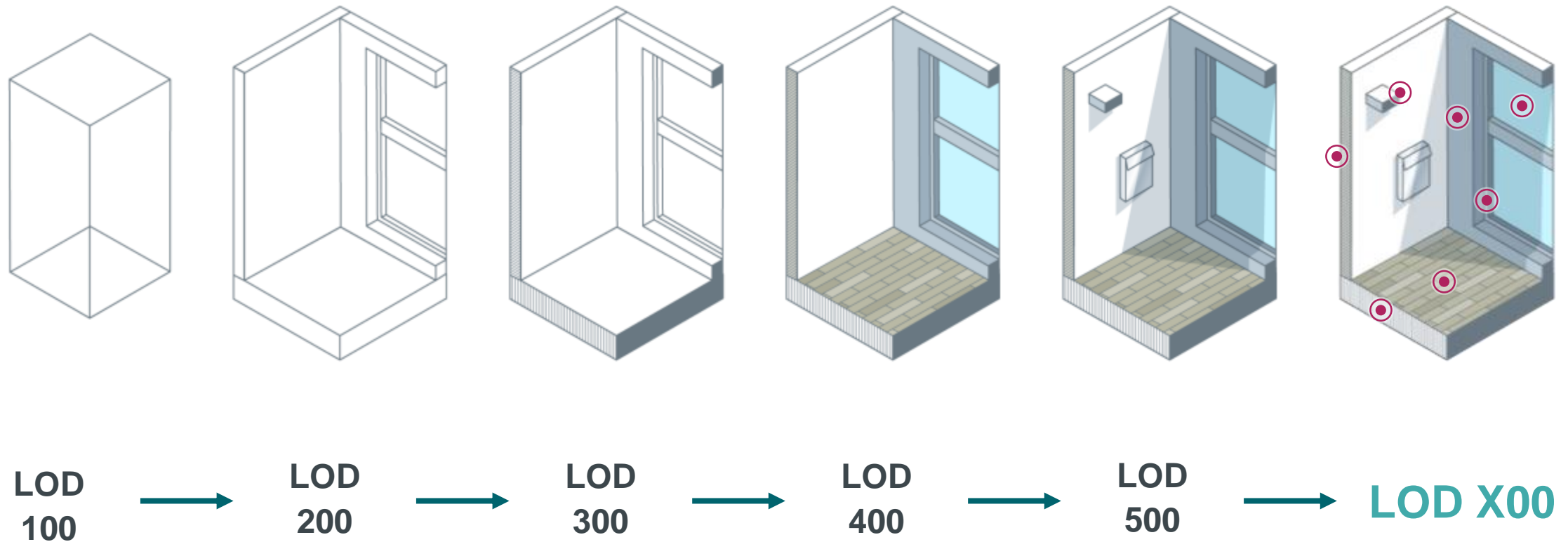


BIM is all about data – BIM offers different dimensions that help us plan and operate buildings

The data model evolves over time ...



BIM is all about data – different levels of detail (LOD) give us important information about the features of a building



BIM is all about data – The foundation for all 3D planning are object libraries

Interdependency
Interactions
Geometry
Classes
Attributes
Relations
...



Data sheets



3D planning



Digital twin

BIM is all about data –
Vendors offer the necessary object libraries

BIM-compliant data according to...

...VDI 3805/ISO 16757

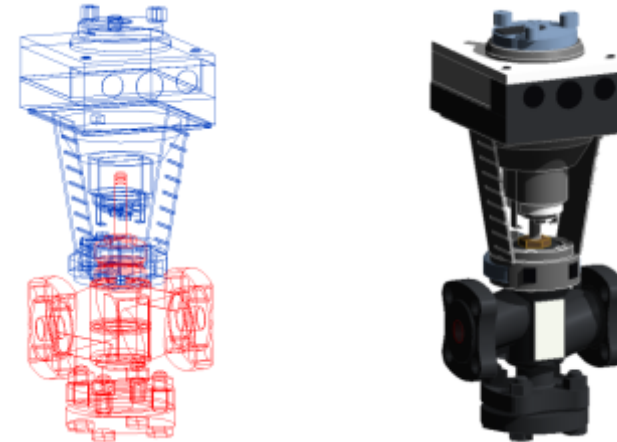
Data structures for electronic product catalogues for building services

...IFC/ISO 16739

Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

...COBie standard

Construction Operations Building Information Exchange

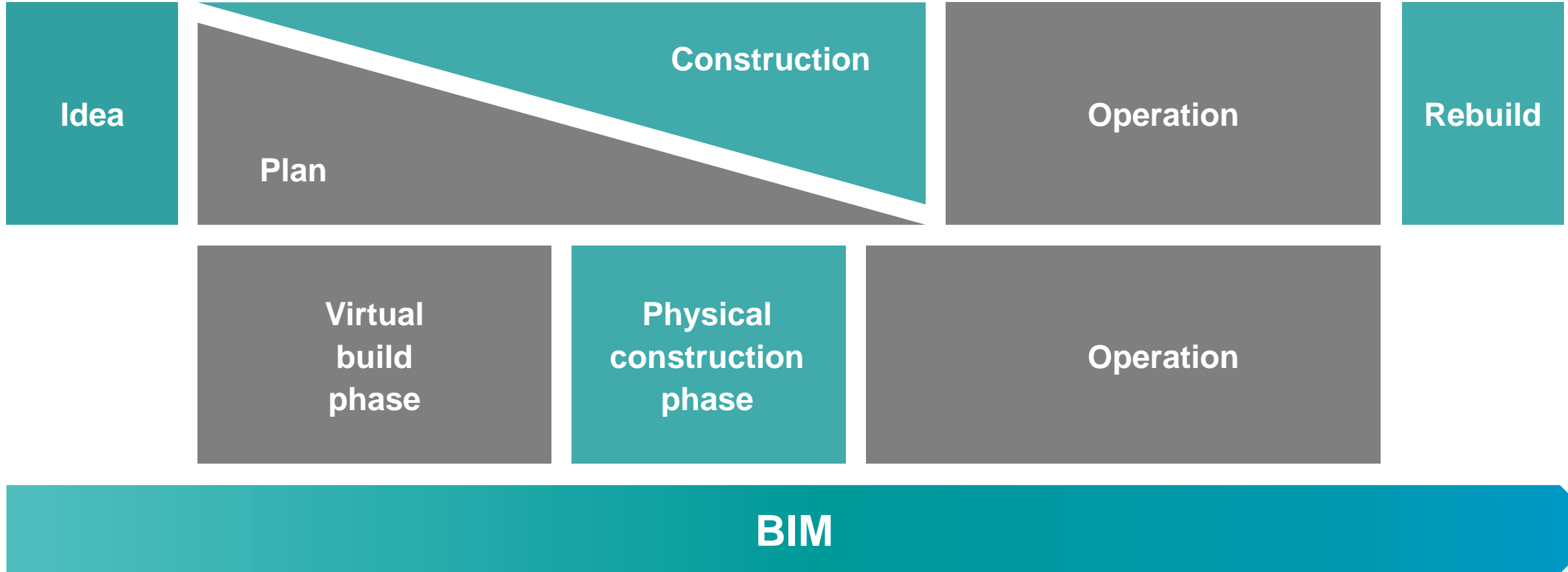


Vendors have 1,000s of products available – and more to come

Enhancing building performance through the power of data

Planning and construction phases with Digital Twin

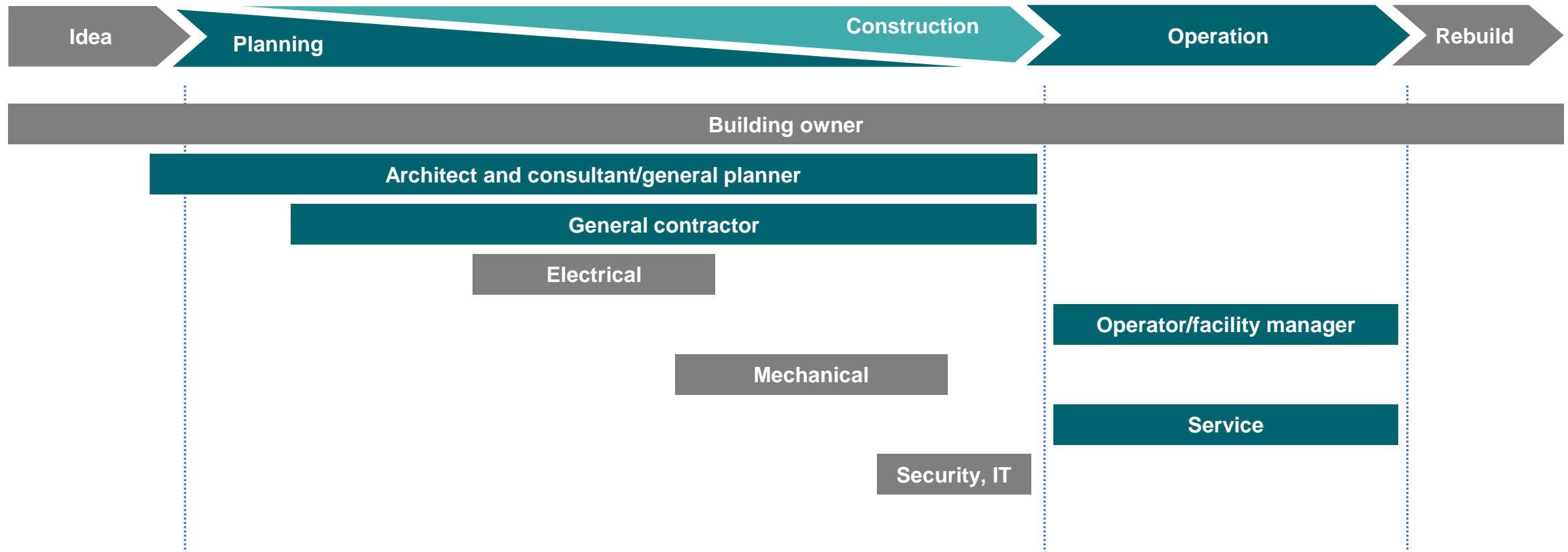
The BIM process – How does BIM change the construction process?



The BIM process – BIM affects the collaboration between the different trades as well as the duration of the different phases

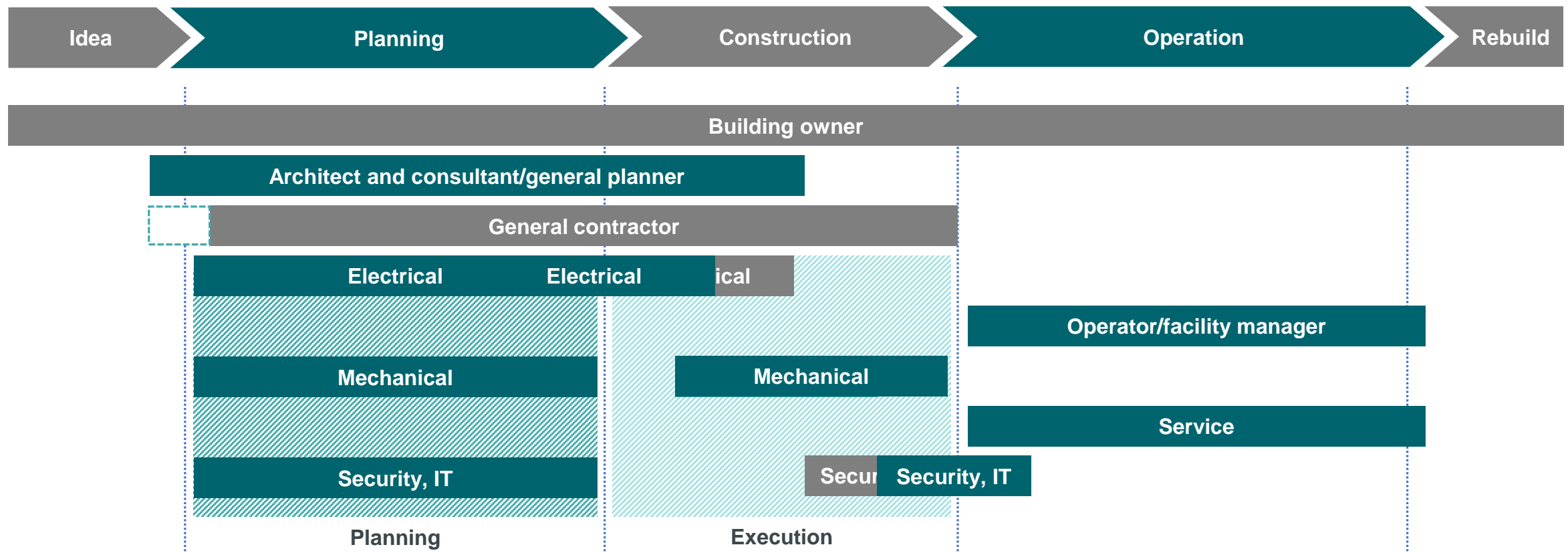


Today

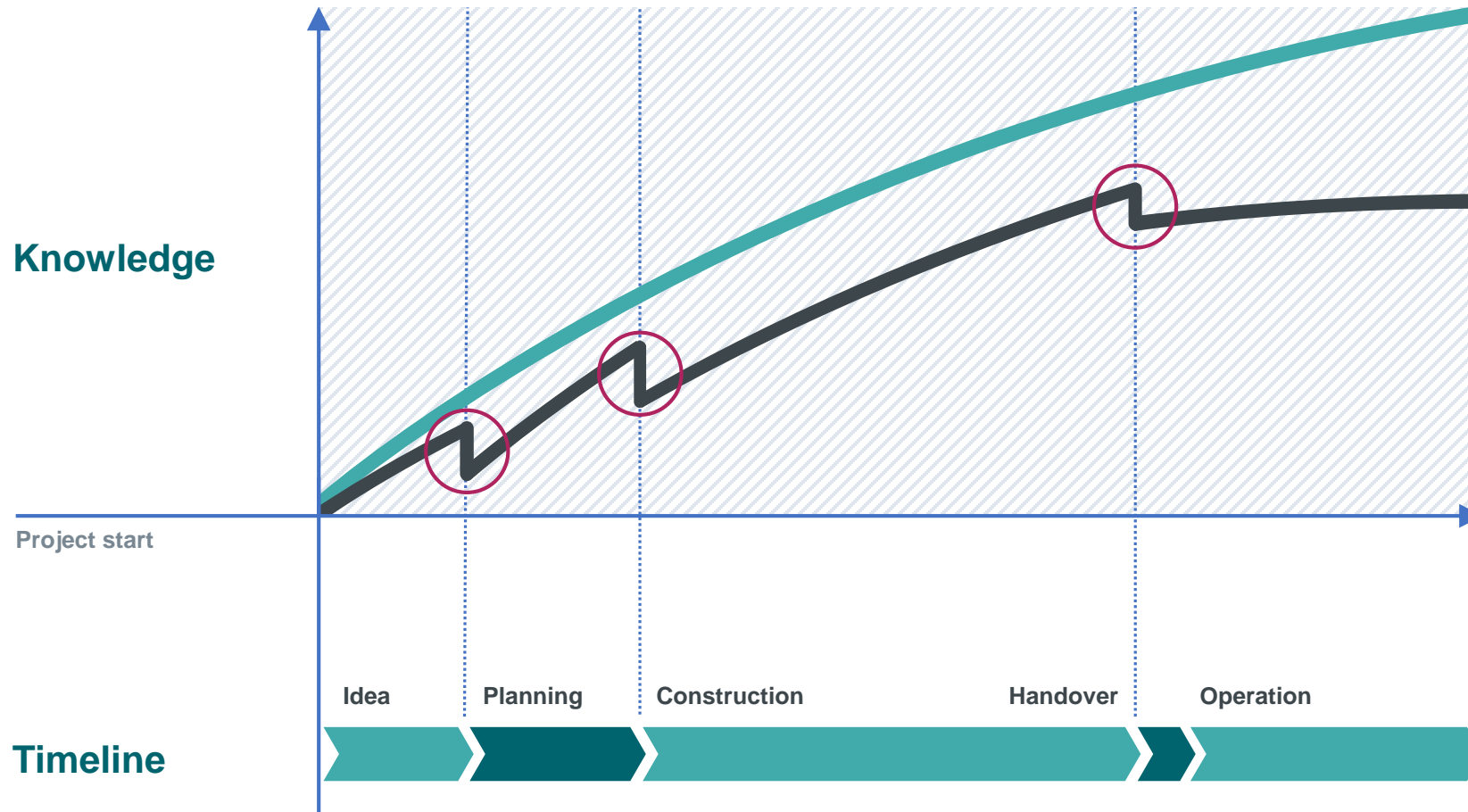


The BIM process – BIM affects the collaboration between the different trades as well as the duration of the different phases

Tomorrow



The BIM process – BIM prevents information loss



BIM-enabled project

Typical construction project

Loss of information at interfaces

- Loss of time
- Additional cost
- Inconsistencies in quality

Use case – planning with BIM

Problem
Design visualization and communication

Solution
Digital twin allows accurate design, which improves the ability to prefabricate and thus the efficiency of the construction phase

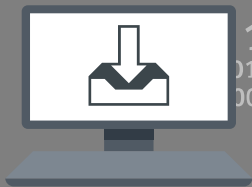
“How to plan with BIM?”



Planner



Engineer/consultant



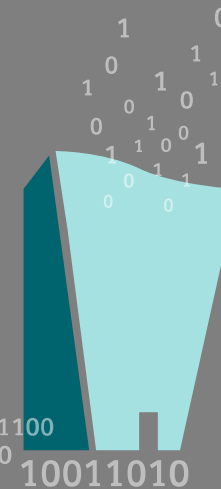
BIM data as a plug-in solution



Product selection in plug-in



Selected product appears in digital twin



- ✓ Efficient planning
- ✓ Increased productivity
- ✓ Enhanced visualization
- ✓ Enhanced coordination

Use case – impact of BIM on prefabrication

Problem

Less prefabrication, more on-site work leads to higher costs and lower quality

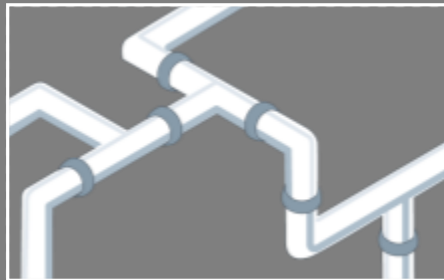
Solution

BIM allows accurate design, which improves the ability to prefabricate

Approach

Past

A single supplier shifts production location from construction site to factory

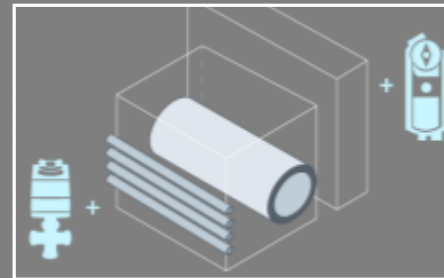


Example

Pipes are welded in the factory before delivery to construction site

Current

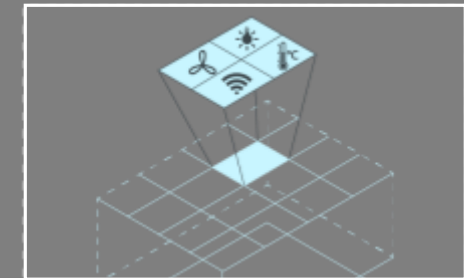
Integrating products from multiple suppliers in single discipline (e.g mechanical)



Suppliers integrate control and actuator in a VAV box with pre-engineering and testing

Future

Integrating products from multiple suppliers in multiple disciplines



Suppliers integrates ceiling module lighting, electrical and mechanical functions in a room

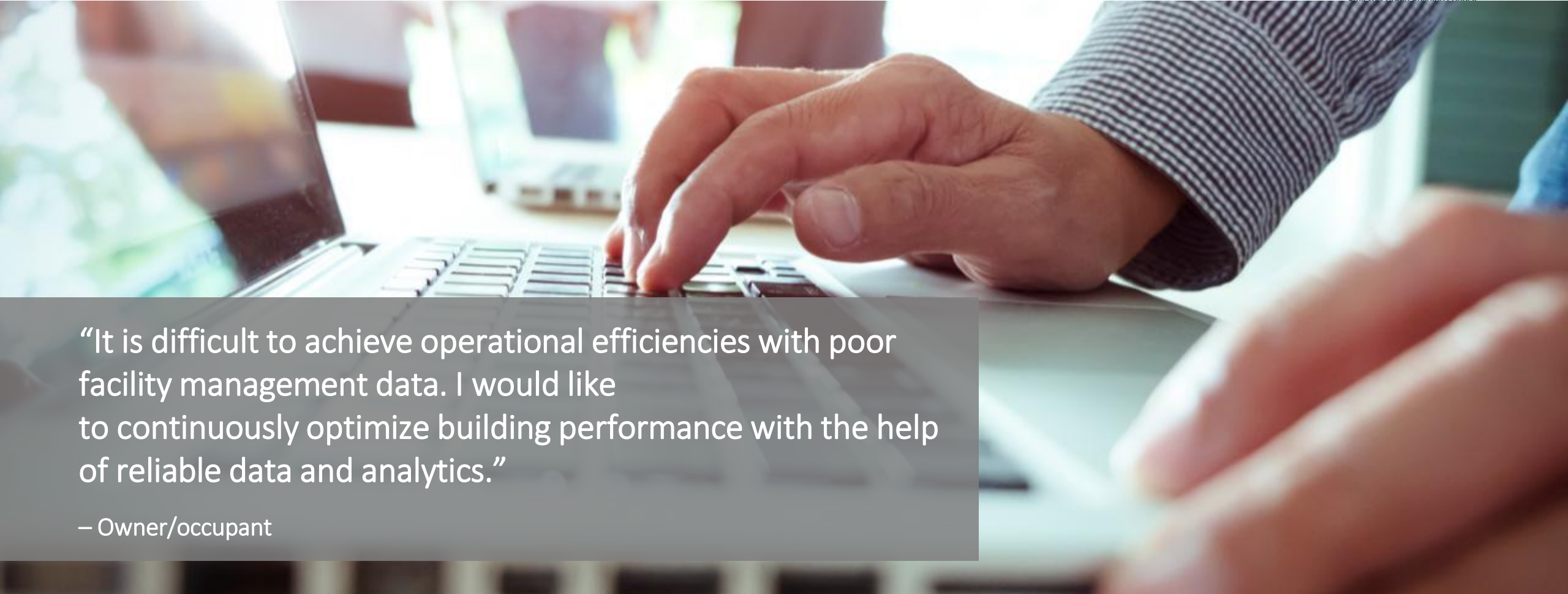
Prefabrication has existed for a long time ...

... and is now being enabled by BIM

Enhancing building performance through the power of data

Digitalizing the operations phase with Digital Twin

Operations phase – stakeholder challenges



“It is difficult to achieve operational efficiencies with poor facility management data. I would like to continuously optimize building performance with the help of reliable data and analytics.”

– Owner/occupant

Digital Twins

Digital models of the physical world



Google Earth



Different views and data types

Siemens Corporate Headquarters



Siemens AG
4,3 ★★★★★ · 15 Berichte
Geschäftsstelle

Routenplaner

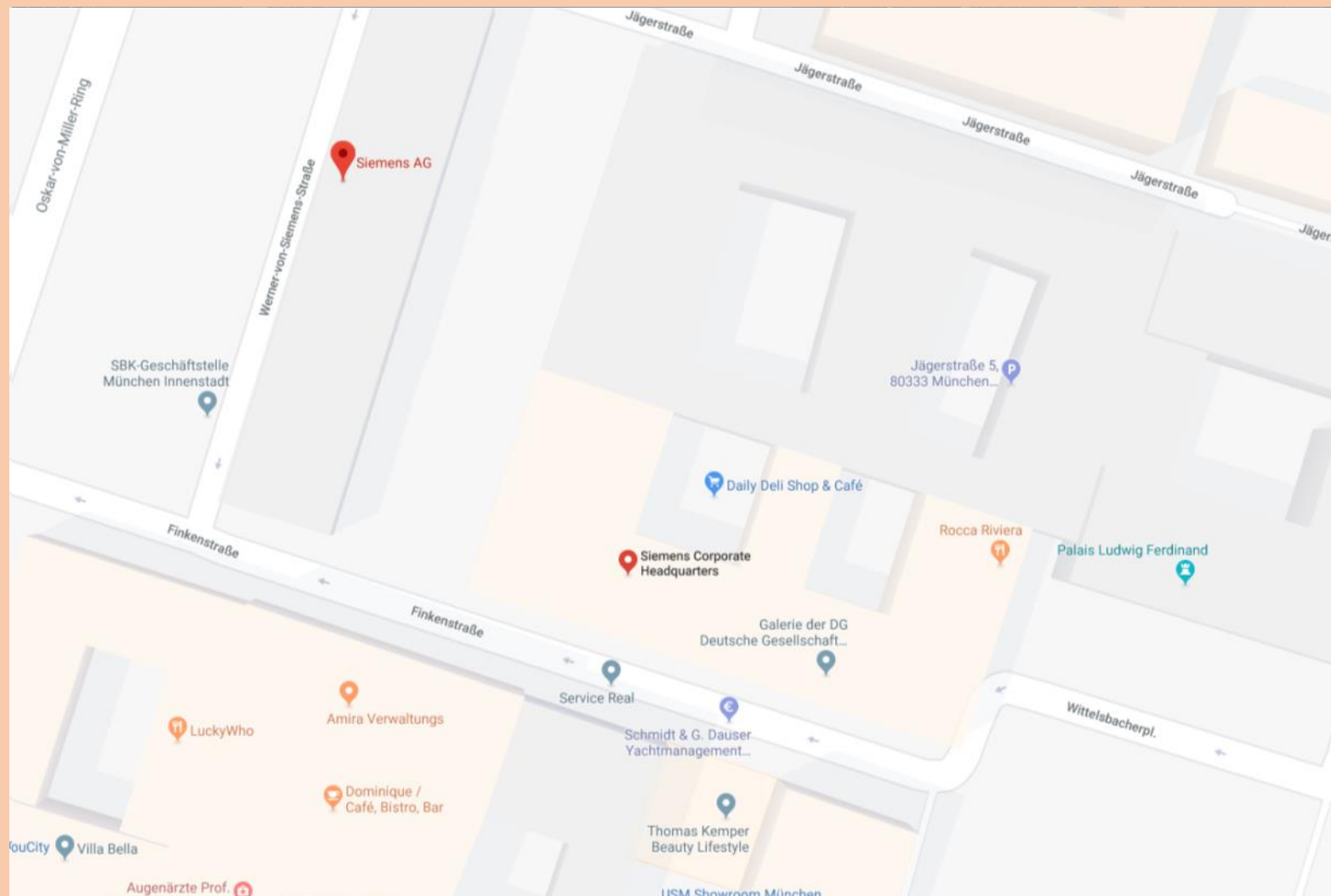
SPEICHERN IN DER NÄHE AN MEIN SMARTPHONE SENDEN TEILEN

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Jetzt geöffnet 24 Stunden geöffnet

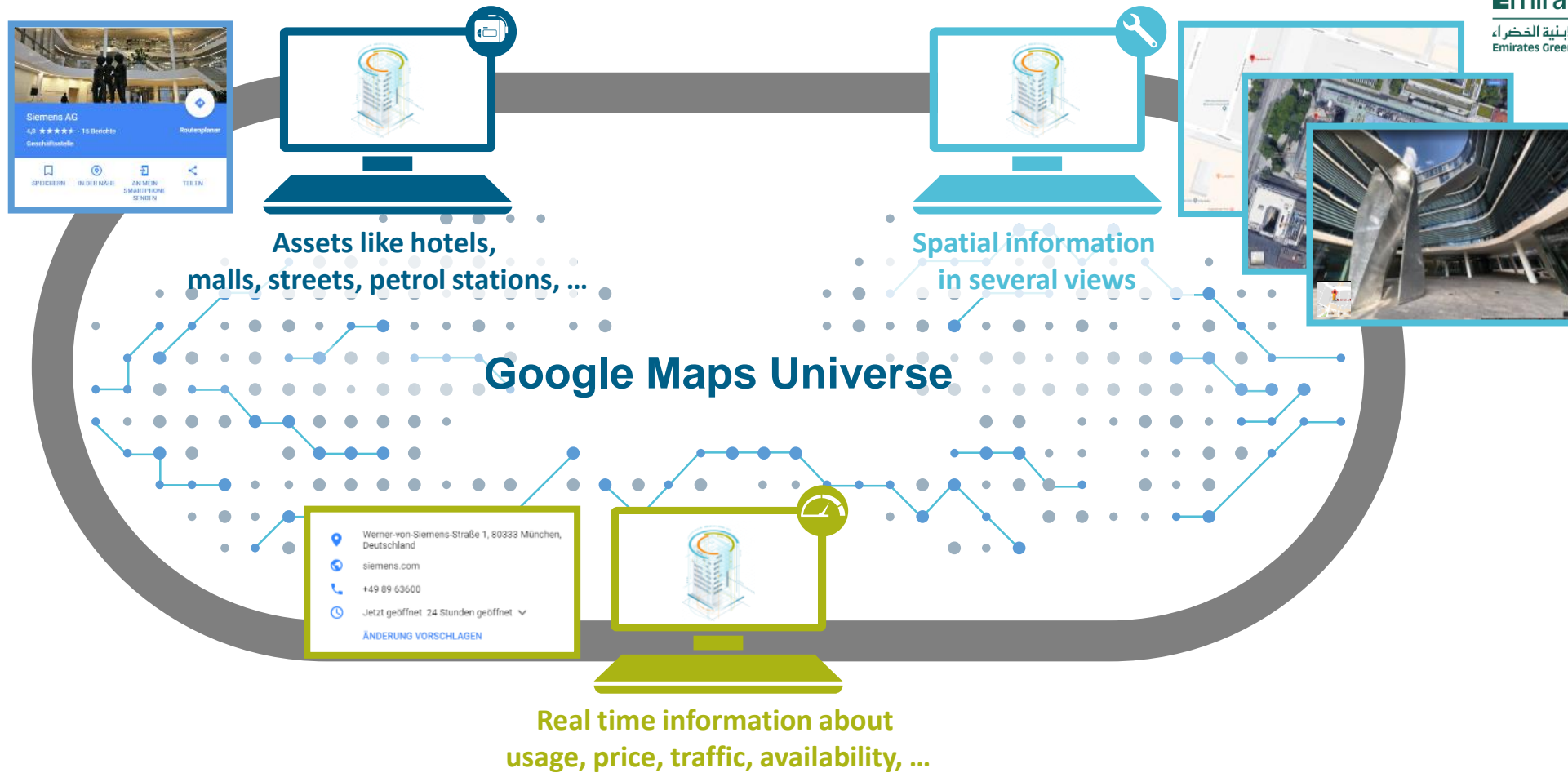
ÄNDERUNG VORSCHLAGEN



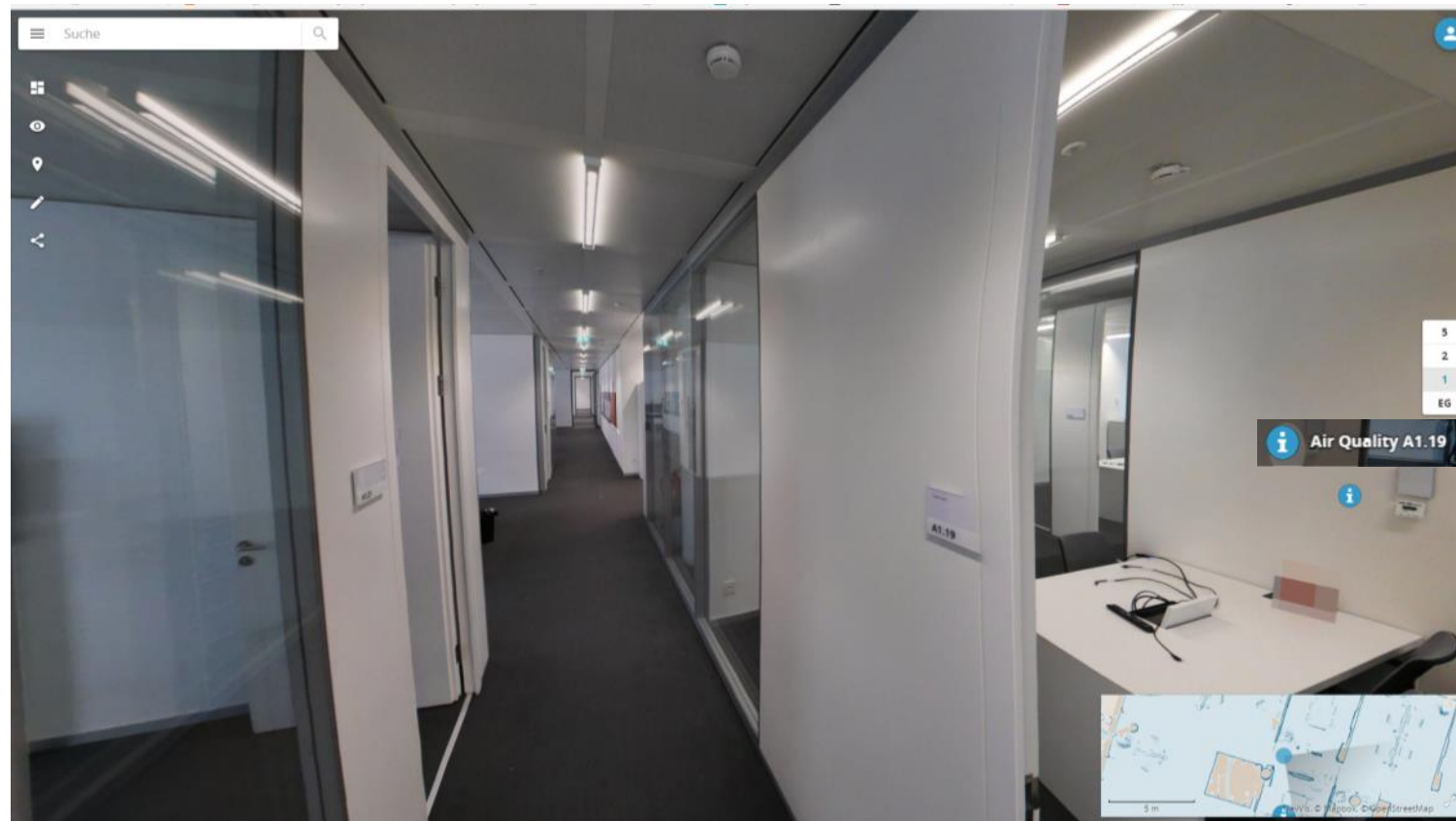
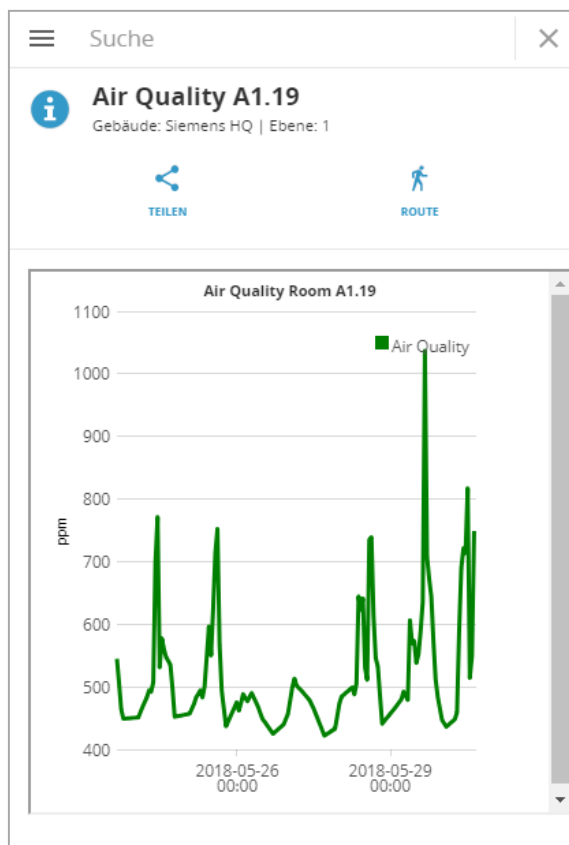
Über 59 Fotos



The Google Maps universe

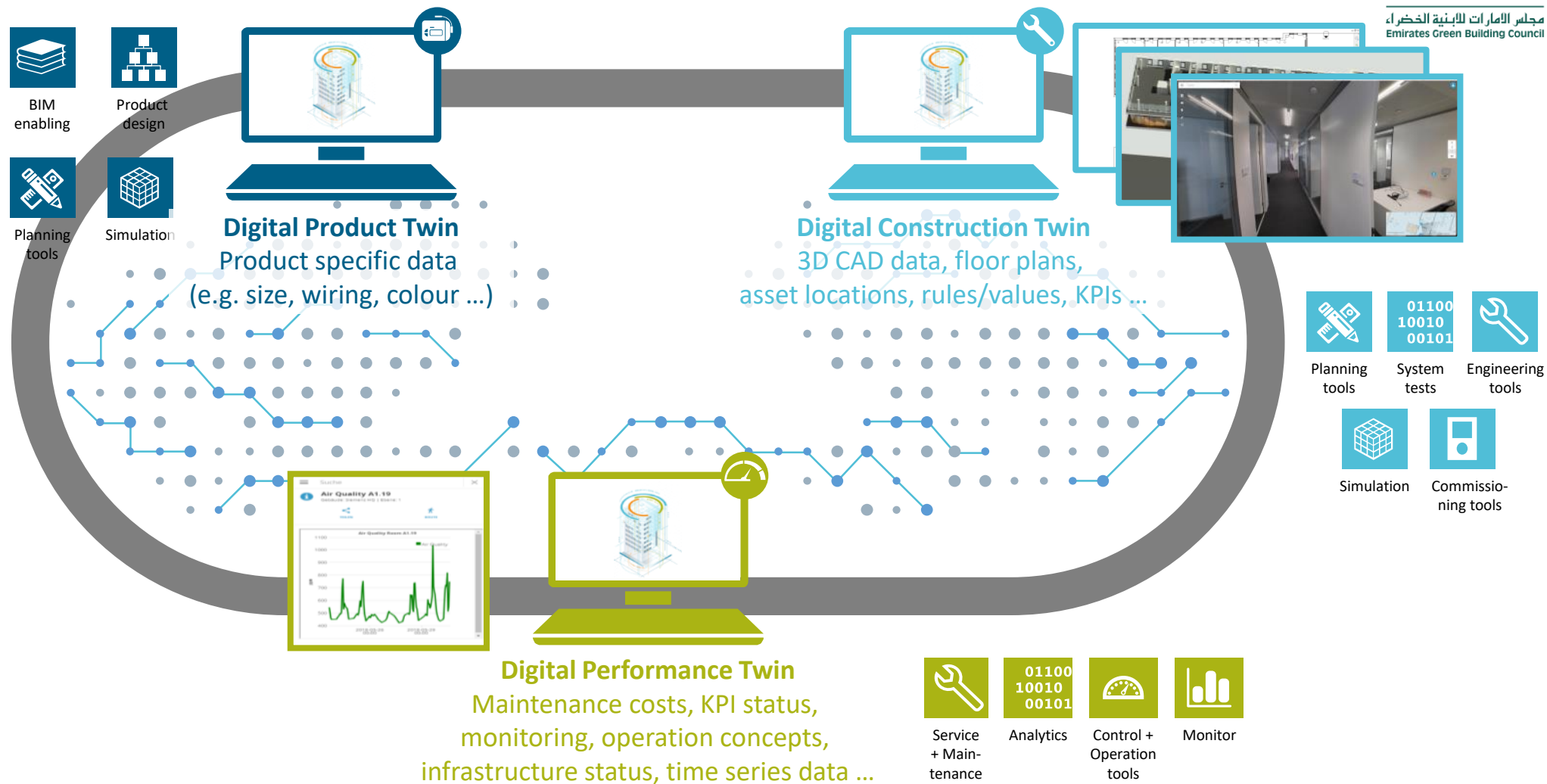


How could that look like in a building?



The “trinity” of digital twins

Centerpiece for a future solution and service business



Space utilization – impact of Digital Twin

Problem

Low efficiencies due to lack of good facility management data

Solution

Complete digital twin handed over to facility management works seamlessly in combination with other technologies like Indoor Positioning to optimize space utilization during operations

Initial floor layout

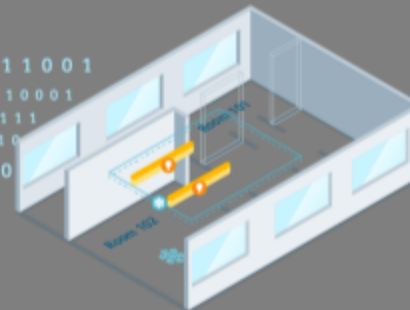


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1 0 0 1 0 0 0 1



0 0 1 1 0 1 1 0 0 1
1 0 0 1 1 1 0 0 1 0 0 0 1
1 0 1 0 0 1 1 1
0 0 1 1 1 0 0 1 0
1 0 0 1 0 0 0

Optimized floor layout



- ✓ Space utilization
- ✓ Operational excellence
- ✓ Modular design

Asset tracking – impact of Digital Twin

Problem

Medical staff spends significant time looking for hospital equipment, leading to overstocking and low employee productivity

Solution

Complete digital twin handed over to facility management works seamlessly in combination with other technologies like Indoor Positioning to track and locate assets easily

Example: hospital



- ✓ Increased staff productivity
- ✓ Asset utilization

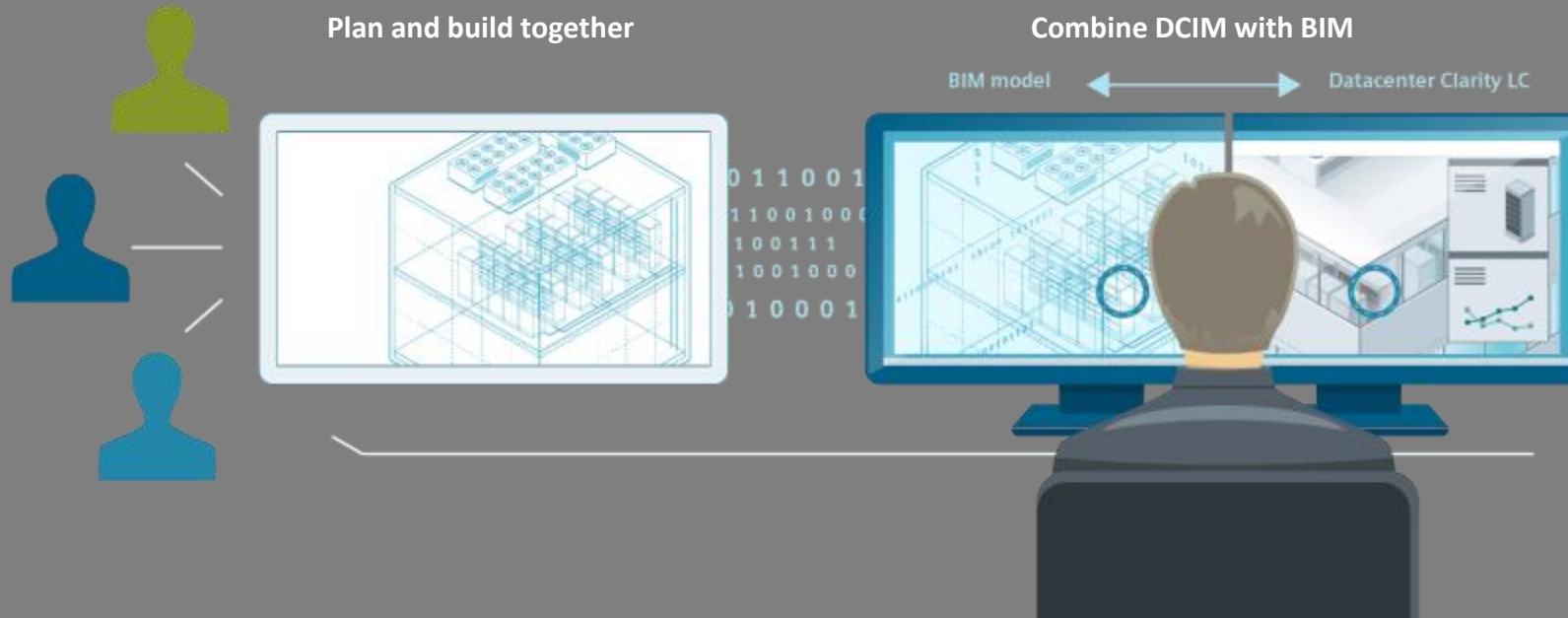
Data center – impact of Digital Twin on operations challenges

Problem

Continuously optimize building performance and achieve operational efficiency gains

Solution

Digital twin of a data center in operation delivers real-time data to link the planning and construction with the operations phase and allow seamless operations of the data center



Evacuation simulation – impact of Digital Twin on operations challenges

Problem

Inability to efficiently manage emergencies due to lack of good facility management data

Solution

Digital twin information handed over in the operations phase has the ability to simulate an evacuation at the time of an emergency



Comfort simulation – impact of Digital Twin

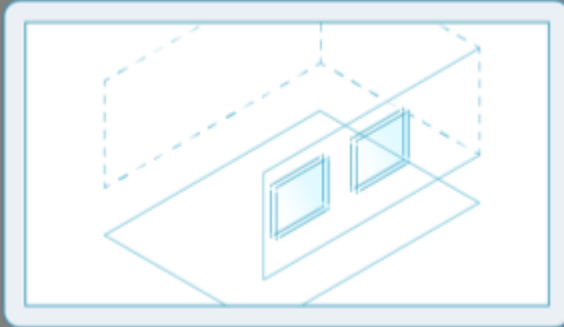
Problem

Inability to contribute positively to health and well-being of building occupants lowers the property value and makes it challenging to attract and retain talented employees

Solution

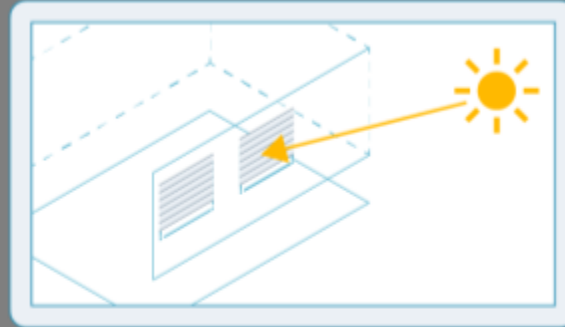
Complete digital twin enables the simulation of various conditions related to the comfort of building occupants

Comfort control 1



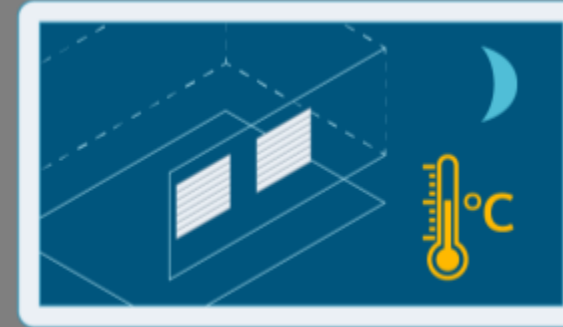
No shading

Comfort control 2



Shades and air conditioning activated

Comfort control 3



At night, when heating is needed – shades and heating activated

- ✓ Optimal comfort
- ✓ Lower energy costs

Use case: alarm detection and resolution

Problem

Having unreliable alarms requires physical inspection on site every time. No transparency. Inability to analyze all incoming information.

Solution

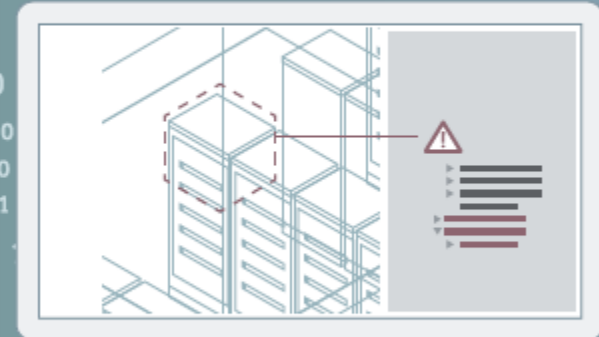
Digital twin delivers real time data that not only identifies the location of the alarm but also delivers historical performance data of the location to facilitate analysis of the situation and informed decision-making.



1 1 0 0 1
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1 0 1 0 0 1
1 1 1 0 0 1 0
1 0 0 0 1



0 1 1 0 0
1 0 0 1 1 1 0
1 0 1 0 0
0 1 1 1 0 0 1
0 1 0 0 0



Enhancing building performance through the power of data

Digital Twin today, tomorrow and beyond

How performance is enhanced through the power of data

1 Define business objectives and KPIs



Productivity

- Higher construction productivity – in time and on budget
- Lower CAPEX and OPEX
- Consistent and accessible data



Coordinated processes

- Holistic process optimization
- Reduce interfaces
- Eliminate double work



Building quality

- Increased building performance during operations
- Business efficiency and employee productivity
- Attract qualified employees and investors
- Predictive maintenance and emergency simulation during operations

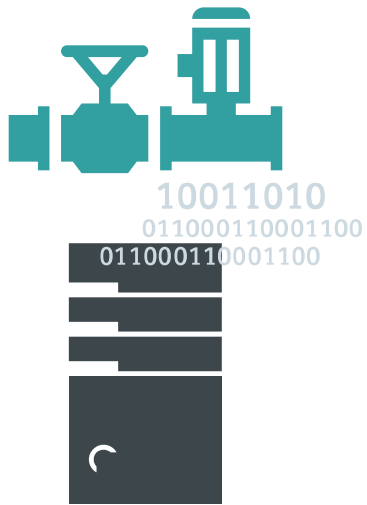


Time to market

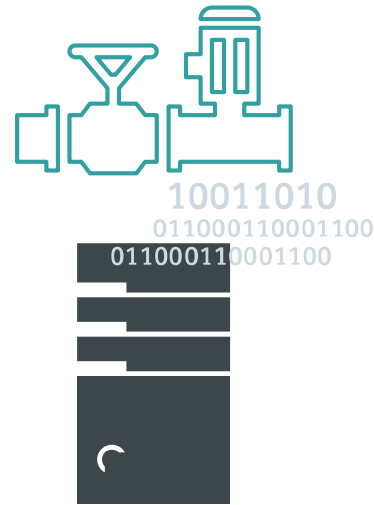
- Decreased complexities
- Coordinated planning and construction

How performance is enhanced through the power of data

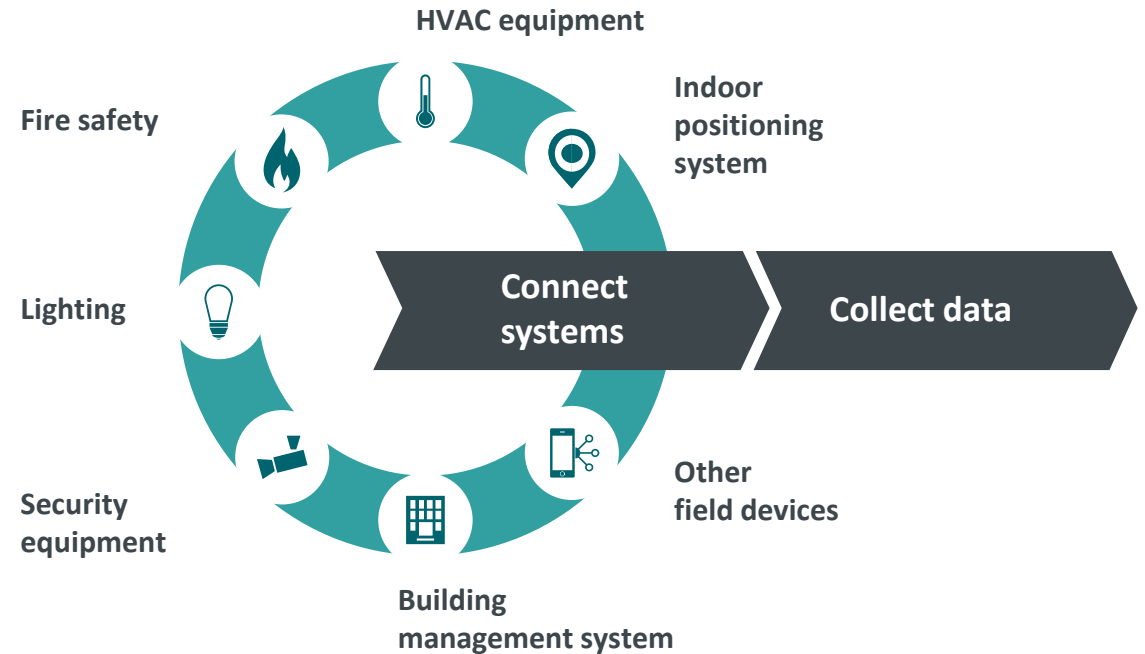
2 Connect systems and collect data



Digital product twin – static product data



Digital construction twin – static structural data



Static data

Dynamic data

How performance is enhanced through the power of data

3 Analyze data to create actionable insights



Analyze data

- Analytics, machine learning and artificial intelligence are using available data to improve processes within a building as well as user productivity
- Siemens uses static and dynamic data to improve the indoor environment
- Siemens is able to deliver analytics today through Navigator platform

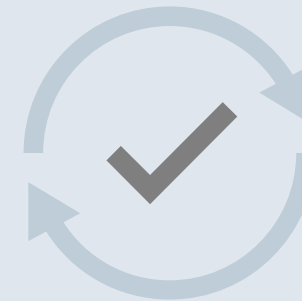


Actionable insight

- Building stakeholders can utilize valuable information to control budget, minimize risk and achieve greater efficiencies in building performance

4 Take action and continuously enhance performance

Continuously implement **improvement measures** and enhance **building lifecycle experience**

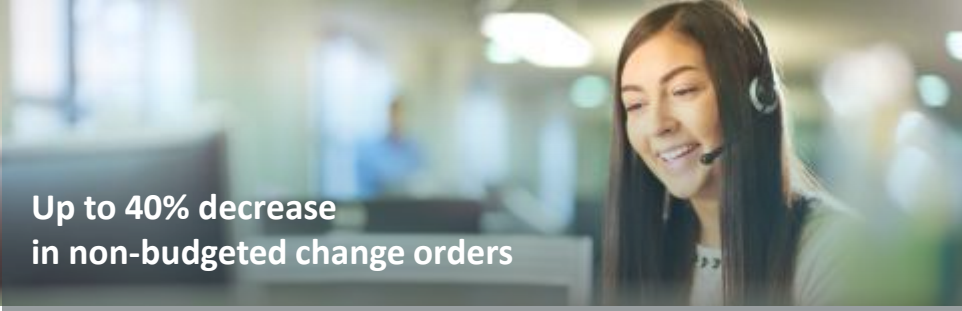


Continuously monitor and benchmark **performance** through real-time building data and feedback

How building performance is enhanced through the power of data



Productivity



Up to 40% decrease in non-budgeted change orders

Building quality



Up to 3.5% more efficient occupancy

Objectives achieved!

Coordinated processes



Operating costs lowered by up to 9%

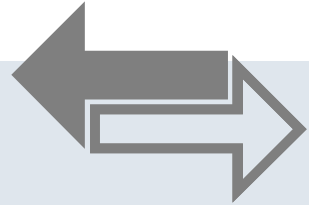
Time to market



Project timeline shorted by up to 7%

Source: CIFE, Center for Integrated Facility Engineering, Stanford University

With Digital Twin we maximize the value proposition for vertical markets



Digital modeling of the building promotes increased **transparency** while facilitating collaborative decision-making, reduced risk, shorter time to construct **and lower investment**.

Owners and investors

With **BIM consulting support** we help you **efficiently design, build and manage projects**.

The combination of static and dynamic data breaks down barriers between disciplines by enabling simulation across the project lifecycle.

Architects and planners

Allows for **flexibility** during the construction and operation phases to simulate changes to the building design and analyze the outcome of the same.

Simulation of retrofits.

Tenants

Integrating design process with construction and engineering is achieved through **simulation of a building** before and during the actual construction process.

General contractors and subcontractors

BIM data combined with real-time building data will enhance **predictive data analytics over the building lifecycle**.

This allows you to achieve significant gains around **productivity, efficiency, reliability and overall quality**.

Facility managers and operators

Digitization in Buildings

Smart Offices and Workplace Trends

Office buildings are changing in tandem with work and work styles



Coworking and flexible workplaces²

Over **60%** of employees say access to external coworking spaces has a positive or a very positive impact on their engagement and productivity at work.

Dynamic workforce¹

60% of the workforce switches employers every 4 years.

Digital drive³

85% of executives report they will invest extensively in AI-related technologies over the next three years.

Growing digital infrastructure⁴

CAGR **78.8%** is the worldwide growth potential of IoT sensor deployments for CRE (2015 – 20).

Adaptive organization⁵

98% of companies report that “agility and collaboration” are critical to their organization’s success, yet only 6% say that they are “highly agile” today.

¹ Source: Accenture, M. Smit (2017) Trends in the workforce changing attitudes, new opportunities, ² Source: JLL (2017) Workplace powered by human experience, ³ Source: Accenture (2017) Technology vision, ⁴ Source: Deloitte (2017) The internet of things in the CRE industry, ⁵ Source: Deloitte (2017) Global human capital trends

A more mobile and digital workforce

needs flexibility that promotes work-life balance

The average knowledge worker is at their desk only 40% of the time.

Between 20% and 30% of the working population is already working in the on-demand or gig economy.

Source: JLL – Occupancy benchmarking guide 2018 – 2019

Source: McKinsey (2016) *Independent work: choice, necessity and the gig economy*

Choice, flexibility, and collaborative working

are becoming key considerations in workplace design

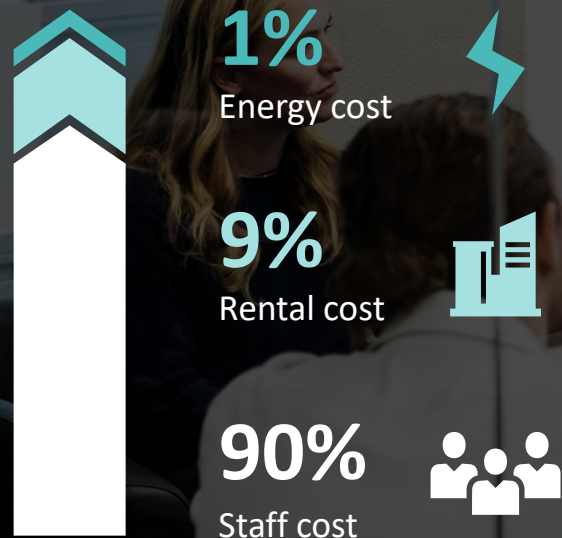
80% of all work is collaborative

Business success will depend upon effectively creating and working with collaborative communities that include customers, suppliers and business partners.

Tenant

Business outcomes for corporate real estate

Typical business operating costs¹



Energy efficiency and sustainability



Efficient facility management – lower OPEX



Business growth



Increased productivity of employees, including health and well-being



Demonstrate image of uniqueness and corporate social responsibility – attract and retain talent



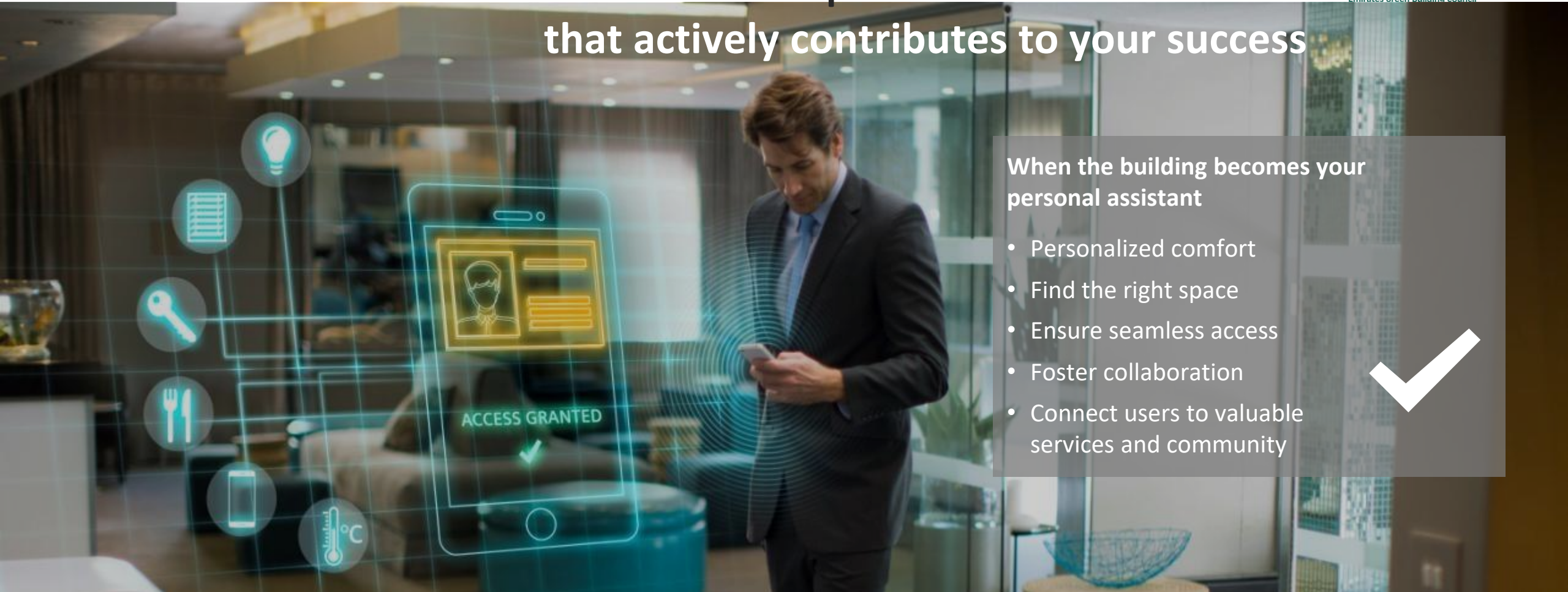
Safe and secure workplace

¹ A 10% variation applied equally to each cost has an impact that is far from equal
 Source: World Green Building Council – Health, well-being & productivity in Offices, 2014

Smart Office is the future workplace that actively contributes to your success

When the building becomes your personal assistant

- Personalized comfort
- Find the right space
- Ensure seamless access
- Foster collaboration
- Connect users to valuable services and community



What could this look like

for the employee or guest?

“Hi Dad! Give me one sec, I need to find a room!”

Allow for work and life to happen



The Pilates class has been moved to Building C. It will take 10 mins to walk. Might want to leave soon!

Events and Community

“I need 2 hours of focused work, where can I do that?”

Find the right space for your activity



“Let’s see if Danny is around today, we need to catch up, and I need a coffee!”

Find a colleague/share location

“I love that the building knows what makes me comfortable and prepares my space!”

Personalized comfort



“At the end of the day I need to feel I have been productive at work.”

Personal dashboards

No need to carry a badge everywhere or wait for guest pass to be issued.

Keyless access/guest solution



“Is this another fire alarm test?” When the emergency is real, I get a personalized exit route.

Location-aware alerting



How does it create opportunities

for building and facility managers?

The modular approach allowed us to deploy the right tools across our diverse and ever-changing portfolio of offices.



“People can quickly find the space they need, so we have been able to increase room utilization and accommodate more employees in our existing spaces!”

Room booking and space optimization

“Our site managers are now spending more time with the occupants and organizing events with the local community.”

Community and events



Enhanced visibility across technologies drives further energy saving opportunities and space efficiency.

“We don’t waste time on the reporting anymore!”

Building insights dashboards

The building tells us when something is off so we have been able to reduce the frequency of maintenance and breakdowns!

Fault detection and diagnostics



“Occupants are reporting more issues and happy to see them resolved quicker.”

Feedback and ticketing platform

This app enhances the guest experience but also frees up our time to focus on important issues.

Keyless access/guest management



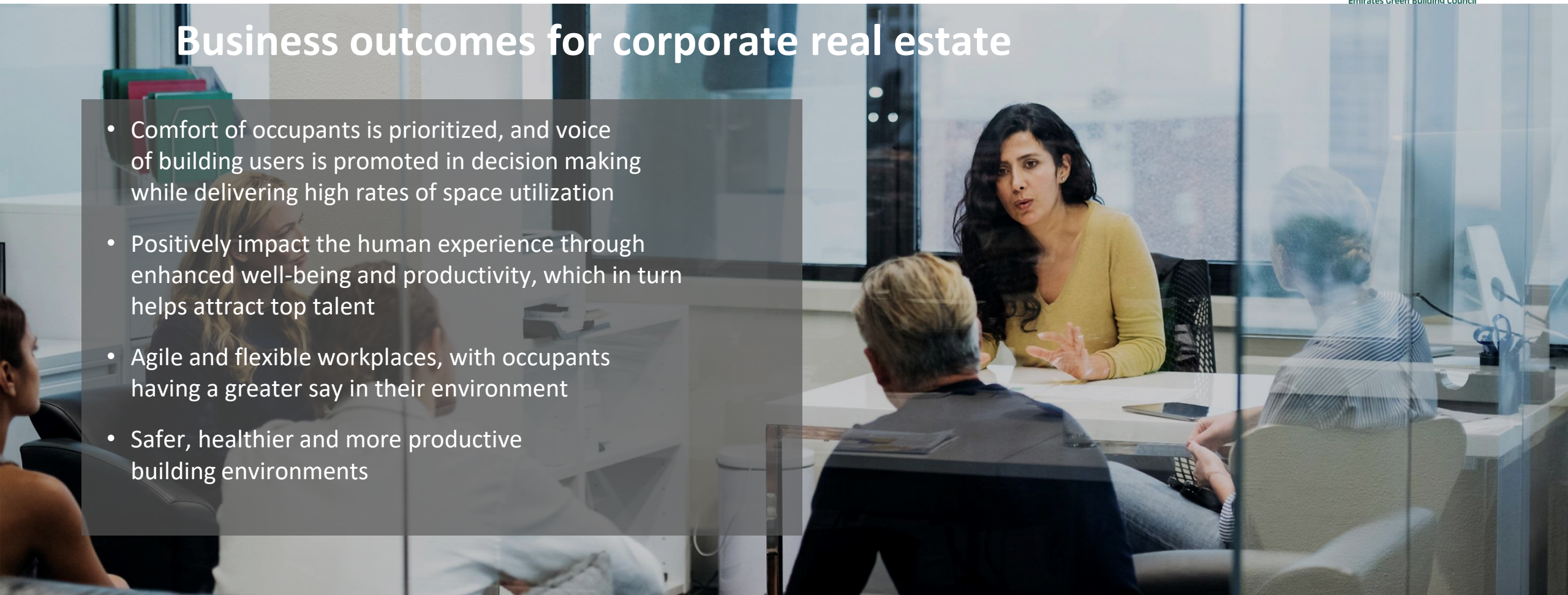
“Our ability to communicate effectively with all building users is a game-changer in case of rare but critical incidents.”

Mass/customized alerting

Tenant

Business outcomes for corporate real estate

- Comfort of occupants is prioritized, and voice of building users is promoted in decision making while delivering high rates of space utilization
- Positively impact the human experience through enhanced well-being and productivity, which in turn helps attract top talent
- Agile and flexible workplaces, with occupants having a greater say in their environment
- Safer, healthier and more productive building environments



Digitization in Buildings

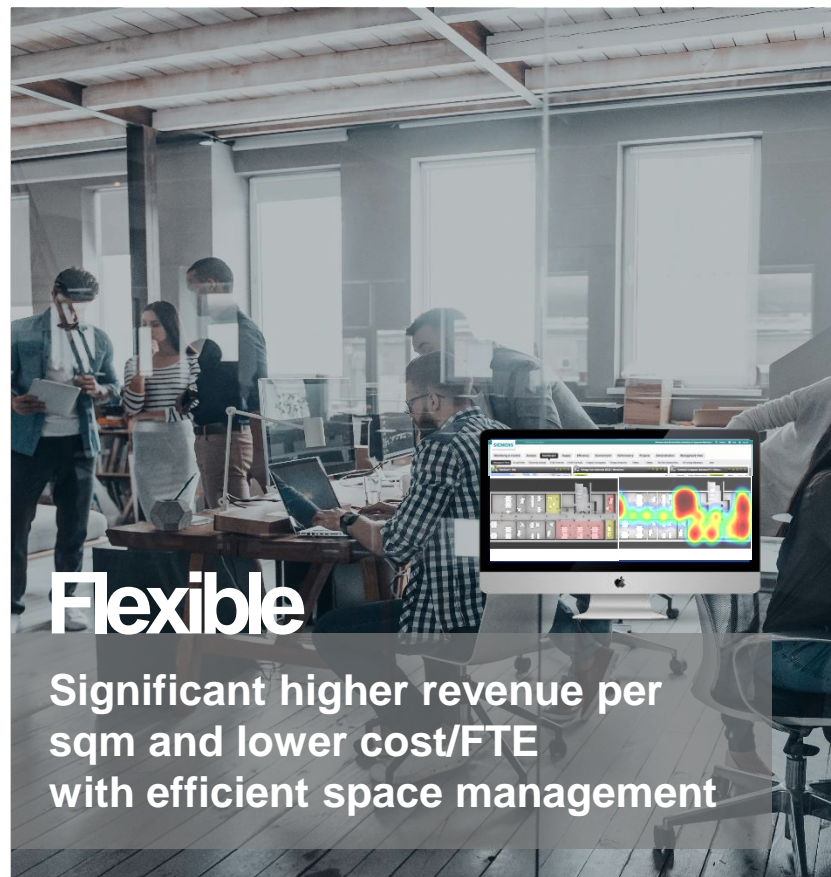
How does Smart Office deliver value?

User-centric, flexible and sustainable office creates value



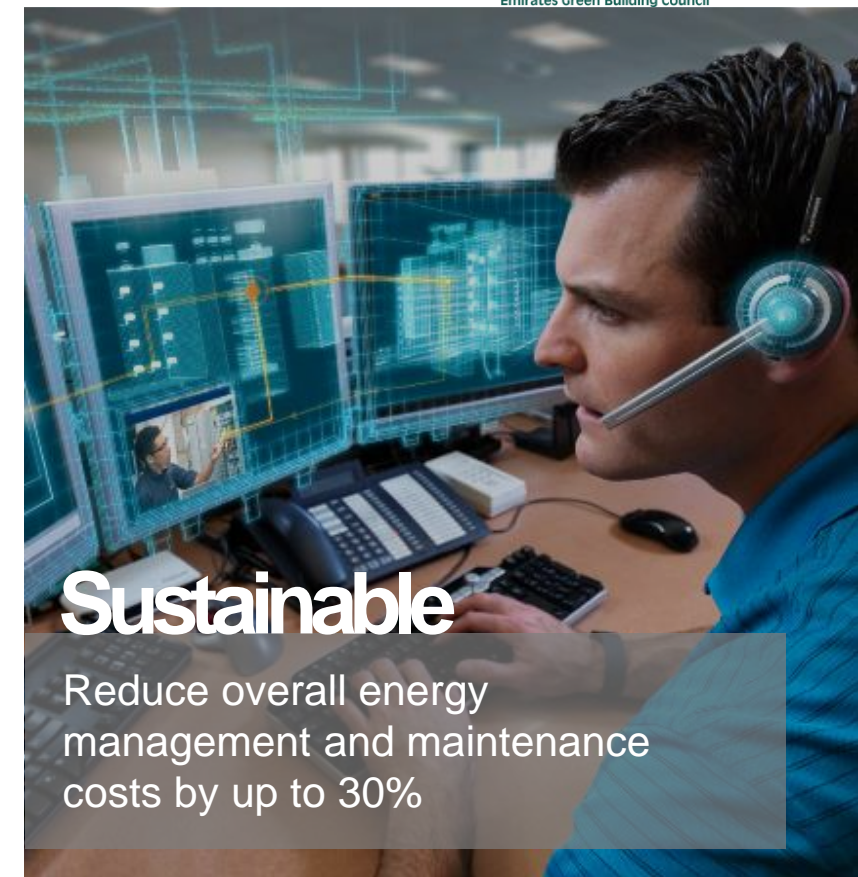
User-centric

Increase employee productivity by up to 9%¹



Flexible

Significant higher revenue per sqm and lower cost/FTE with efficient space management



Sustainable

Reduce overall energy management and maintenance costs by up to 30%

¹ STOK: The financial case for high-performance buildings

User-centric

Innovation is critical to business performance while employee retention has a direct impact on costs.

Q: How are you changing your workspace to promote innovation and influence your retention rate?

Personalized workplace experience

Innovation, creativity and retention

Adaptive environment contributing to health and well-being

Creating communities by connecting people and spaces

Safe and secure workplace



97%

of large companies stated that open innovation is important or critical to higher levels of future business performance.¹

2.83%

increase in annual profit due to increased employee retention of **5%** in high-performance buildings.²

81%

of occupants report that smart buildings improve employee retention.²

Source: 1. Accenture (2017) Building a Digital Ecosystem: Collaborate for Growth, 2. STOK: The financial case for high-performance buildings

Flexible

Rapid growth of coworking and the shift toward on-demand consumption of spaces is driving a massive demand for commercial leases with shorter duration.²

The average life expectancy of a company from birth to death is only 7.3 years¹, and 52% of the year 2000's Fortune 500 firms are no longer listed.¹

Q: How will you (commercial real estate industry) adapt to the fact that your tenants may not survive as long as the leases they sign?

Workplace becomes the key asset

Flexibility – future proofing

Space efficiency with new ways of working

Real estate asset efficiency



Up to
80%

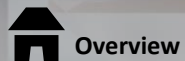
of corporations considered “improving our real estate portfolio management” and “improving our capital planning processes” as one of their top ten 2019 priorities.¹

1 year

will be the average lease term of commercial office spaces by 2030.¹

Source: 1. Verdantix global survey 2018
2. Convene

Sustainable



Optimizing energy costs becomes more and more important in order to increase competitiveness. With a local energy solution, it's also possible to reduce grid fees and to create additional revenue by selling surplus energy to the energy market.

Q: How has your energy consumption been impacting your financial performance? How can your energy strategy improve your competitiveness?

Minimized environmental impact

Optimized resource and energy efficiency

Improved financial performance with a sustainable design

Building asset performance



Up to

40%

of all energy is consumed by buildings.¹

Up to

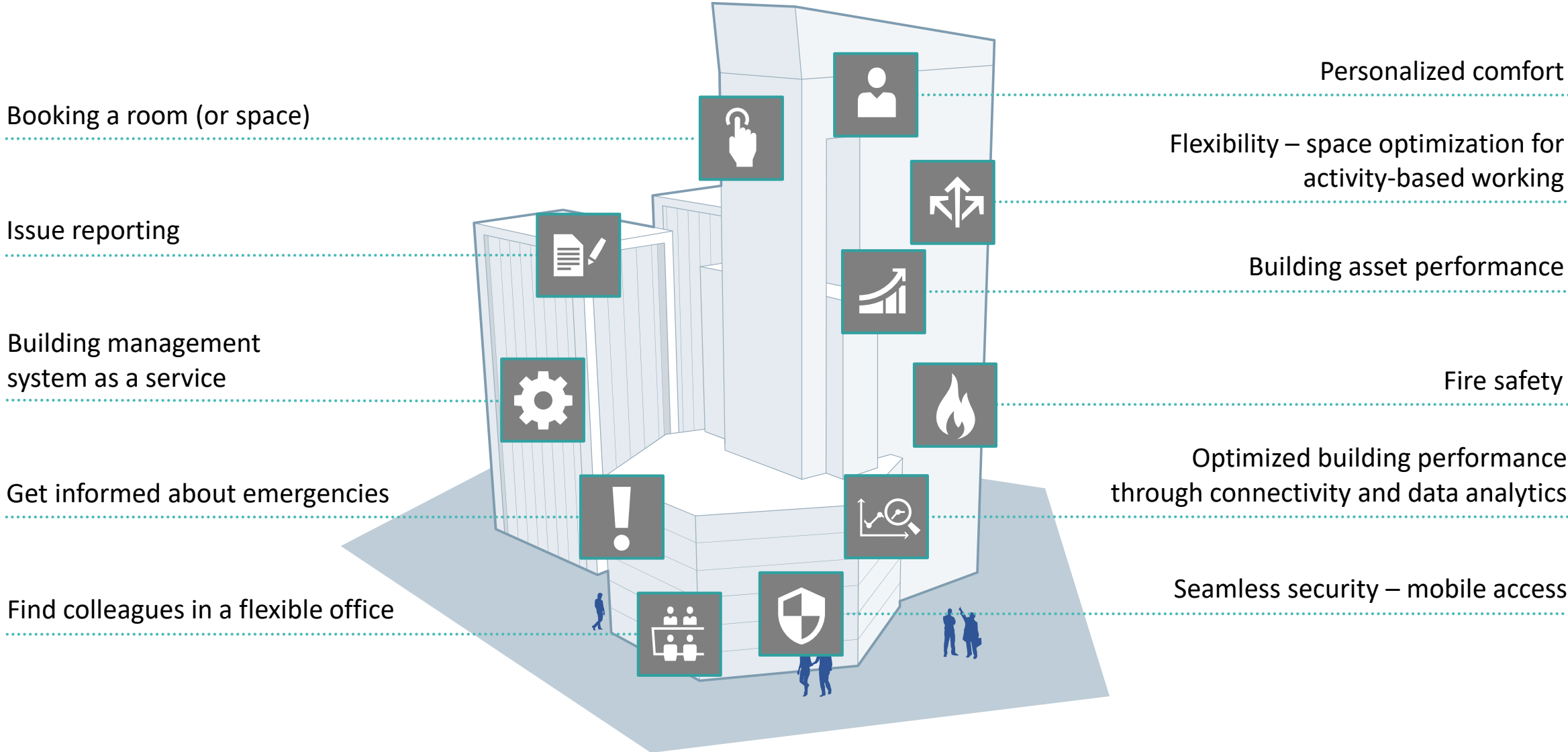
57%

increase in electricity demand globally by 2050²

Source: 1. CommScope/IDC Energy Insights

2. [Bloomberg](#)

Smart Office in action



Thank You