EmiratesGBC Technical Workshop

DIGITALIZATION
IN THE BUILDING INDUSTRY

Digital Twin & Smart Offices

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Challenges of the construction industry

-Global Trends
Planning and construction phases – stakeholder challenges

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

“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.”

“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.”

Owners

Planners

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?

Source: Statistische Bundesamt, Fachserie 18, Reihe 1.5, 2013; Volkswirtschaftliche Gesamtrechnungen
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

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

Source: CMAA Owners Survey, CMAA Industry Report, Economist Magazine
Market/customer demands are changing ... 

- Flexibility
- Time to market
- Customized solution
- Mitigate risk - quality, time, cost
- Flexible design and use of assets

... 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.
BIM is synonymous with digitalization in the construction industry
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.

Digital twin is the basis for physical construction

Structured information flow across building lifecycle
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

Data sheets → 3D planning → Digital twin

- Interdependency
- Interactions
- Geometry
- Classes
- Attributes
- Relations
- ...
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?

Virtual build phase
Physical construction phase
Operation
Operation
Plan
Construction
Ideas
Rebuild

BIM
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.
The BIM process – BIM prevents information loss

Typical construction project
- Loss of information at interfaces
  - Loss of time
  - Additional cost
  - Inconsistencies in quality

BIM-enabled project
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?”

**Engineer/consultant**

**Planner**

- 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)

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

Future
Integrating products from multiple suppliers in multiple disciplines

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

Prefabication 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
The Google Maps universe

Assets like hotels, malls, streets, petrol stations, ...

Spatial information in several views

Real time information about usage, price, traffic, availability, ...

Google Maps Universe
How could that look like in a building?
The “trinity” of digital twins
Centerpiece for a future solution and service business

Digital Product Twin
Product specific data (e.g. size, wiring, colour ...)

Digital Construction Twin
3D CAD data, floor plans, asset locations, rules/values, KPIs ...

Digital Performance Twin
Maintenance costs, KPI status, monitoring, operation concepts, infrastructure status, time series data ...
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

- Space utilization
- Operational excellence
- Modular design

Initial floor layout → Optimized floor layout

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.

Plan and build together
Combine DCIM with BIM
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

- Building is more secure
- Building permit is received faster
- Building operation starts faster
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.
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

Dynamic data

Static data

Connect systems

Collect data

HVAC equipment

Building management system

Indoor positioning system

Other field devices

Fire safety

Lighting

Security equipment
How performance is enhanced through the power of data

3 Analyze data to create actionable insights

- 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

4 Take action and continuously enhance performance

Analyzable insight

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

Continuously implement improvement measures and enhance building lifecycle experience

Performance

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

**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.

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.

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.

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

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

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

Owners and investors

Architects and planners

Tenants

General contractors and subcontractors

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 workplaces
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 workforce
60% of the workforce switches employers every 4 years.

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

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

Adaptive organization
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.

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
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.

Source: JLL – Occupancy benchmarking guide 2018 – 2019
Tenant

Business outcomes for corporate real estate

<table>
<thead>
<tr>
<th>Typical business operating costs¹</th>
<th>Energy efficiency and sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% Energy cost</td>
<td>Efficient facility management – lower OPEX</td>
</tr>
<tr>
<td>9% Rental cost</td>
<td>Business growth</td>
</tr>
<tr>
<td>90% Staff cost</td>
<td>Increased productivity of employees, including health and well-being</td>
</tr>
<tr>
<td></td>
<td>Demonstrate image of uniqueness and corporate social responsibility – attract and retain talent</td>
</tr>
<tr>
<td></td>
<td>Safe and secure workplace</td>
</tr>
</tbody>
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¹ A 10% variation applied equally to each cost has an impact that is far from equal
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

“I need 2 hours of focused work, where can I do that?”
Find the right space for your activity

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

No need to carry a badge everywhere or wait for guest pass to be issued.
Keyless access/guest solution

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

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

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

“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.

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

Community and events

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

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

Keyless access/guest management

“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

Enhanced visibility across technologies drives further energy saving opportunities and space efficiency. “We don’t waste time on the reporting anymore!”

Building insights dashboards

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

Feedback and ticketing platform

“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
- Safe and secure workplace
- Creating communities by connecting people and spaces

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.³

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 years\(^1\), 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?

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
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

2. Bloomberg
Smart Office in action

- Booking a room (or space)
- Issue reporting
- Building management system as a service
- Get informed about emergencies
- Find colleagues in a flexible office

Features:
- Personalized comfort
- Flexibility – space optimization for activity-based working
- Building asset performance
- Fire safety
- Optimized building performance through connectivity and data analytics
- Seamless security – mobile access
Thank You