BIM and Digital Twin: Roadmap and Maturity Levels

BIM	Digital Twin Roadmap	Digital Twin Maturity Levels

Technology

Applications

Maturity Levels

Digital asset information management through BIM:

- Design collaboration and coordination
- Project management
- Document management
- Cost management
- Planning: Quality and Safety

- Autonomous Operations
- Interactive Immersive Experiences

- What-if Simulation
- Asset Optimization

- Predictive Maintenance
- Asset Performance Management

- Real-time Data Analytics
- Remote Diagnostics

- Data Orchestration (Common Data Environment)

Decision Automation, Gamification, AR/VR

AI/ML

Data Science Techniques

Data Analytics

Cognitive Twin
Autonomous Actions and Interventions

Prescriptive Twin
Prescriptive Analytics

Predictive Twin
Real-time Performance Monitoring and Prediction

Informative Twin
Insight Derivation through Data Analysis

Descriptive Twin
Real-time Data Aggregation, Storage, and Management

Data Collection Sources

Including IoT sensors, actuators, BMSs, CMMSs, and SCADA systems

BMS: Building management system; CMMS: Computerized maintenance management system; SCADA: Supervisory control and data acquisition

Source: Frost & Sullivan

SIEMENS

Lifecycle TWIN
Enabling the creation of digital twins

Common Data
Environment (CDE)

Data Integration
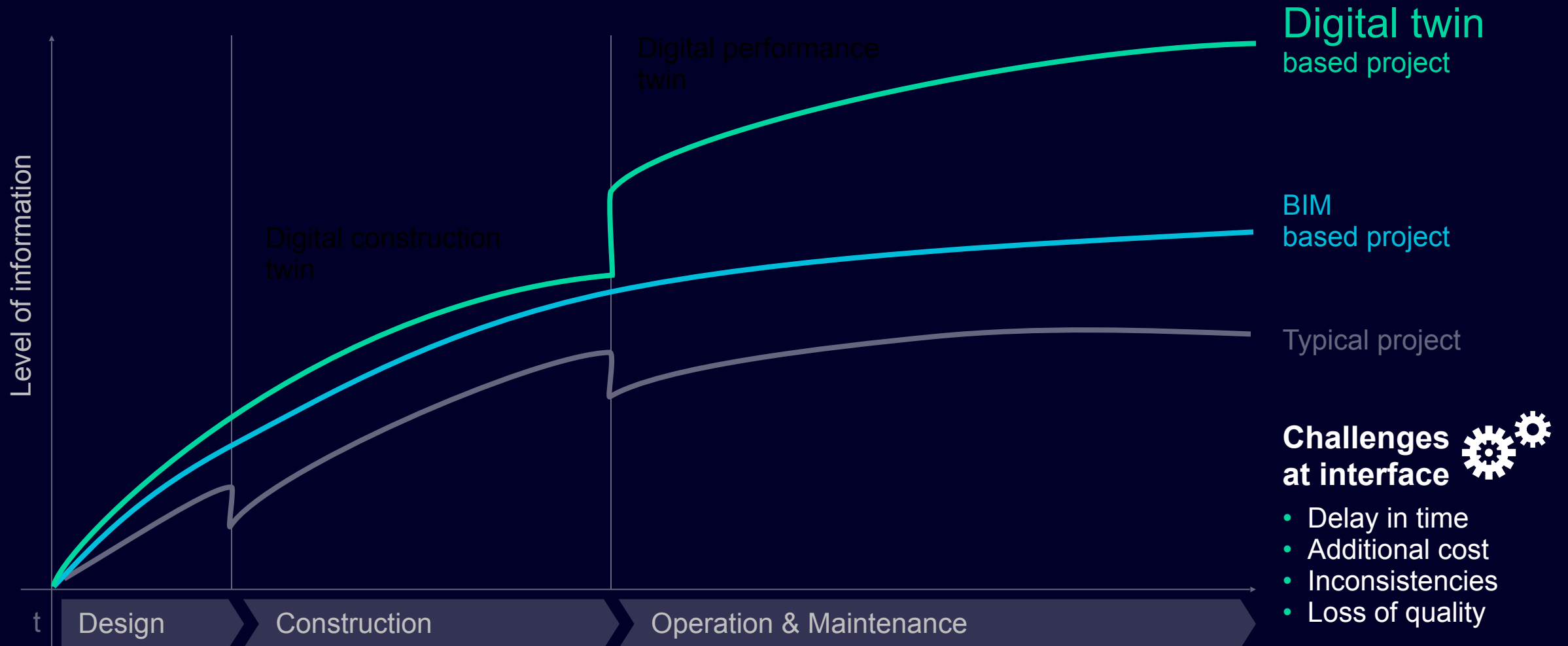Platform

Lifecycle
Twin

SIEMENS

What is BIM?

+

Start with the end in mind

bsi BIM Software KITEMARK™

Information Management framework

SIEMENS

Digital performance twin

Digital twin
based project

BIM
based project

Digital construction twin

Typical project

Level of information

Challenges at interface

- Delay in time
- Additional cost
- Inconsistencies
- Loss of quality

t | Design | Construction | Operation & Maintenance

SIEMENS

Data center owner/investor

Demonstrating the value of BIM

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

SIEMENS

Construction Data Management Issues and Consequences

Wrong Processes:
Most modelers disregard BIM authoring tools' capabilities and produce good looking 3D models that are <u>not information models</u>, and do not provide much value to facility owners.

Lack of Responsibility:
Without Information Managers the quality of data is not guaranteed. Data providers are not held accountable for their quality of work which often results in missing data.

Wrong Tools:
Inexperienced providers, or those not incentivized by owners, try to use free tools and manual labor, resulting in higher total costs, poor data quality, and issues with data updates

No Requirements:
When facility owners do not specify asset types, attributes, documents, etc. as contractual requirements, their providers do not know how to price the job, and most of the time provide very little <u>useful </u>information.

Schedule Delays:
When data validation milestones are not defined, all activities are pushed to the final stages of the contract, and often it is too late to find missing information, and the handover is delayed by months.

01

02

03

04

05

SIEMENS

Resilience | Prefabricated Power Skids
Remotely made ready for operation with BIM
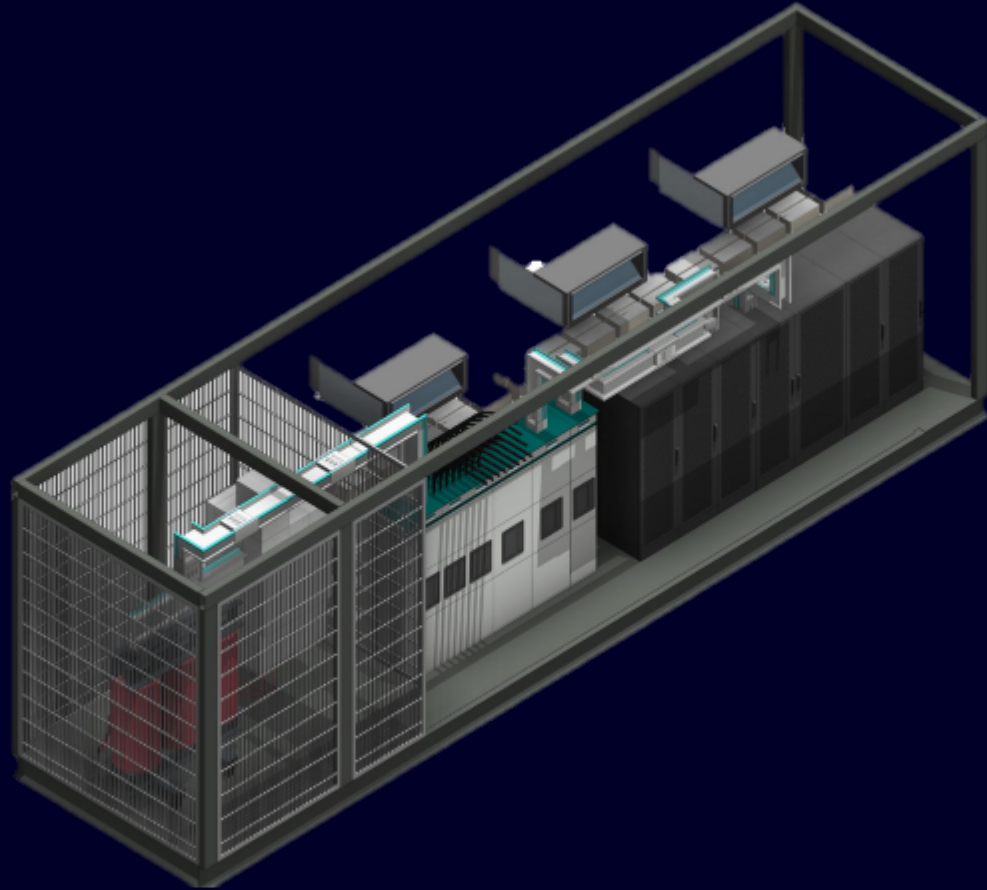
Plug & play energy

units for data centers

•# Optimized

•design for minimal footprint

•# Native BIM

•Including third-party products

SIEMENS

# Prefabrication made much simpler with BIM, deliver every Project on time and on budget every time

Problem

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

Solution from Siemens

Digital twin delivers real-time data on capacity usage.
This allows for modular data centers where assets in the form of pre-engineered modules can be added when additional data capacity is needed.

Construction can be streamlined and Onsite Tasks streamlined with Site Verification, Survey and Contractor collaboration.
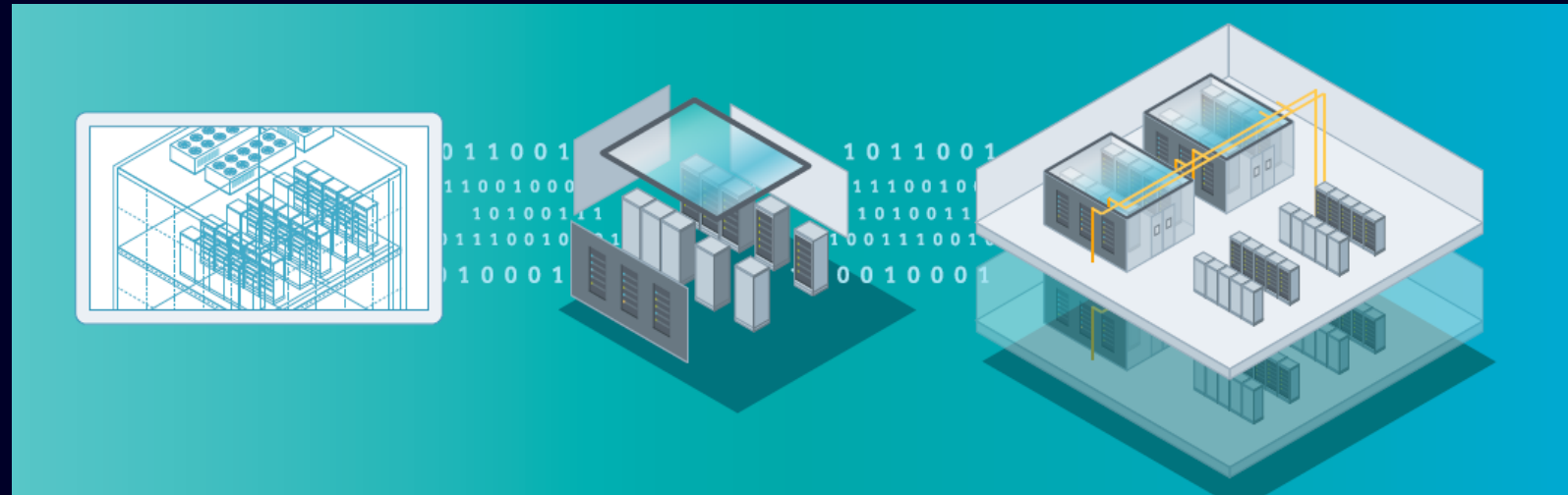
Modular prefabricated Solutions.

- Deliver the same way every time.
- Have Turnkey Operational Digital TWIN ready to go.
- Cloud allows remote operations and Predictive Simulation.

SIEMENS

Driving digital evolution during design and construction
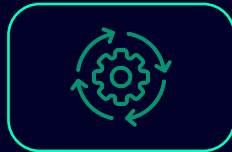
Documents are stored in one location with workflow, security, version control, and links to assets and spaces

All asset data is stored in Lifecycle TWIN from day one
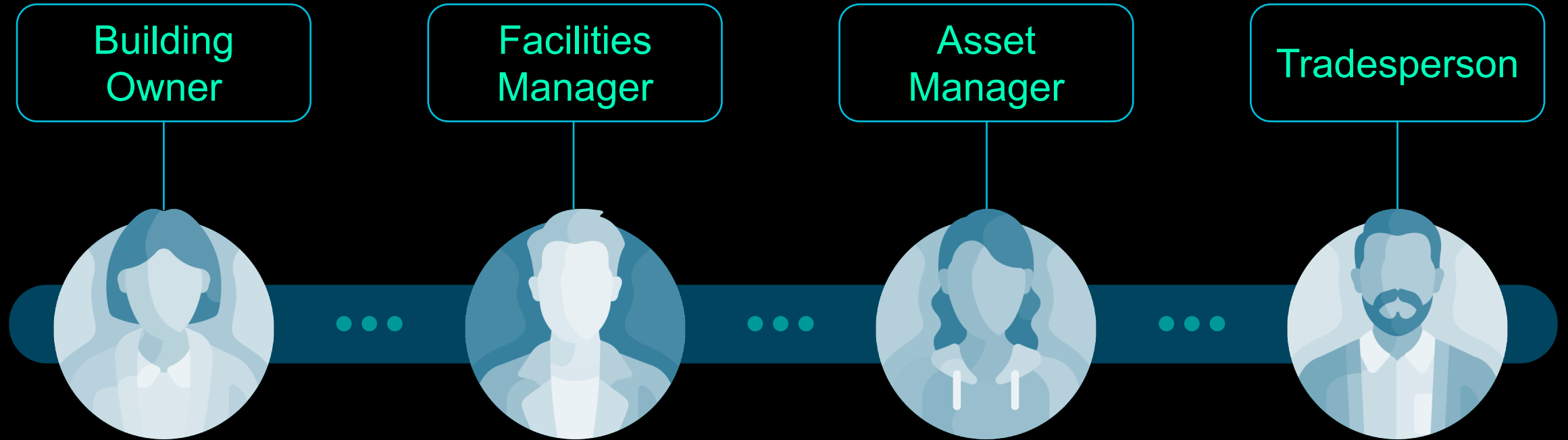
Test scripts / commissioning are completed via iPad

Tasks are assigned with a full workflow and record tracking

Data is validated against handover requirements

SIEMENS

Operations

Building Owner	Facilities Manager	Asset Manager	Tradesperson

Full transparency of facility

Access information efficiently and leverage for decision making, produce reports and evidence trail quickly

Easily identify assets to replace or overhaul based on performance, ensure critical asset uptime

Reduce administration, information at fingertips in the field

SIEMENS

Facilities management overview

CMMS (Maintenance)
- Work Orders (preventative / Reactive)
- Asset Register

EDMS (Documents)
- O&Ms, As-builts, mgmt. reports
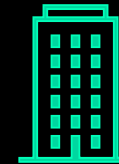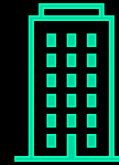- Service reports, Compliance documents

Lifecycle Forecasting
- Asset register, capital replacements and overhauls, condition assessments

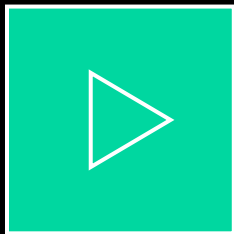**Operational Tech**
- BMS, CCTV, Access Control, IoT

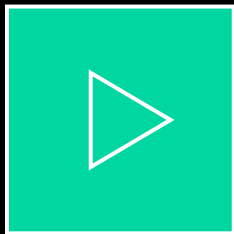Often a portfolio of buildings have different systems

SIEMENS

A single pane of glass intersects information siloes
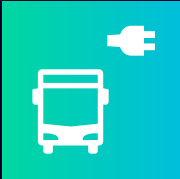
Lifecycle Digital Twin in Operations

BIM and IOT, BMS Integration

Rapid Deployment
Siemens Prefab Modular Solutions

Mobile
Substations

E-House
& Kiosks

Skids

SIEMENS

Siemens Prefab Power Supplies
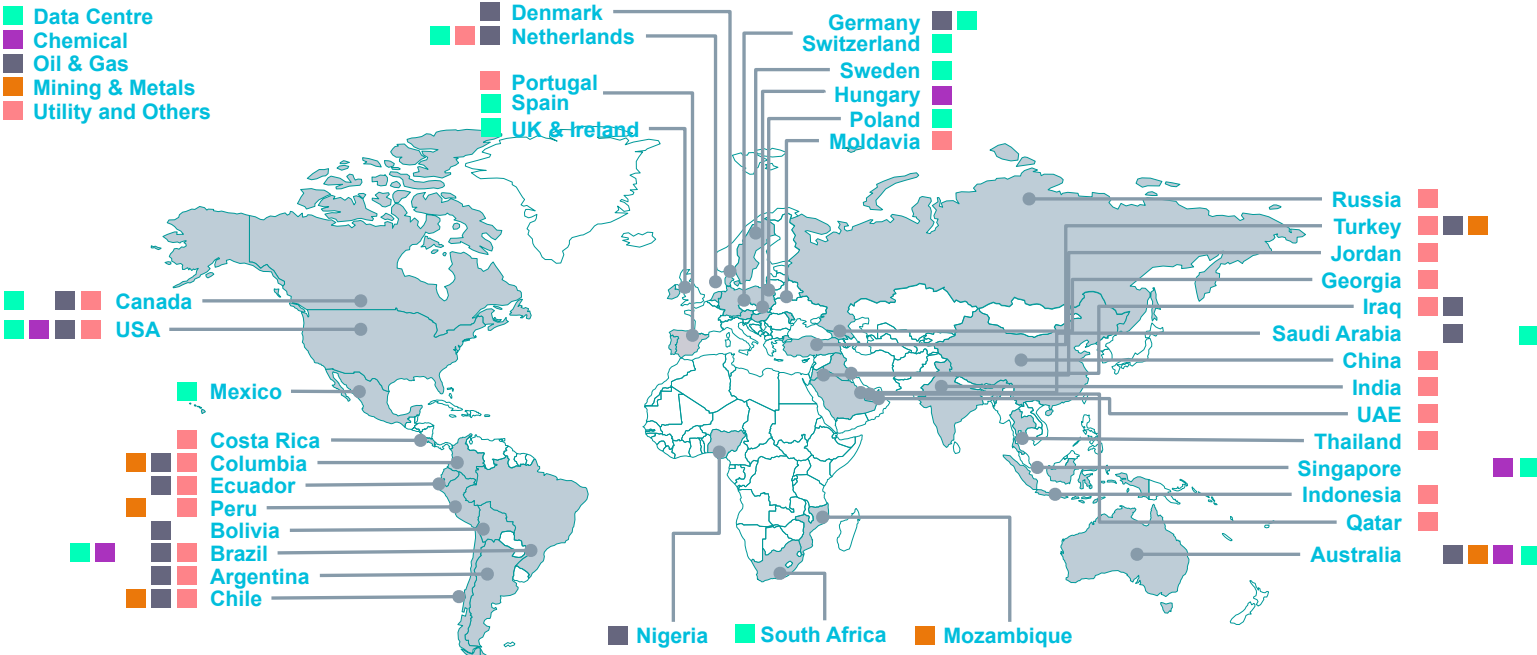## On-Shore Portfolio and world map of references

Siemens applies prefabricated solutions in many industries/verticals since decades.

Own in house engineering tool available and specially skilled employees in center of competence (CoC) organization.

Expertise ranging from simple solutions to large complex multi module and multi stack solutions.

Existing own Siemens yard and large global network of partner yards available.

Experience in delivering both one-off solutions and large scale assembly line programs.

Data Centre
Chemical
Oil & Gas
Mining & Metals
Utility and Others

Denmark
Netherlands
Portugal
Spain
UK & Ireland
Germany
Switzerland
Sweden
Hungary
Poland
Moldavia

Canada
USA
Mexico
Costa Rica
Columbia
Ecuador
Peru
Bolivia
Brazil
Argentina
Chile

Russia
Turkey
Jordan
Georgia
Iraq
Saudi Arabia
China
India
UAE
Thailand
Singapore
Indonesia
Qatar
Australia

Nigeria
South Africa
Mozambique

SIEMENS

Prefab Power Supply Modules
More than 50 years of excellence

50+ years ago

E-House Business started

2015

First **Skid** reference in Data Center market with Digital Reality

Capex driven

2020

Discipline overlapping **Skid** design for Hyperscale Data Center

2022

Standardized discipline overlapping **Power Modul** 2 MW IT-load Skid or E-House

Execution time driven

End of 80s

Mobile substation

Total cost of owner-ship approach

2018

Kiosks for Colocation Data Center

Economic and optimized project realization

2021

Discipline overlapping **E-House** design for Hyperscale Data Center

SIEMENS

Newest development of discipline overlapping prefabricated modular skid or E-House design


Integrated
solution of ...

- Dry type transformer
- MV Switchgear
- LV Switchgear
- Redundant UPS system (non Siemens)
- Battery racks (non Siemens)
- Power monitoring system and Control cabinets, Generator control panel
- Bus Way systems, All electrical main power DC cabling, All control circuits
- Fire detection and fire extinguishing
- Cooling system (non Siemens)
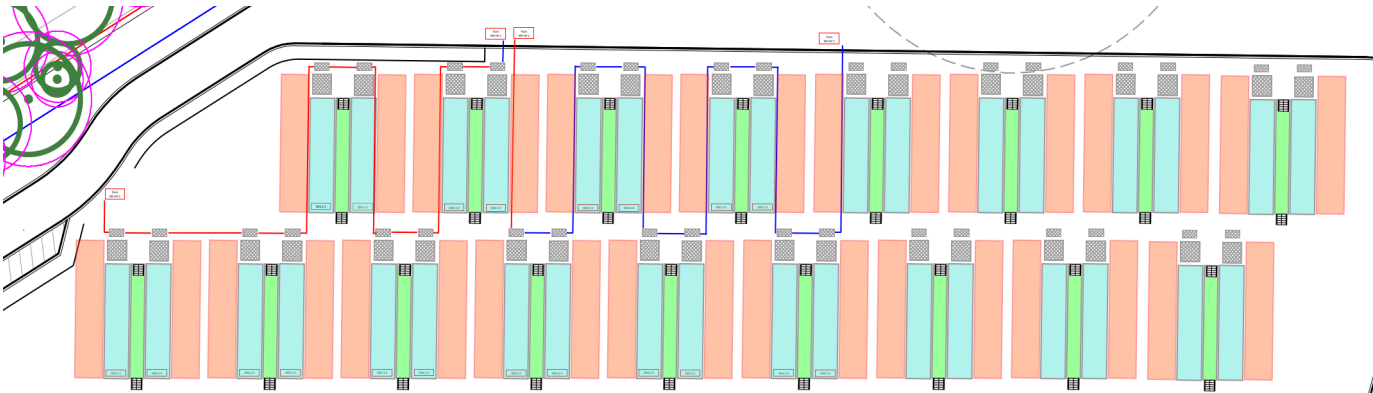- All off-site tested

SIEMENS

Total Cost of Ownership Approach
The new thought process in design
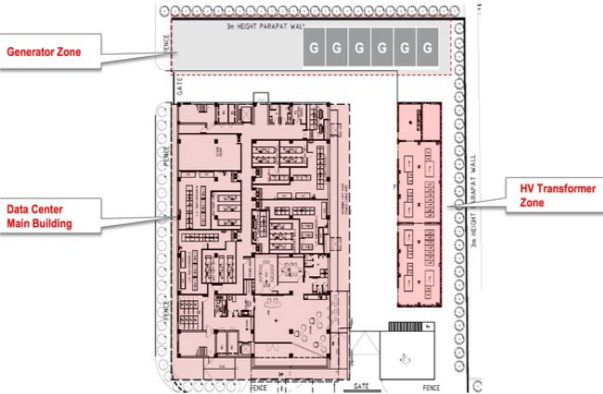
Building Layout
Source: Equinix

Separate UPS Infrastructure for Each Colo Area
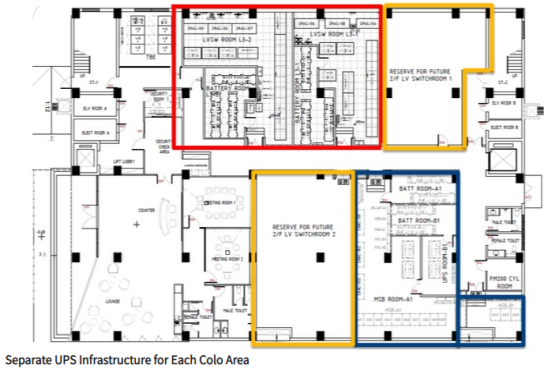
New prefabricated modular standard design

17- x 2 MW IT Block – total power 34 MW IT load

Bottlenecks at Data Center hot spot areas force investors to act faster.

AI and new Hyperscale designs are changing now classical way to build.

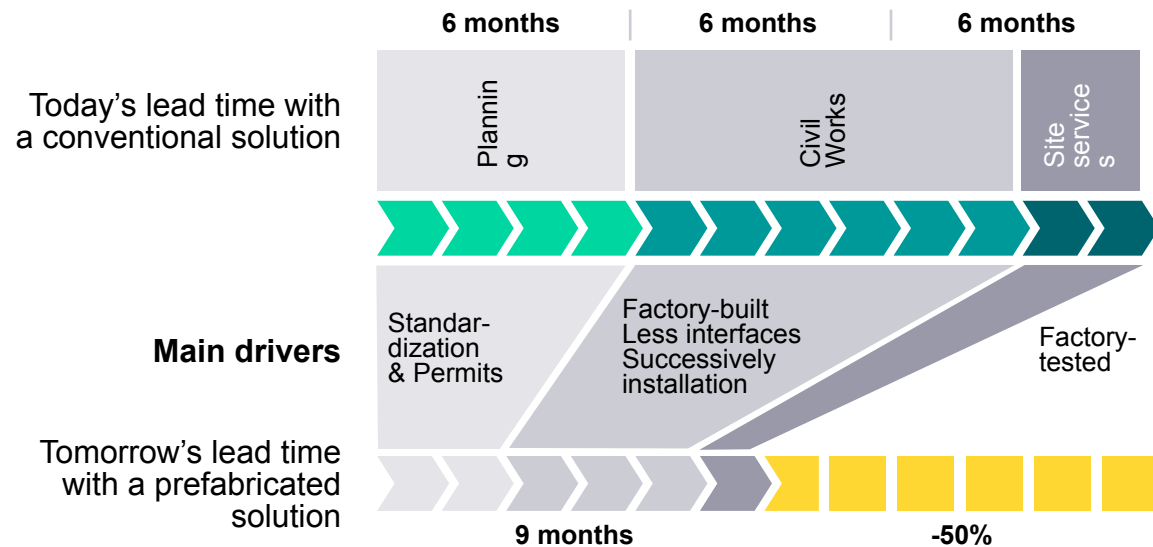TCO thought process helps to optimize the modularization.

Discipline overlapping approach has to be applied for maximum benefit.

SIEMENS

Prefabricated Power Supply Solutions
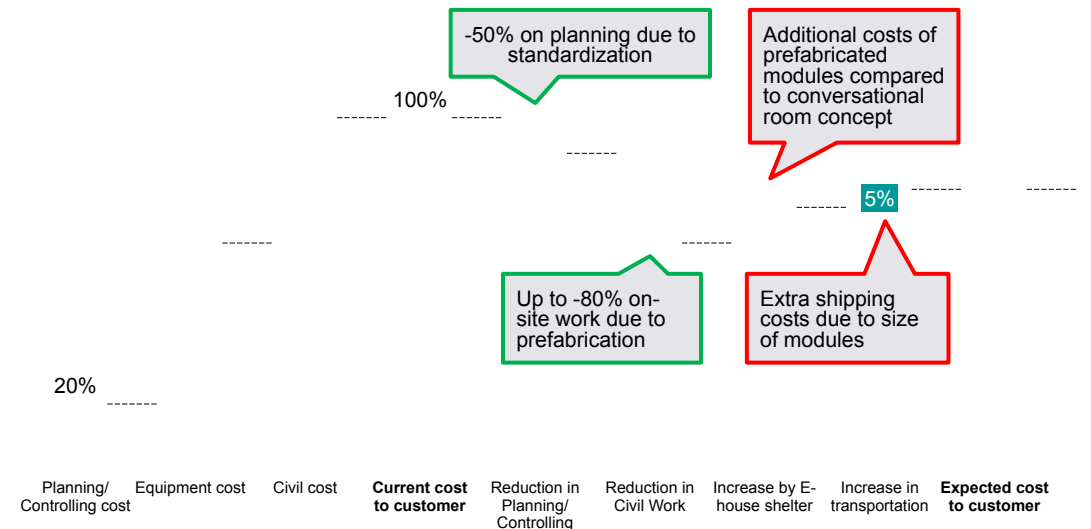## Benefits and optimization potential

Reduced lead time up to 50%

Scenario simulation with a conventional solution and a prefabricated solution

| 6 months | 6 months | 6 months |

Today's lead time with a conventional solution
- Planning
- Civil Works
- Site services

Main drivers
- Standardization & Permits
- Factory-built / Less interfaces / Successively installation
- Factory-tested

Tomorrow's lead time with a prefabricated solution

9 months — **-50%**

Cost saving potential up to 20%

Expected capex reduction with prefabricated solutions

- -50% on planning due to standardization
- Additional costs of prefabricated modules compared to conversational room concept
- Up to -80% on-site work due to prefabrication
- Extra shipping costs due to size of modules

100%
5%
20%

| Planning/ Controlling cost | Equipment cost | Civil cost | **Current cost to customer** | Reduction in Planning/ Controlling | Reduction in Civil Work | Increase by E-house shelter | Increase in transportation | **Expected cost to customer** |

- Fast design and approval process (Standardization)
- Just in time in factory integration of all equipment
- Factory assembly can be done in parallel to the site construction
- More efficient commissioning and testing

- Design standardization, only copy and modify
- Footprint optimization due to functional design of defined modules
- Easy handling of prefabricated modules during site installation
- Minimum interference with other on-site activities and suppliers

SIEMENS

Prefab Modular Data Center Solutions
Customer Benefits

100%

Standard design

Up to **50%**

Shorter delivery time

Up to **20%**

Capex reduction

SIEMENS

Questions

Q

A

Answers

SIEMENS