第6回国際土木委員会
資料3-2

2019 Autumn, bSI Beijing Summit
Construction Room

Quest of 4D&5D
and
Higher Dimension BIM

Chairman: Ken Endo 遠藤 賢
KAJIMA Corporation, Japan

buildingSMART
International home of openBIM

Definition of 4D, 5D, and More...

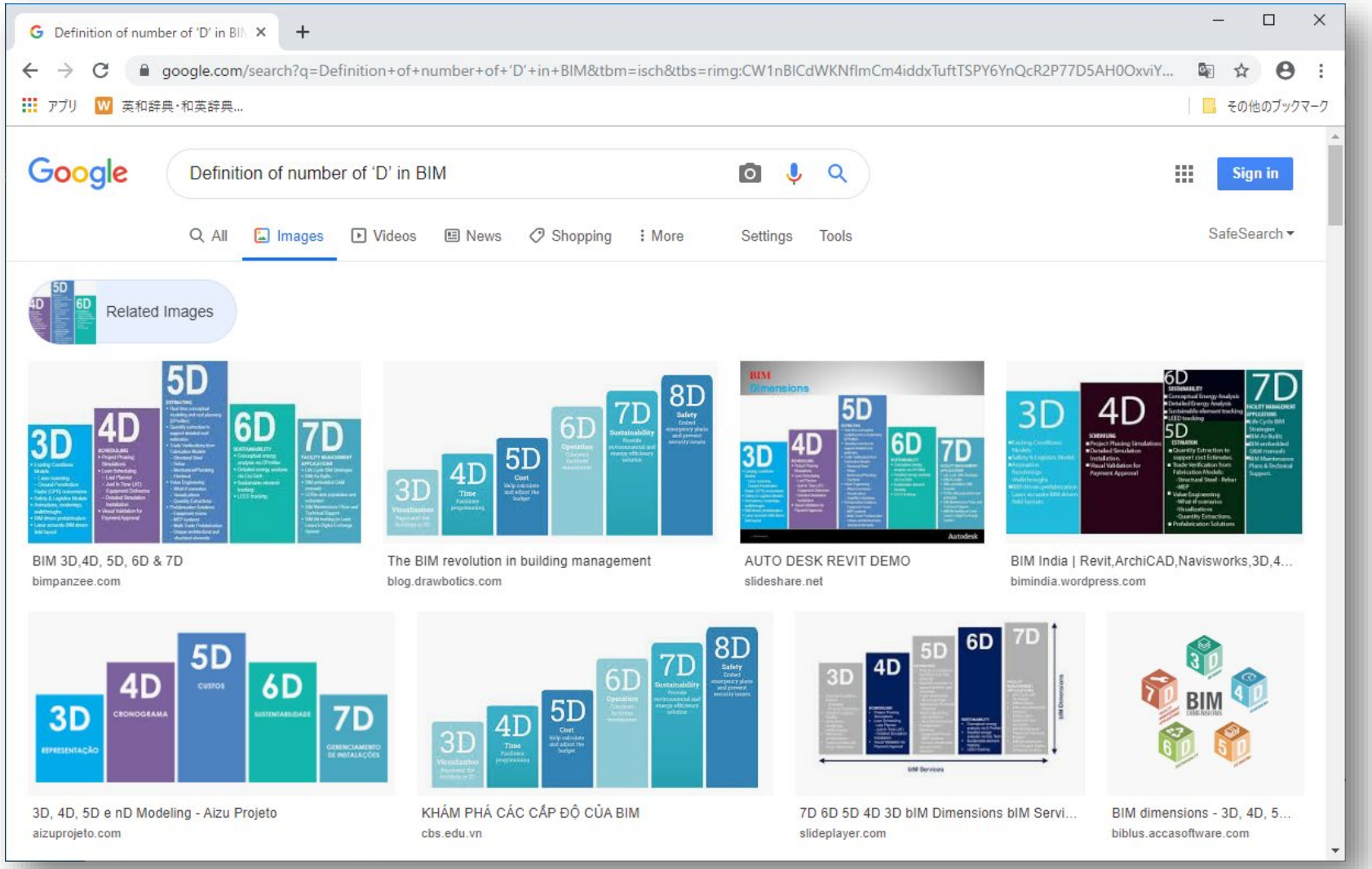
4D: Time/Schedule

5D: Cost

6D: Operation

7D: Life Cycle FM

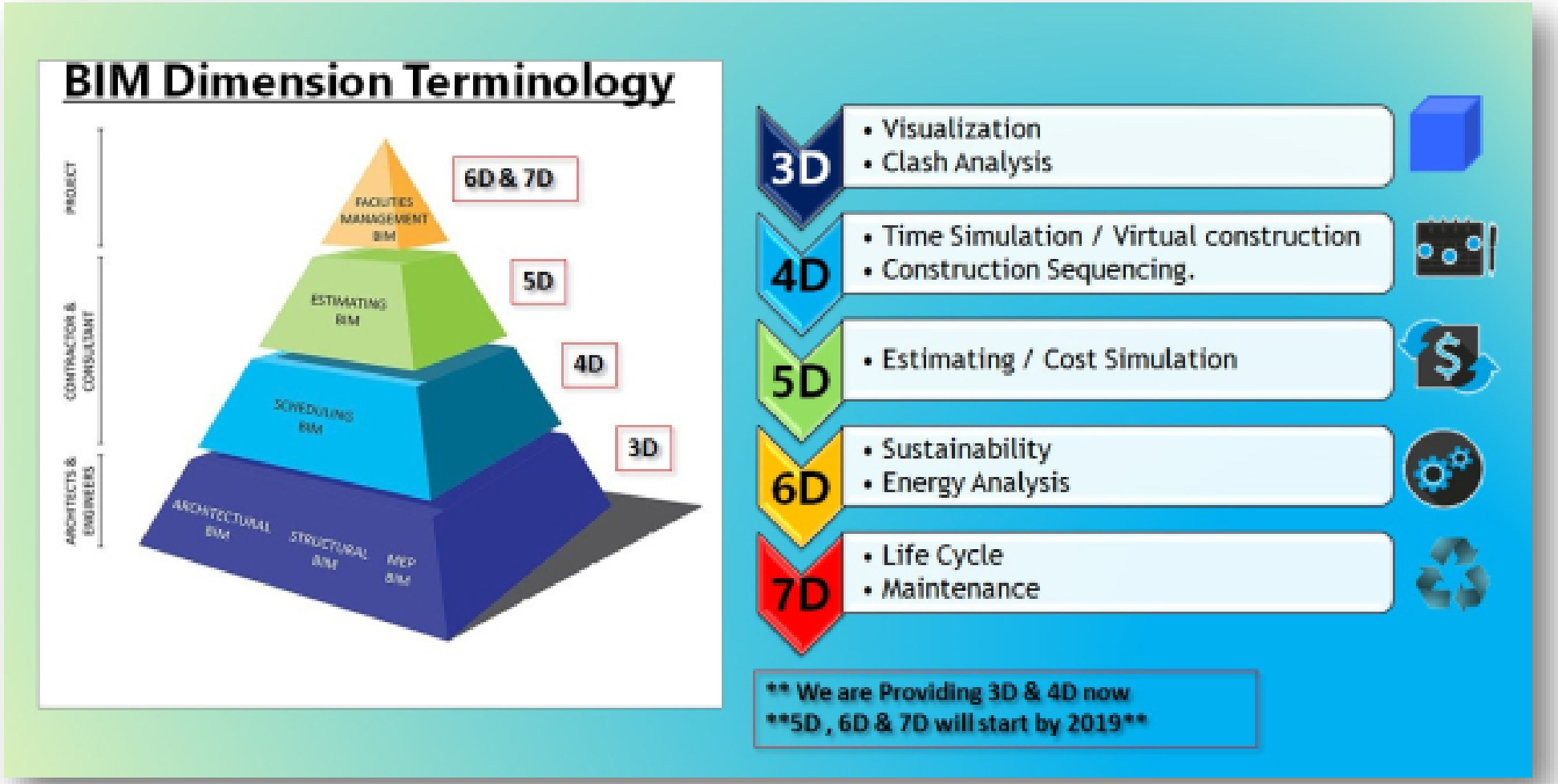
Definition of Number of “D” in BIM(1)



Result of General Search

buildingSMART International home of openBIM

Definition of Number of “D” in BIM (2)

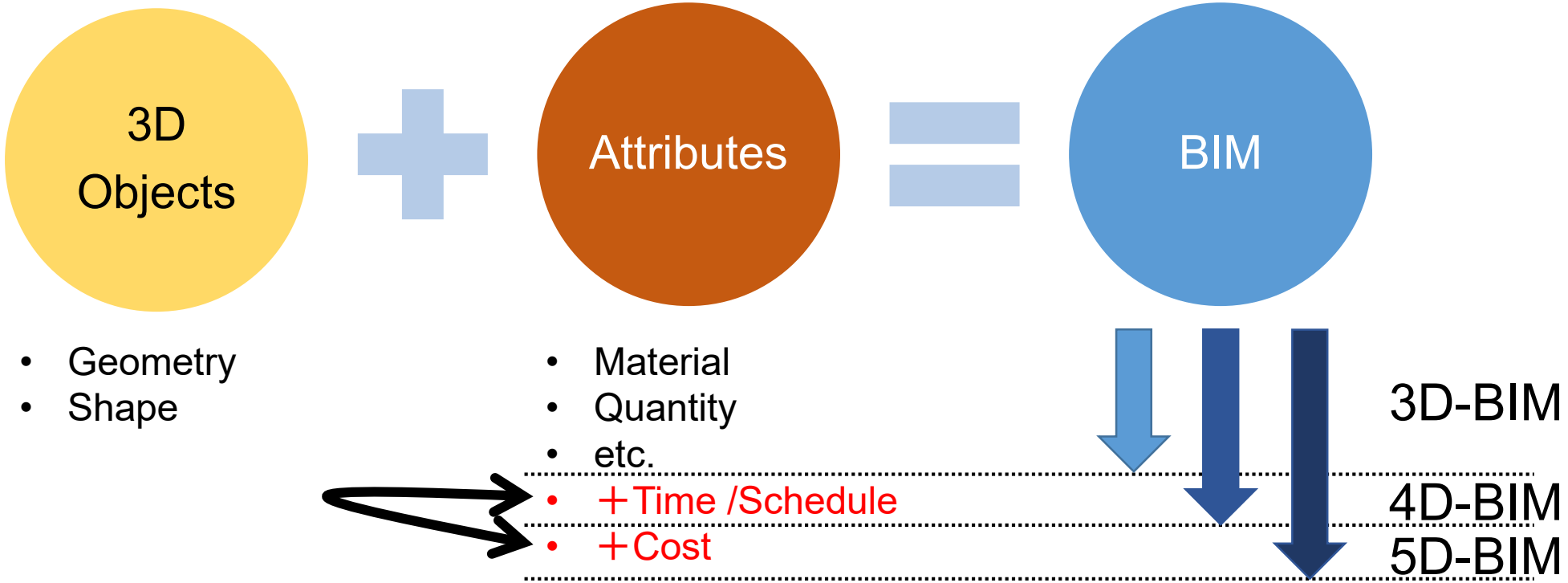


Cited form https://ilovemyarchitect.com/tag/bim-6d/

Result of General Search

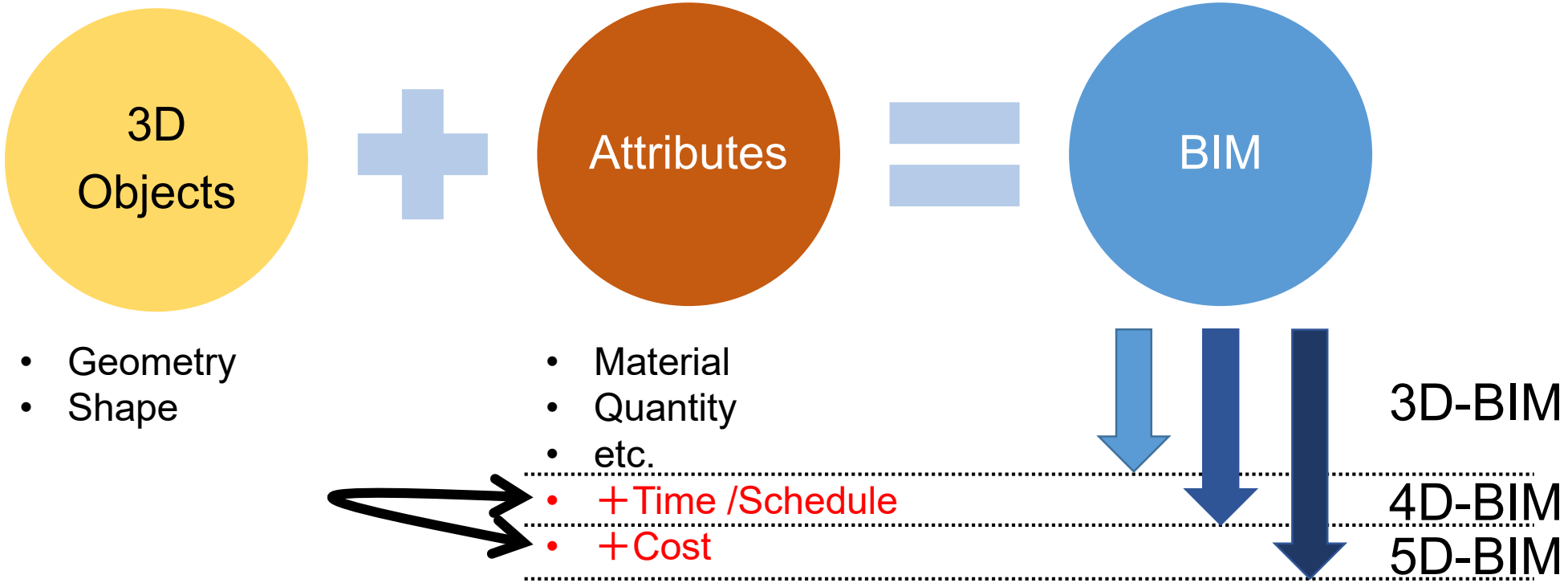
buildingSMART International home of openBIM

● Time(4D) & Cost(5D) are NOT independent.



◆ **Scheduling(4D) includes resource planning (Machinery, Labor, etc). And it affects Cost(5D).**

● But can I do “Cost estimation”(5D) without “Time Scheduling”(4D)?



◆ **Yeah, “QTo & Estimation” (5D) is needed for Tendering for Project…**

4D = 3D + Time

5D = 4D + Cost

Sure?

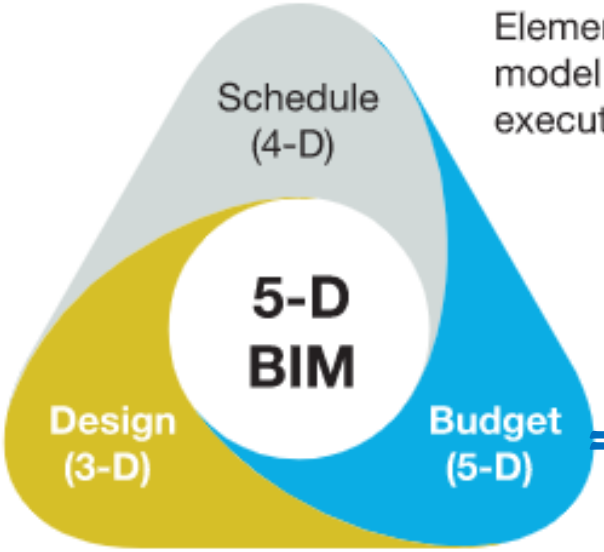
Mckinsey Chart

5-D functionality can integrate design, cost, and schedule in a 3-D output.

Building information modeling (BIM) is a digital representation of the physical and functional characteristics of a project, forming a reliable basis for decisions during the project's life cycle.

Information that can be embedded in 3-D model:

- Geometry
- Spatial data (from geographic information systems/lidar)
- Specifications
- Aesthetics (eg, color)
- Thermal properties
- Acoustic properties



Elements of a 3-D model are linked to the execution schedule

=Cost

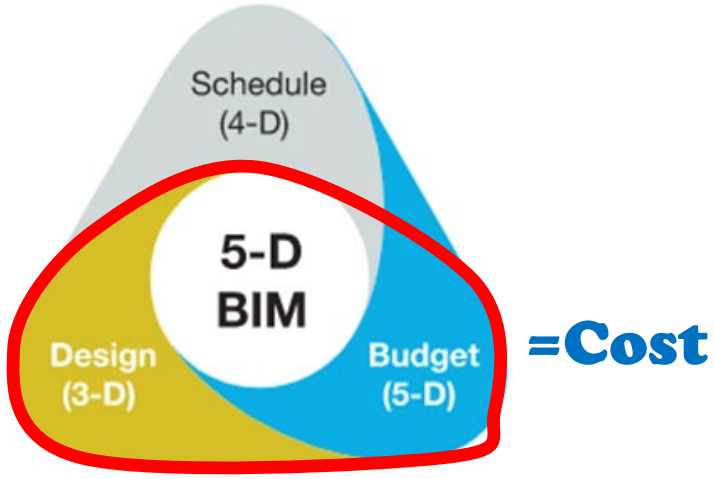
Elements of the 3-D model are used to develop budget and linked to cost heads

McKinsey&Company

Cited from:

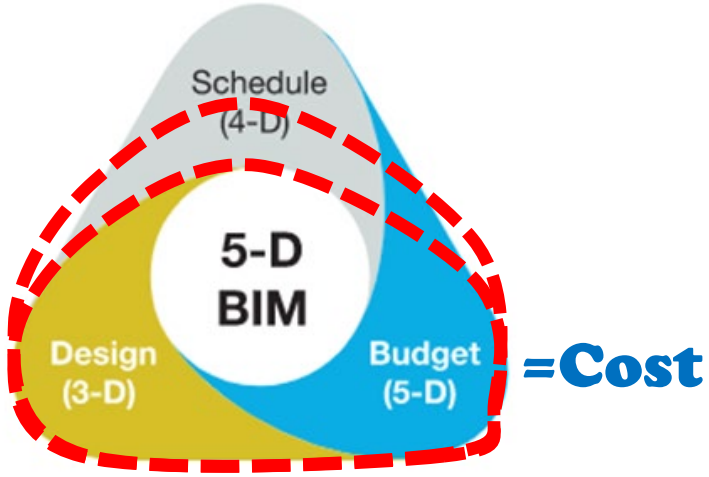
https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/imagining-constructions-digital-future

Character of Mckinsey Model



=Cost

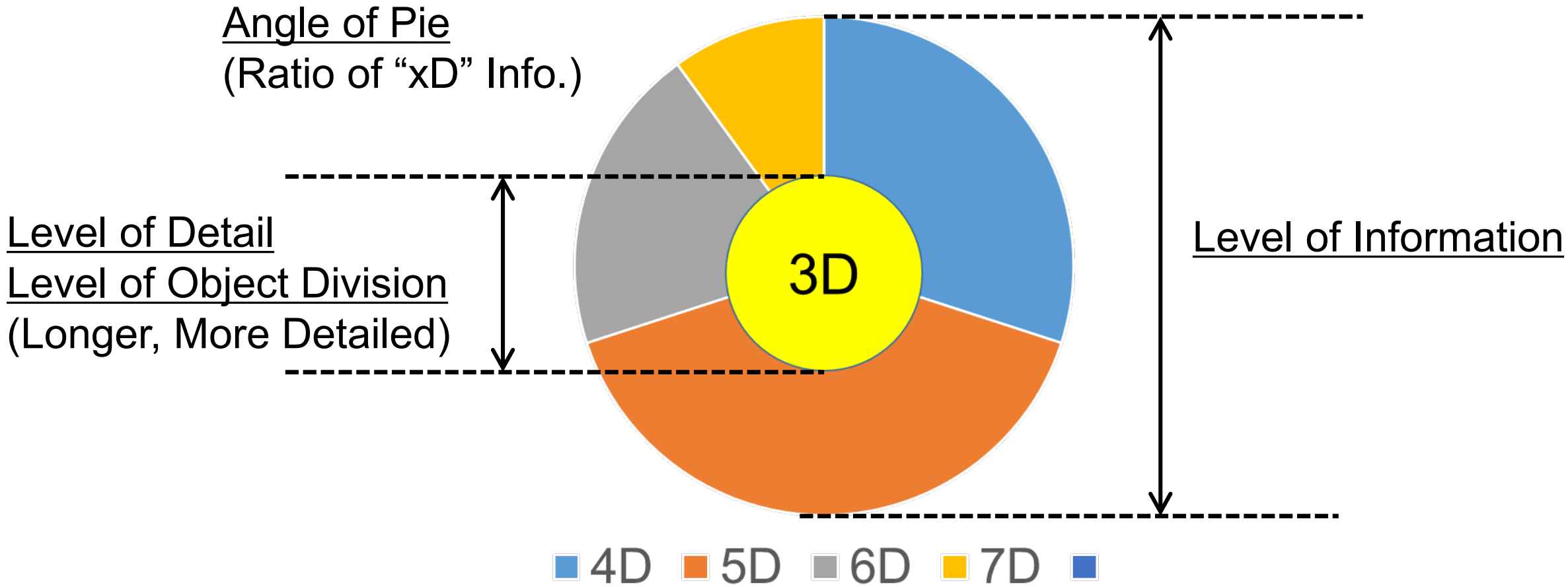
It can describe...
3D + Time (=4D)
3D + Cost
4D + Cost (=5D)



=Cost

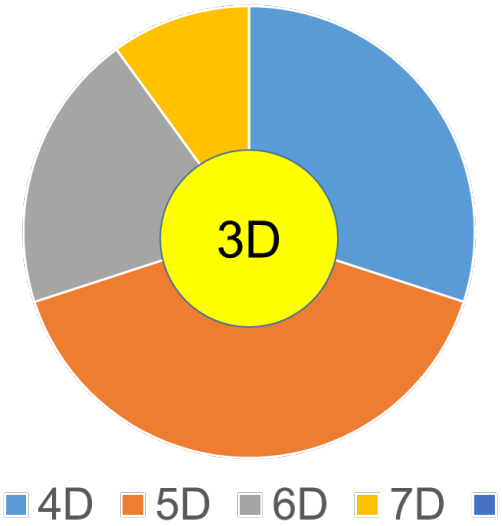
It can control mixture ratio of Time and Cost

Proposal (1)
Ken's Pie Chart Model for xD



Proposal (2)

- 4D, 5D, 6D, 7D, 8D… are Labels/Signs.
- Number does NOT mean sequence of BIM progression.

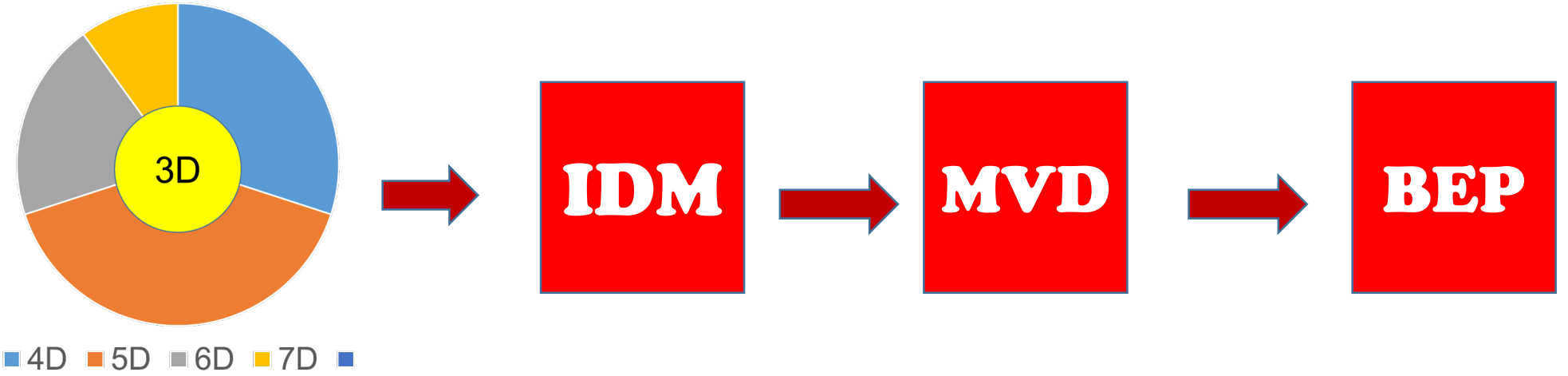


Proposal (3)

And we need more Use Cases!

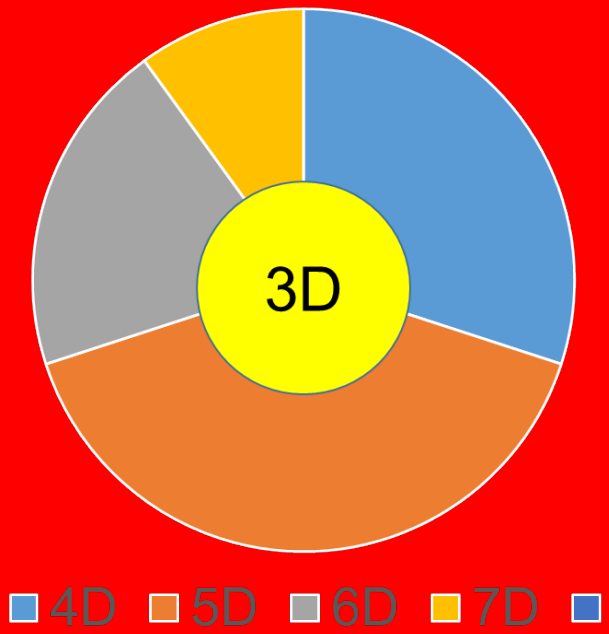
- **IDM : Information Delivery manual**
- **MVD : Model View Definition**
- **BEP: BIM Execution Plan**

to facilitate xD matters to commonly use.



Dragon - Pie Chart

Born in Beijing on Oct. 31st, 2019




谢谢啦

2019 Autumn, bSI Beijing Summit

Construction Tech Room

Use Cases (事例紹介)

Chairman: Ken Endo

KAJIMA Corporation, Japan

e-mail: endouk@kajima.com

Tuesday, October 29th (CR1-CR4)

Time	Session	Title of Presentation	Time (mins)	Company	*: Main Presenter	
9:00	CR1 (Opening session)	Quest of 4D&5D □and Higher Dimension BIM	60	bS Japan Kajima (Japan)	*	Ken Endo (Chairman of CR)
10:30						
11:00	CR2 (Case Case of Construction BIM)	"Finalist of bSI Award Program 2019" "West 65 Project" and 4D/5D BIM Solution of BEXEL Consulting	30	BEXEL Consulting (Slovenia/Serbia)	*	Veljko Janjic
		Application Research of BIM in Railway Steel Bridges	30	China Tiesiju Civil Engineering Group (China)	*	Li Yang
12:30						
13:30	CR3 BIM and Logistics **(Joint Session with PR3)**	BIM Logistics System	20	Sungkyunkwan University (Korea)	*	Sangyoon Chin
				Doalltech (Korea)	*	Cheolho Choi
			10	Kajima (Japan)	*	Masanori Hosoda
		Norwegian project with ETIM (GS1 Code) (Presentation from Poduct Room)	30	Cobuilder (Norway)	*	Espen Schulze
					*	Lars Chr Fredenlund
				GS1 (Belgium)	*	Enzo Blonk
15:00						
15:30	CR4 QuantityTakeOff	Open BIM-based quantity take-off system for schematic estimation of building frame in early design stage	30	bS Korea (Korea)	*	Lim Choi
		Discussion of QtO	20	bS Japan Kajima (Japan)	*	Ken Endo
17:00						

Wednesday, October 30th (CR5-CR8)

Time	Session	Title	Time (mins)	Company	*: Main Presenter	
9:00	CR5 (Common Data Environment for "long term data repository", "Multi use of data")	APIs in buildingSMART	20	bS Japan Kajima (Japan)	*	Yoshinobu Adachi
		Open CDE APIs	20	Oracle (Australia)		Yoram Kulbak
				Solibri (Finland)		Pasi Paasiala
		BIMcloud NEXT	20	Graphisoft (Japan/Hungary)	*	Bence Kovacs
10:30						
11:00	CR6 (Digital Twin at Construction Site **(Joint Session with TR6, AR6)**	Virtual Construction System & Digital Twin	20	Shenzhen Hongtao Group Co. LTD (China)	*	Liu Yan (刘燕)
		Digital Twins for building operation (Presentation from Technical Room)	20	Siemens Building Tecnologise Private Limited (Germany)	*	Wolfgang Hass
		(Title tentative) Digital Twins for airport operation (Presentation from Airport Room)	20	buildingSMART Netherland Asset Wise (Netherland)	*	Alexander Worp
12:30						
13:30	CR7 (Tech Session: Technical and Business Trend of Industries)	Dassault's 3DEXPERIENCE solution for virtual construction	20	Dassault Systems (China)	*	Peter CHEN
		"Integration with BIM and the IoT", "BIMx with a Maintenance Management System"	20	MINNUCCI ASSOCIATI (Italy)	*	Roberto Minnucci
					*	Ernesto Minnucci
15:00						
15:30	CR8	Summary&Resolution	60	Kajima (Japan)	*	Ken Endo (Chairman of CR)
17:00						

Presenters (CR2-1)

BEXEL Consulting (Slovenia/Serbia)

Veljko Janjic

抜粋資料

WEST 65

Building Information Modelling

Operation & Maintenance

WEST 65 AVENUE

WEST 65 TOWER

WEST 65 MALL

BEXEL CONSULTING

buildingSMART International home of openBIM

ABOUT US

BEXELMANAGER

NUMBERS

- 15 YEARS in development of bim software
- 10 YEARS of Construction Project Management Experience
- 160 PROJECTS of diverse type and size
- 6 MILLION square meters of construction projects delivered
- 35 COUNTRIES
- 5 CONTINENTS

SERVICES

INTEGRATED BIM PROJECT MANAGEMENT

BIM EDUCATION, AND IMPLEMENTATION

PRODUCTS

BIM SOFTWARE DEVELOPMENT

INTEGRATED 3D | 4D | 5D | 6D

BEXELMANAGER

INTELLIGENT BIM SOLUTION

PARTNERS

buildingSMART International Alliance for Interoperability

buildingSMART German Chapter Member

AUTODESK Authorised Developer

GRAPHISOFT A NEMETSCHEK COMPANY

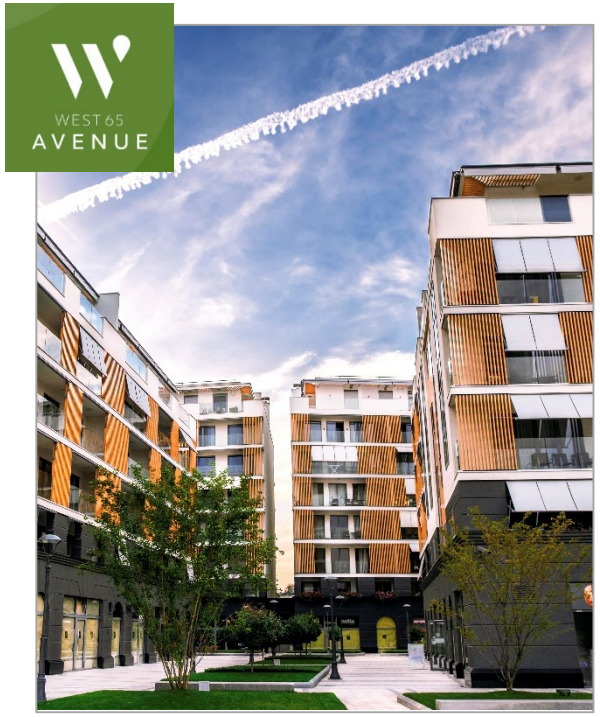
efca

FIDIC

Delivered by BEXELMANAGER buildingSMART International Home of OpenBIM

Key Project information

- West 65 Complex is one of the most ambitious, appealing and significant projects the capital of Serbia has seen in the past decades.
- It's a mixed-use, commercial/residential complex, located on one of the most attractive locations in Belgrade.
- It consists of 3 main parts, Avenue, Tower and Mall, constructed in 2 phases.
- Entire complex lays above underground garage, covering 2 levels and total of 1175 parking spaces covering almost 29.000m² of underground area.
- Total area of the complex is 166.000 m².

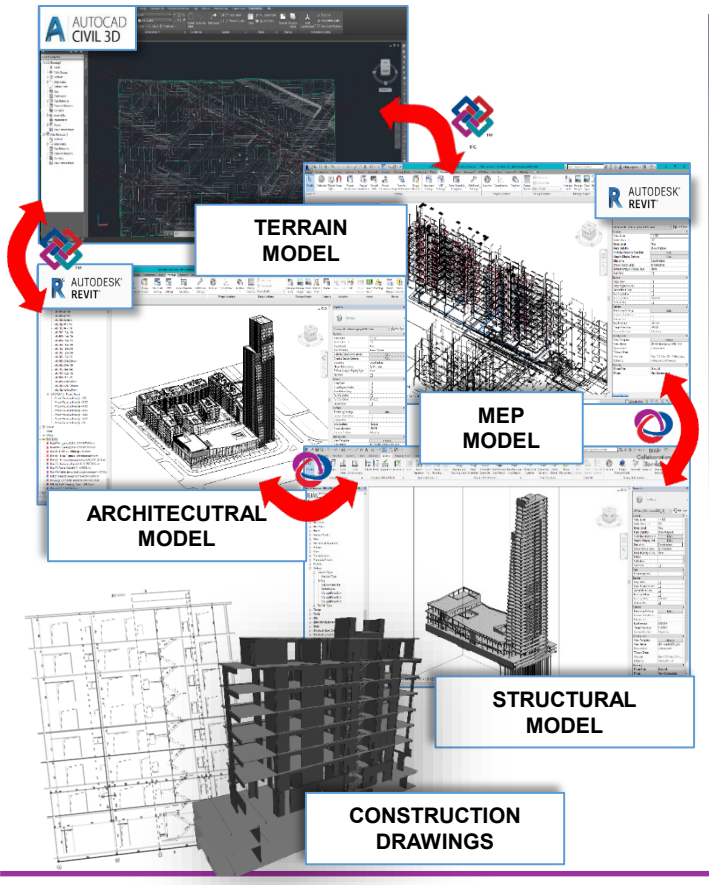


Key openBIM information

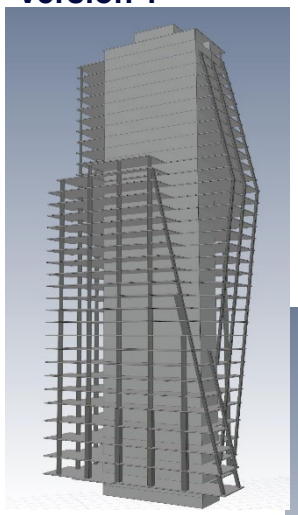
WEST 65 BIM USES

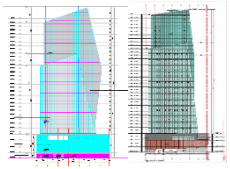
DEVELOPMENT DESIGN	DETAILED DESIGN	CONSTRUCTION	OPERATION

DESIGN AUTHORING

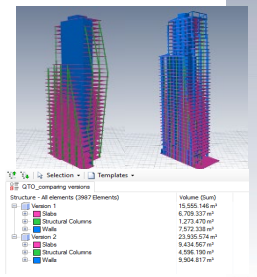


Version 1

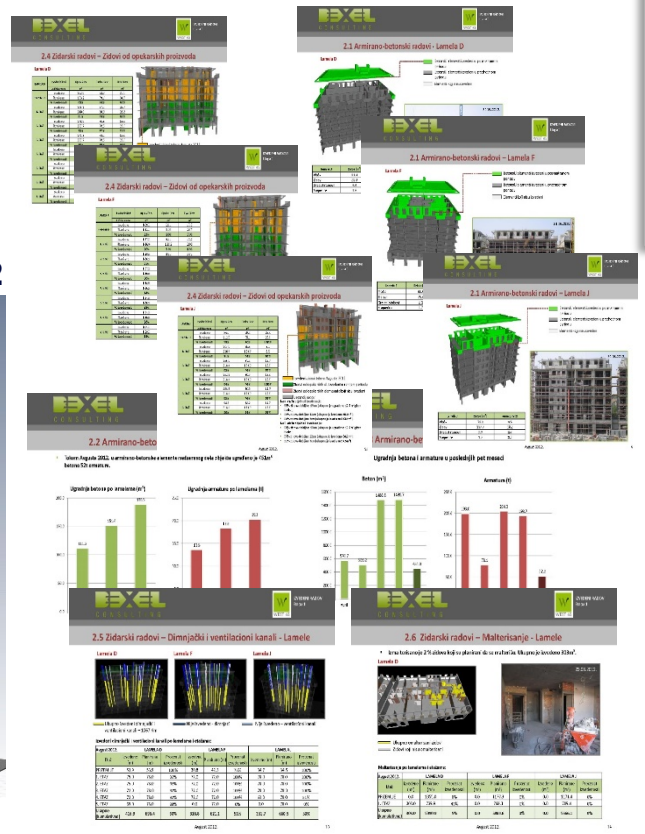


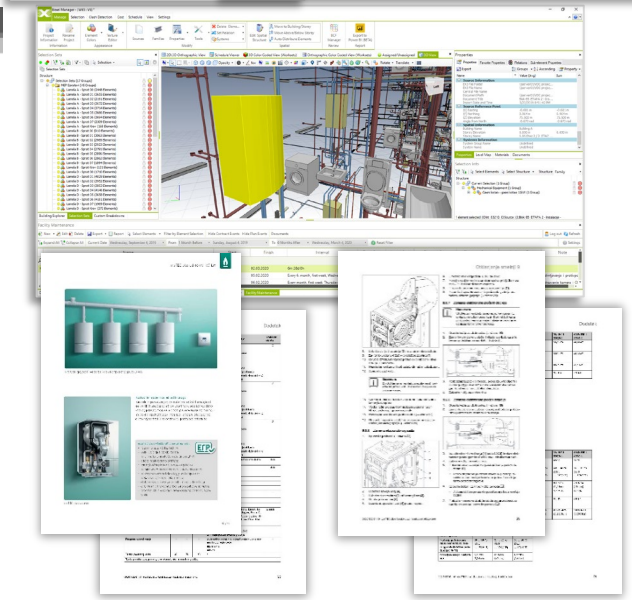


Version 2



PROGRESS REPORTS





CDE – Cloud based Common Data Environment

Stakeholders collaboration

- Structural Design
- Architectural Design
- MEP Design
- Project Management
- BEXEL Consulting
- Contractors

IFC

BCF
BIM Collaboration Format support

BEXEL DMS

AS-BUILT BIM MODEL

- ARCHITECTURAL MODEL (AUTODESK REVIT)
- STRUCTURAL MODEL (AUTODESK REVIT)
- MEP MODEL (AUTODESK REVIT)

AIM BIM MODEL

BEXEL DMS

BEXEL MANAGER FM

CLOUD BASED FM PLATFORM

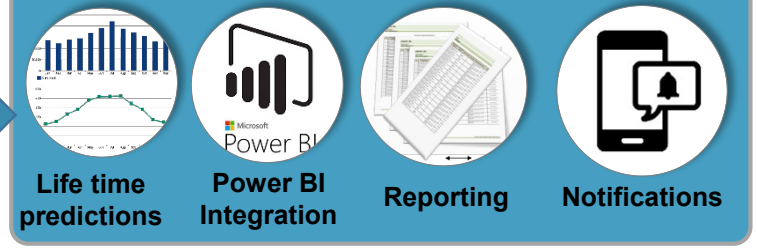
Microsoft Dynamics 365 · SAP · Project · scada · ORACLE PRIMAVERA

INTEGRATION

BEXELMANAGER

BEXELMANAGER FM

cloud based FM plans



Model data, sub-models and information exchange

- Autodesk Civil 3D → DWG + IFC
- Autodesk Revit → RVT + IFC + DX3
- Archicad → PLN + IFC

BEXEL Consulting (BIM Management, Supervision, Coordination)
Cepting (Firefighting)
PFB design (Architectural & Structural Design)
Nenvel (Electrical)
Unioninvest (Mechanical, Heating, Ventilation)
Other Partners (Specialty, Lifts,)

Total of **204 IFC** models is created and frequently updated during the period of **9 years.**

- Existing Terrain
- Existing MEP systems
- Excavation
- Backfill

- Existing Ground
- Underground Garage
- 11 Residential buildings
- W65-Tower
- W65-Shopping mall

Models for each of 6 Phases (Total 54)

- Structural
- Architectural
- HVAC
- Drainage
- Water
- Firefighting
- GAS
- Electrical
- Signage

Models for each of 11 Residential Buildings (Total 110)

- Structural
- Architectural
- HVAC
- Drainage
- Water
- Firefighting
- GAS
- Electrical
- Elevators
- Signage

Tower Sub-models lvls 0-30, 31-40 (Total 24)

- Structural
- Architectural
- Interior
- HVAC
- Drainage
- Water
- Firefighting
- GAS
- Electrical
- Elevators
- Signage
- Facade

Shopping Mall Sub-models (Total 12)

- Structural
- Architectural
- Interior
- HVAC
- Drainage
- Water
- Firefighting
- GAS
- Electrical
- Elevators
- Signage
- Facade

Asset Information Model – O & M Data Enrichment

Updating the As-built model with additional data for the maintenance and operations phase

Each 3D model element contains common information:

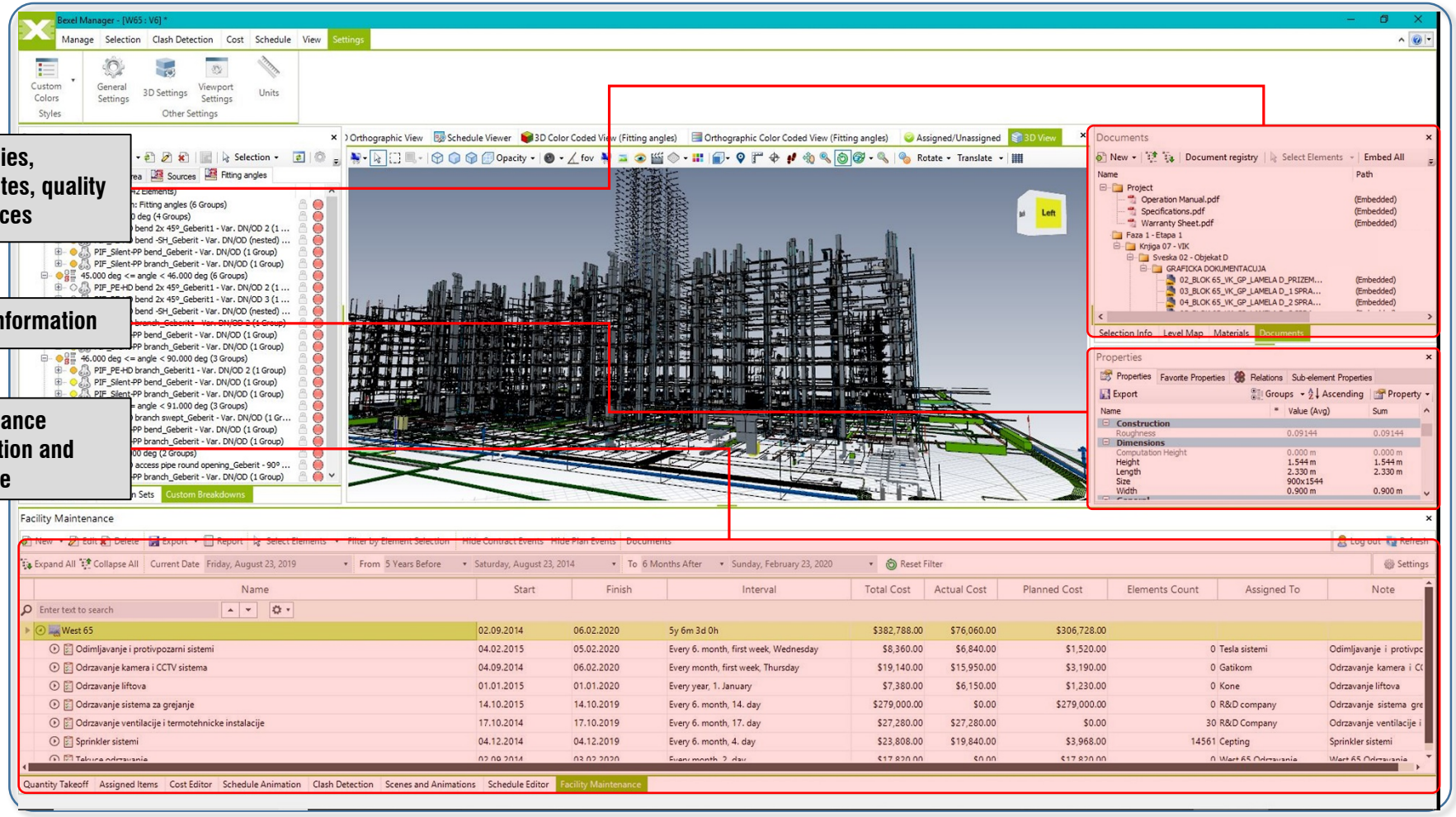
- Name
- Description
- Quantity
- Manufacturer
- Material
- Price

Required information:

- Model Number
- Installation Date
- Replacement Cost
- Expected Life
- Warranty Description

Additional information:

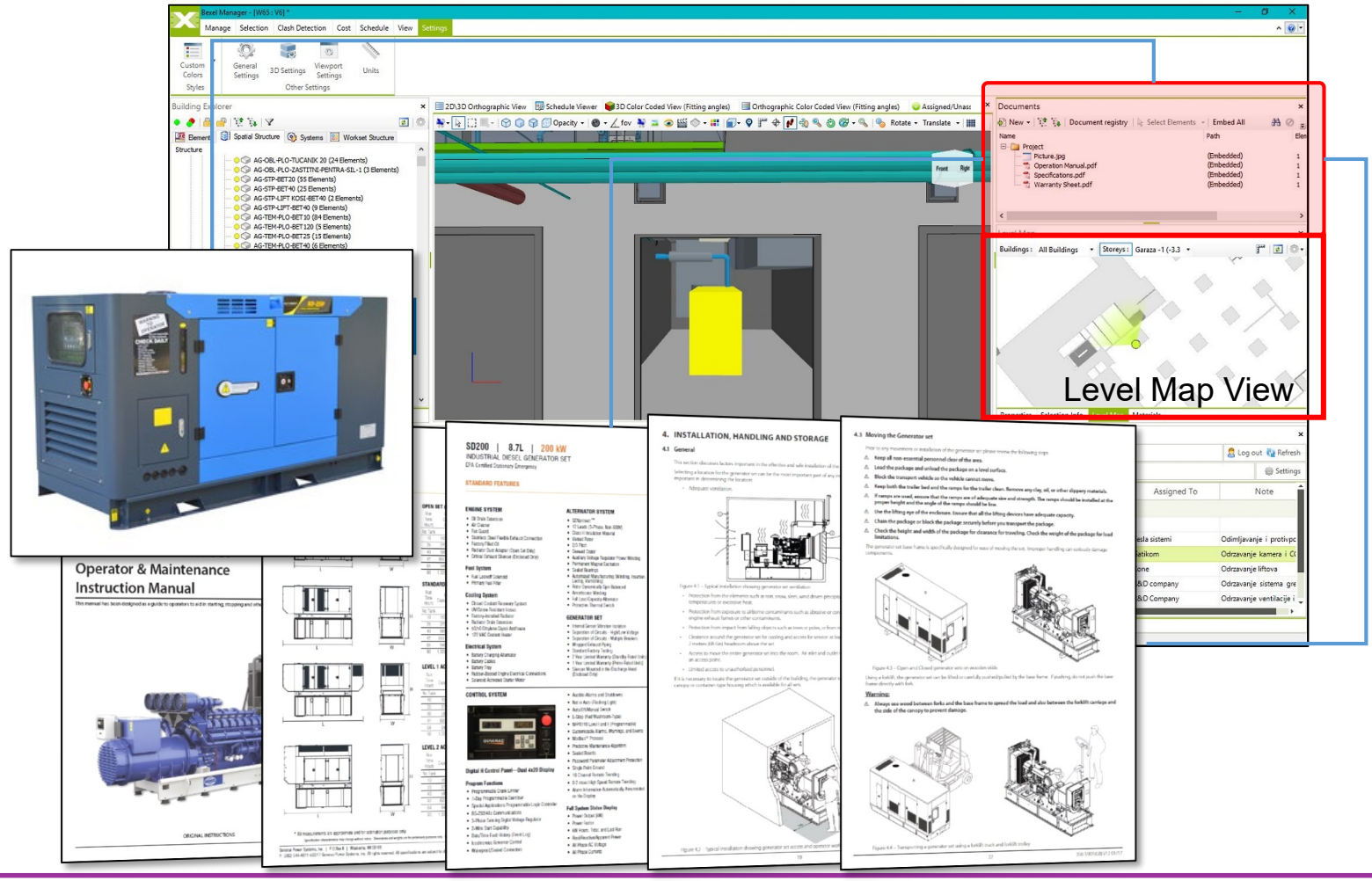
- COBie metadata



Asset Information Model – BIM Process

Updating As-built model with additional data required for maintenance and operation process

- BEXEL Manager model collects and stores all requested data and documents within the model file or within agreed CDE, accessible to authorized stakeholders on the project
- Pictures (jpg)
- User's and operational manuals (pdf, docx)
- Specification and warranties (pdf, docx)
- Technical / project documentation (dwg, pdf, docx)
- All documents are linked with respective 3D element accessible within a mouse-click and clearly noticeable in the main and Level Map views



BEXELMANAGER FM

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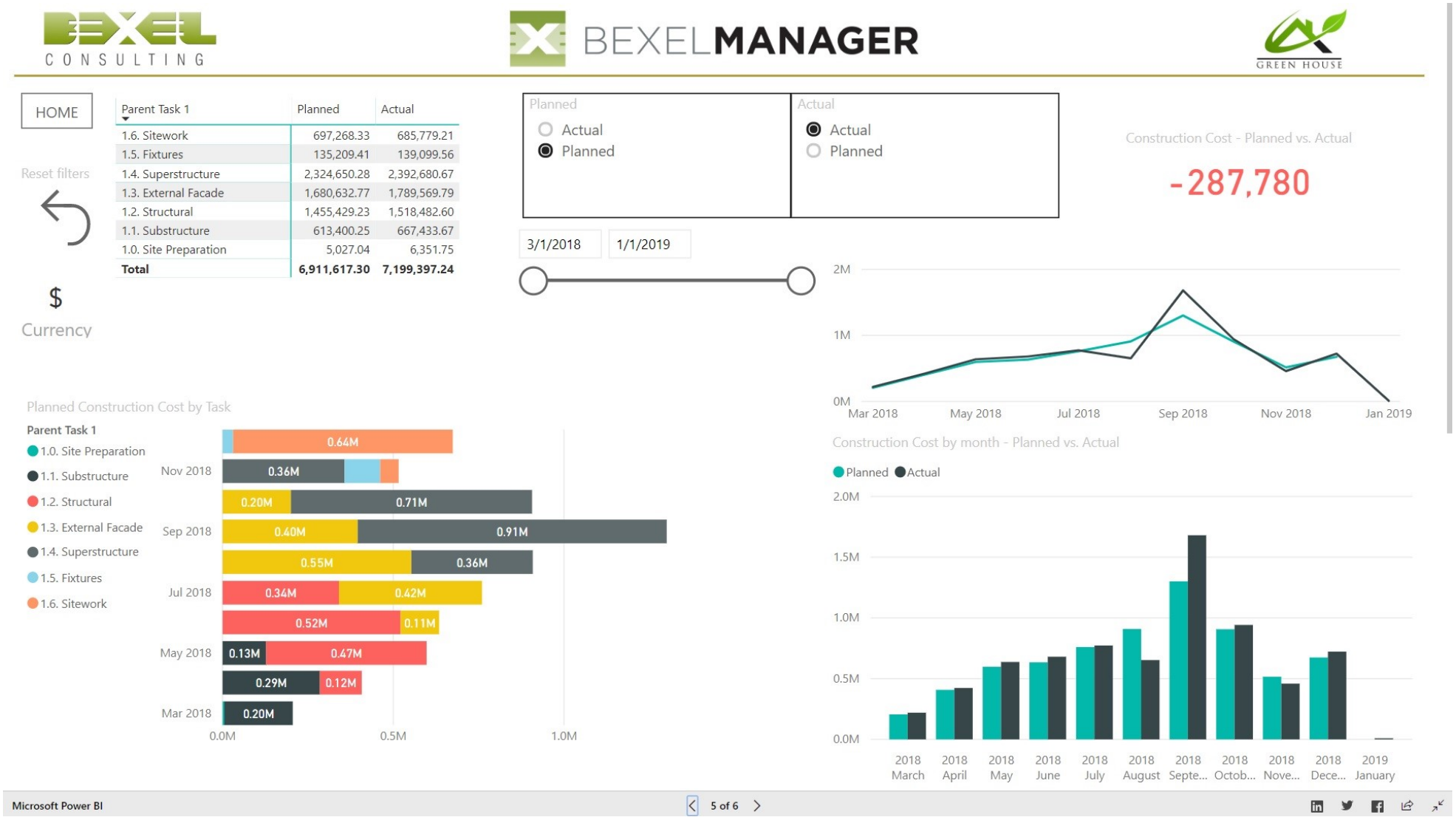
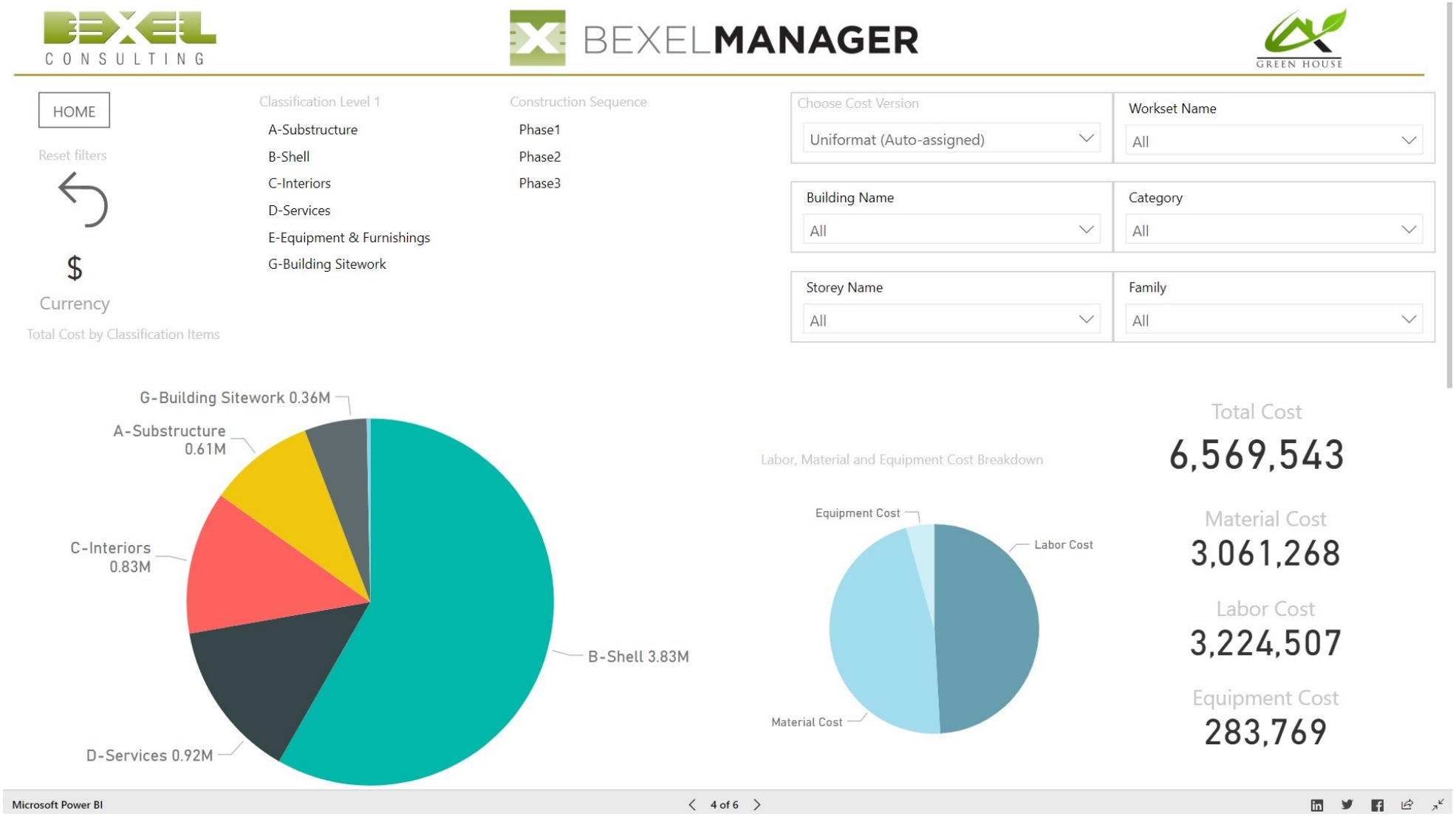
Integrated 5D Earned Value Analyses - BEXEL Manager and Power BI



Integrated 5D Earned Value Analyses - BEXEL Manager and Power BI



BEXELMANAGER

API

Application Programing Interface

BEXELMANAGER

- Click to edit Master text styles
  - Second level
    - Third level
      - Fourth level
        - Fifth level

BEXEL MANAGER LITE

BEXEL ENGINEER

BEXEL MANAGER

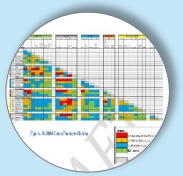
BEXEL MANAGER FM

BEXEL MANAGER ENTERPRISE

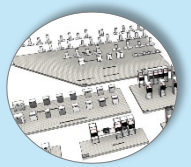
CDE – Cloud based Common Data Environment

BEXELMANAGER


BIM EIR


Clash detection matrix

BEP & Manuals


BIM libraries


Progress Monitoring

Change Management


Manuals and warranties


As-built drawings


FM plans & Cost estimates

Regulations and legislations

Stakeholders collaboration

- Structural Design
- Architectural Design
- MEP Design
- Project Management
- BEXEL Consulting
- Contractors

IFC

BCF

BIM Collaboration Format support

BEXEL DMS

BEXEL MANAGER FM

CLOUD BASED FM PLATFORM

AIM BIM MODEL

Microsoft Dynamics 365 · SAP · Project · scada · ORACLE PRIMAVERA

INTEGRATION

BEXELMANAGER

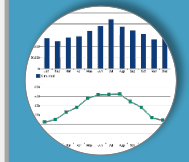
BEXELMANAGER FM

cloud based FM plans


Servicing companies


O&M services


Owner


Life time predictions

Power BI Integration


Reporting


Notifications

buildingSMART International home of openBIM

INTEROPERABILITY

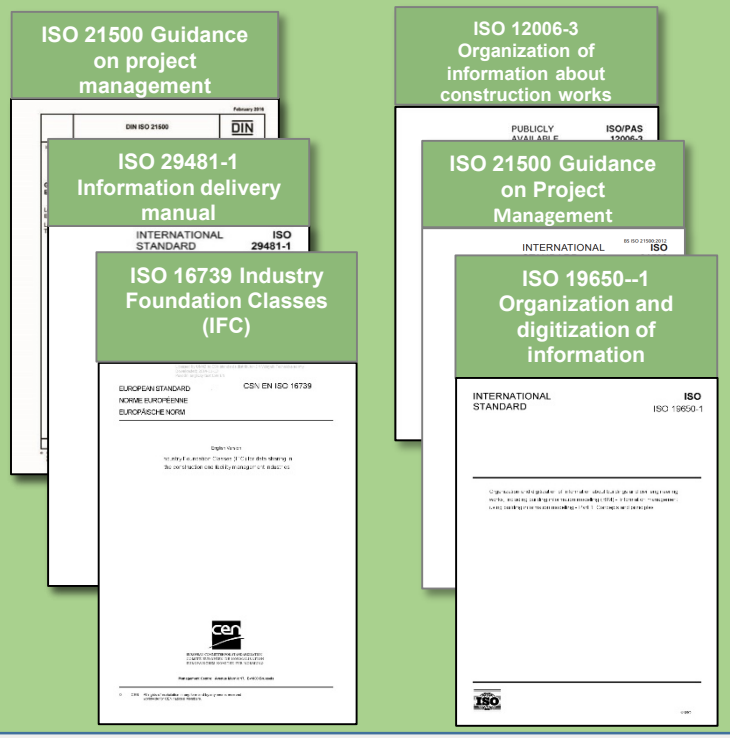
BEXELMANAGER

Reporting and integration with other applications

Excel · Project · Trimble Connect · AUTODESK® BIM 360™ · SAP ERP · BIMx · Tekla®

Power BI · AUTODESK NAVISWORKS · AUTODESK REVIT · ALLPLAN A NEMETSCHEK COMPANY · SOLIBRI A NEMETSCHEK COMPANY · GRAPHISOFT ARCHICAD · ORACLE PRIMAVERA

International Standards



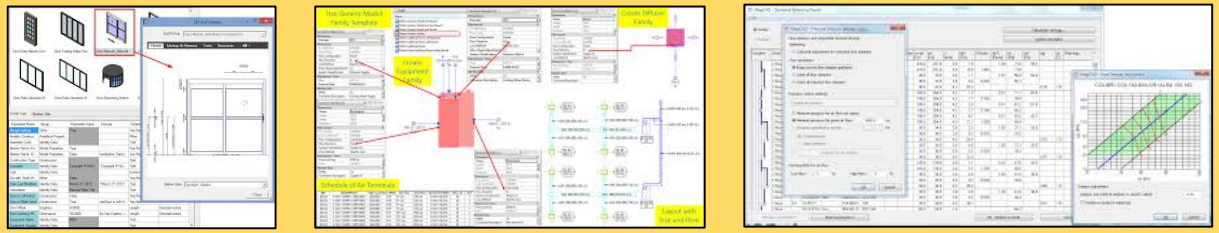
BEXELMANAGER API

BEXELMANAGER

LITE · ENGINEER · MANAGER · FM · ENTERPRISE

BEXELMANAGER FM

Company, region and country specific standards



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Presenters (CR2-2)

China Tiesiju Civil Engineering Group (China)

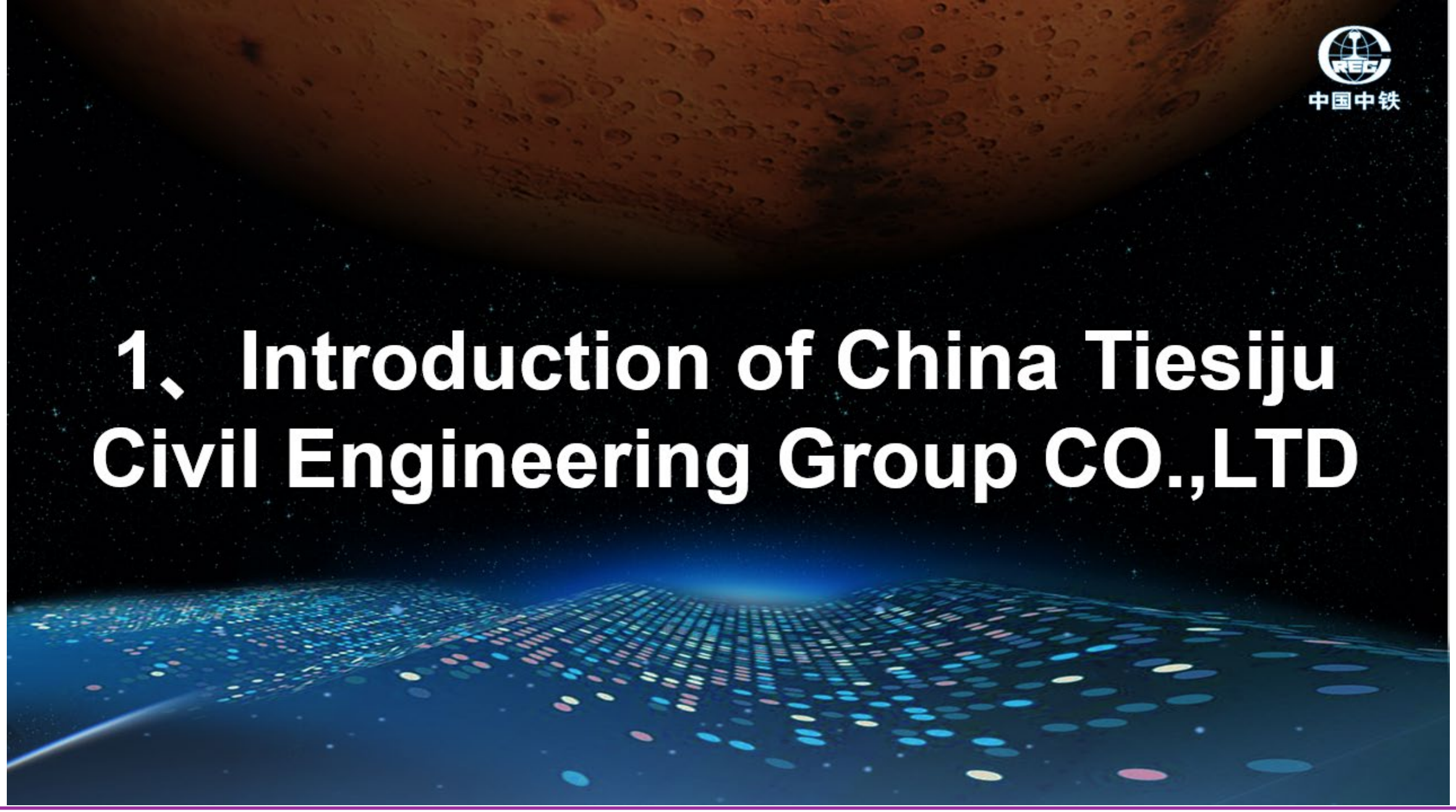
Li Yang

抜粋資料

Application Research of BIM in Railway Fabricated Steel Bridge

Reported by: Li Yang

China Tiesiju Civil Engineering Group CO.,LTD

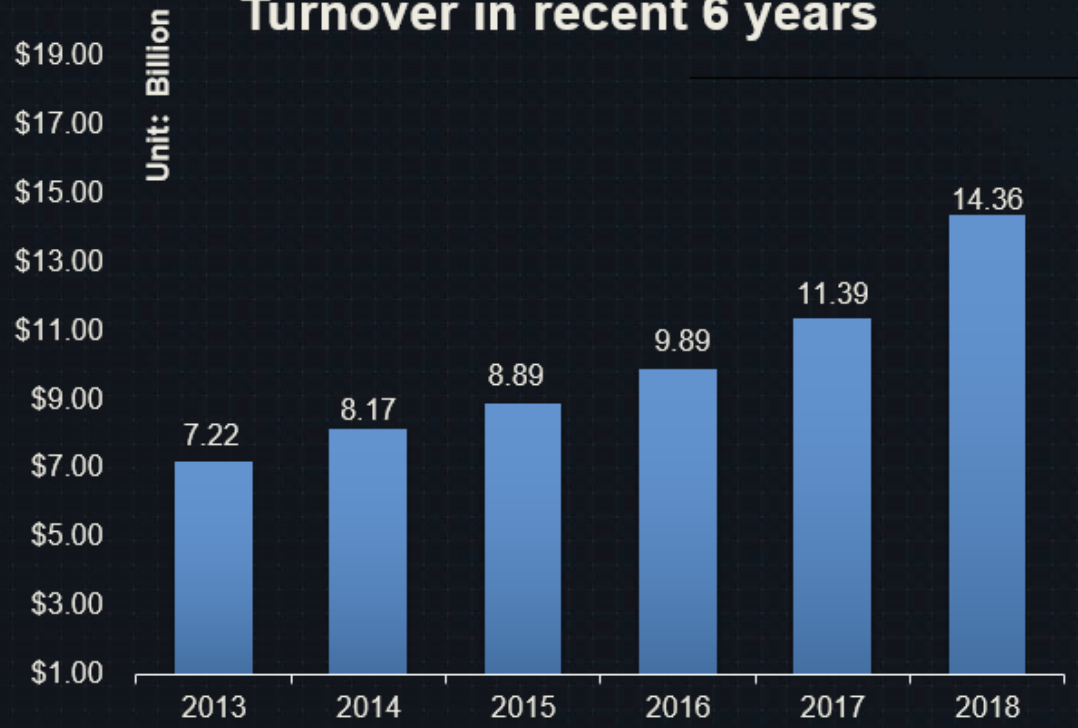


Overview of China Tiesiju Civil Engineering Group CO.,LTD

中国中铁

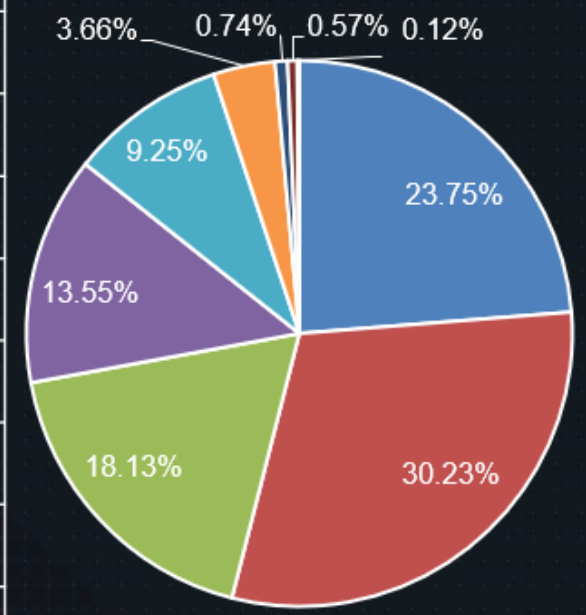
China Tiesiju Civil Engineering Group CO.,LTD (CTCE) was founded in 1950. It was a wholly owned subsidiary of China Railway Corporation Limited. It is a large-scale construction enterprise with comprehensive construction capacity. The company has participated in the construction, reconstruction and expansion of more than 100 railway trunk, branch and special lines, built more than 10 large-scale railway hub. At the same time, the company has been actively competing in the international market, while more than 100 railway, highway, housing, water conservancy projects among others have been completed or under construction in over 20 countries and regions.

Turnover in recent 6 years

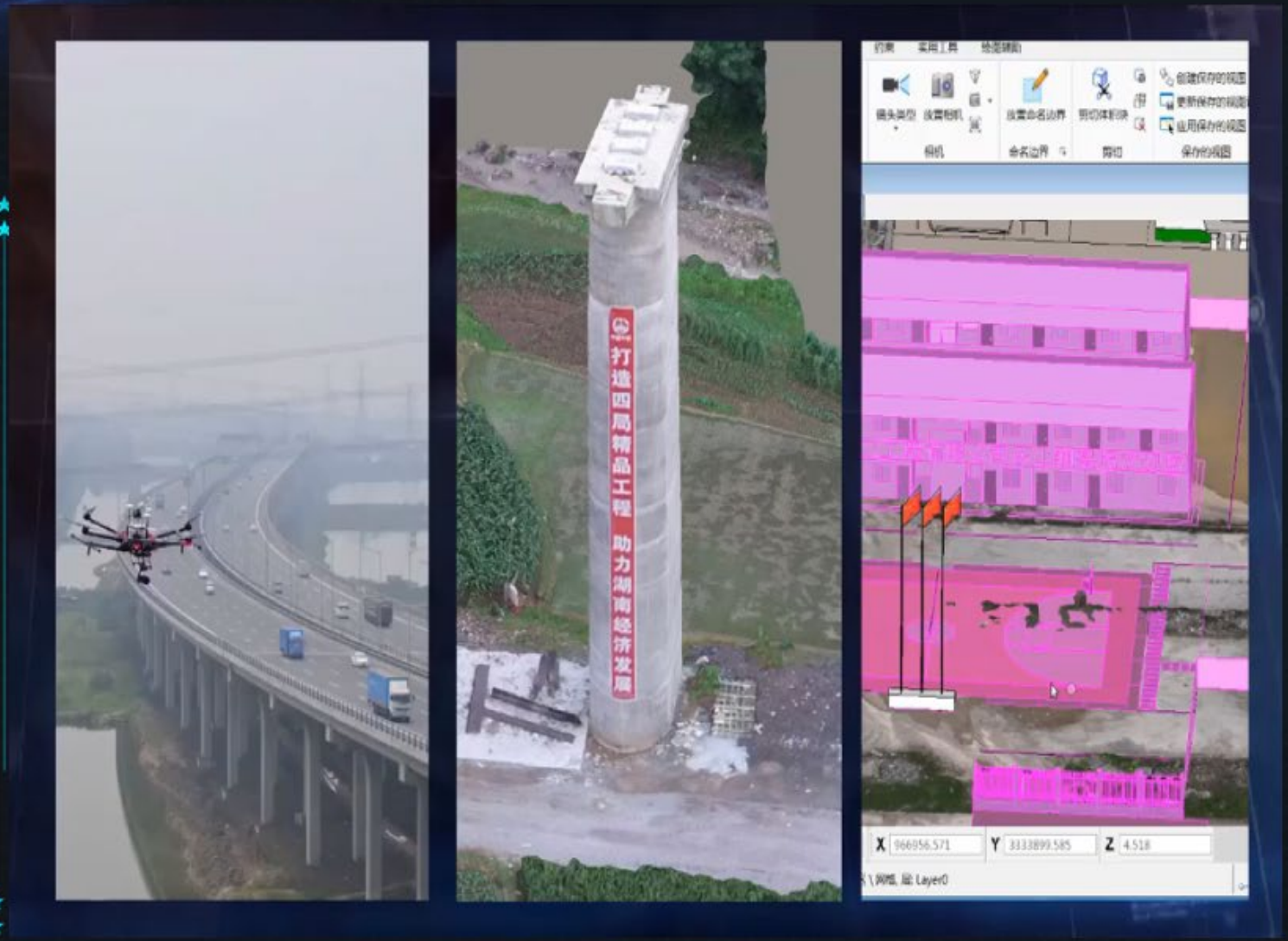


Engineering field distribution

Municipal	30.23%
Railway	23.75%
Subway	18.13%
Highway	13.55%
Building	9.25%
Others	3.66%
Real Estate	0.74%
Material trade	0.57%
Exploration and design	0.12%



UAV Real Scene Modeling Technique Application



- Construction Survey
- Large Scale Temporary Equipment Arrangement
- Land Expropriation and Housing Demolition
- Service Road Selection

3、Application of BIM in Railway Steel Bridge Construction

中国中铁

The Field and Scale of China's Fabrication Engineering Development

中国中铁

Bridge and Tunnel

The world's longest cross-sea bridge, with the longest submerged tube tunnel.

Hong Kong-Zhuhai-Macao cross-sea bridge

High Speed Railway

The very first section of prefabricated, integrated bridge for China's high-speed railway.

Jingxiong intercity railway

Subway

China's first prefabricated subway station which holds the world's largest scale and utterly unique structure.

Yuanjiadian subway station

Application Analysis of BIM Technology in Prefabricated Building

中国中铁

Digital Manufacturing → **Logistics Transportation** → **Fabricated Construction**

Digital processing based on BIM

QR code management system

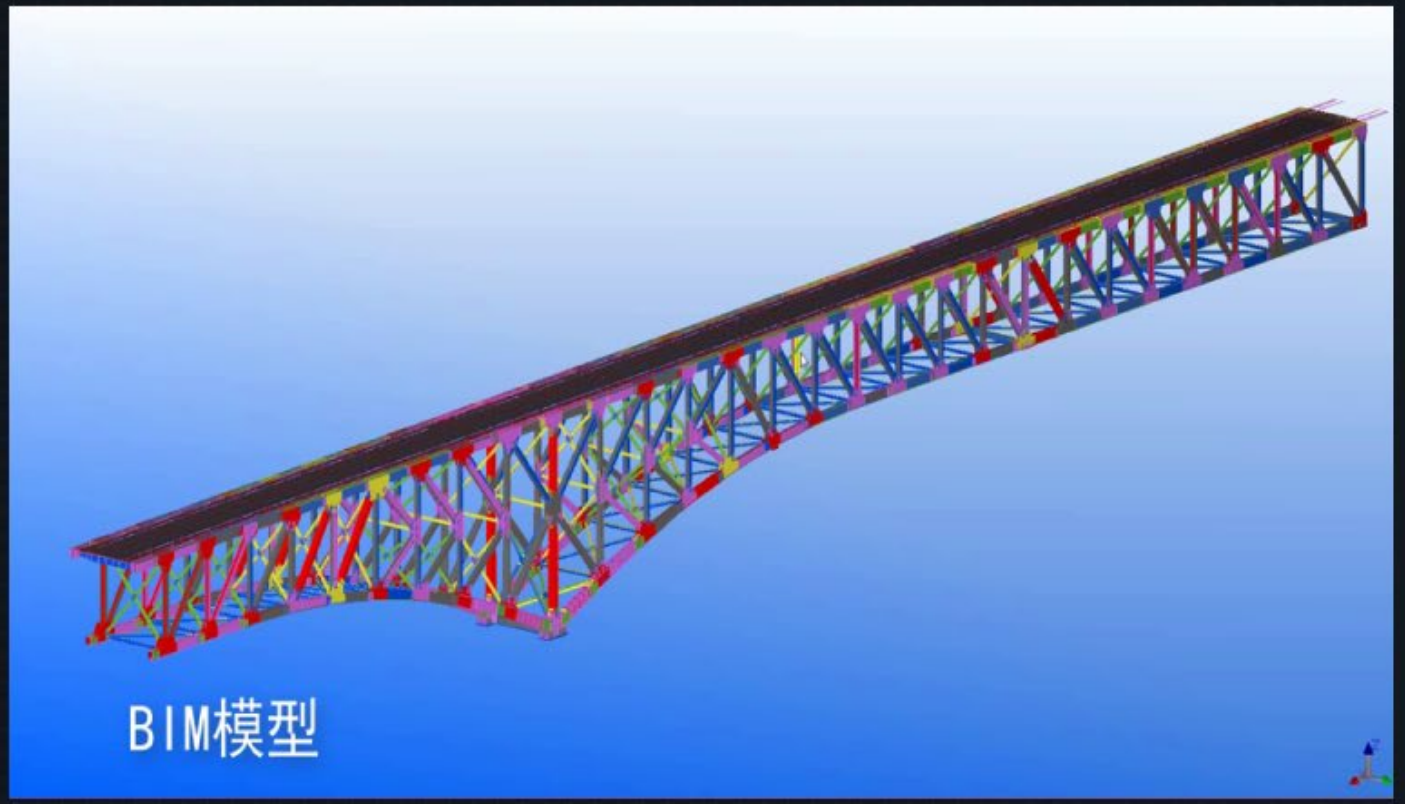
Fabricated information construction

Digital Processing of Steel Structure Based on BIM

中国中铁

Steel structure model → Model optimization → Assemble simulation → Output digital control file → Automatic layout → Intelligent digital controlled cutting → Excess stock management

Build a structural model using BIM software Tekla.

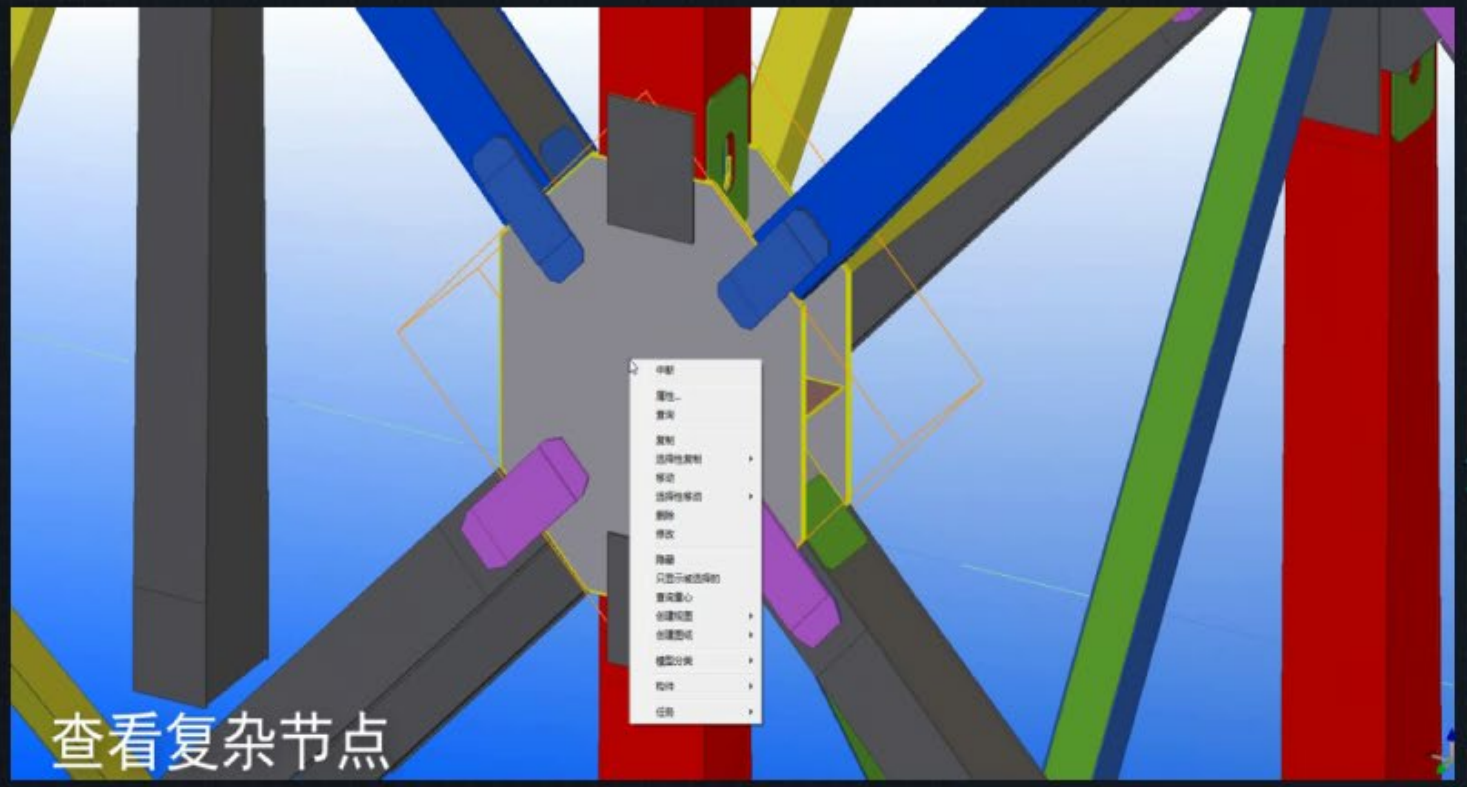


Digital Processing of Steel Structure Based on BIM

中国中铁

Steel structure model → Model optimization → Assemble simulation → Output digital control file → Automatic layout → Intelligent digital controlled cutting → Excess stock management

Utilizing the model with complex nodes, the spatial positioning relationship among parts can be checked, while improving the design efficiency and accuracy in the deepening design.

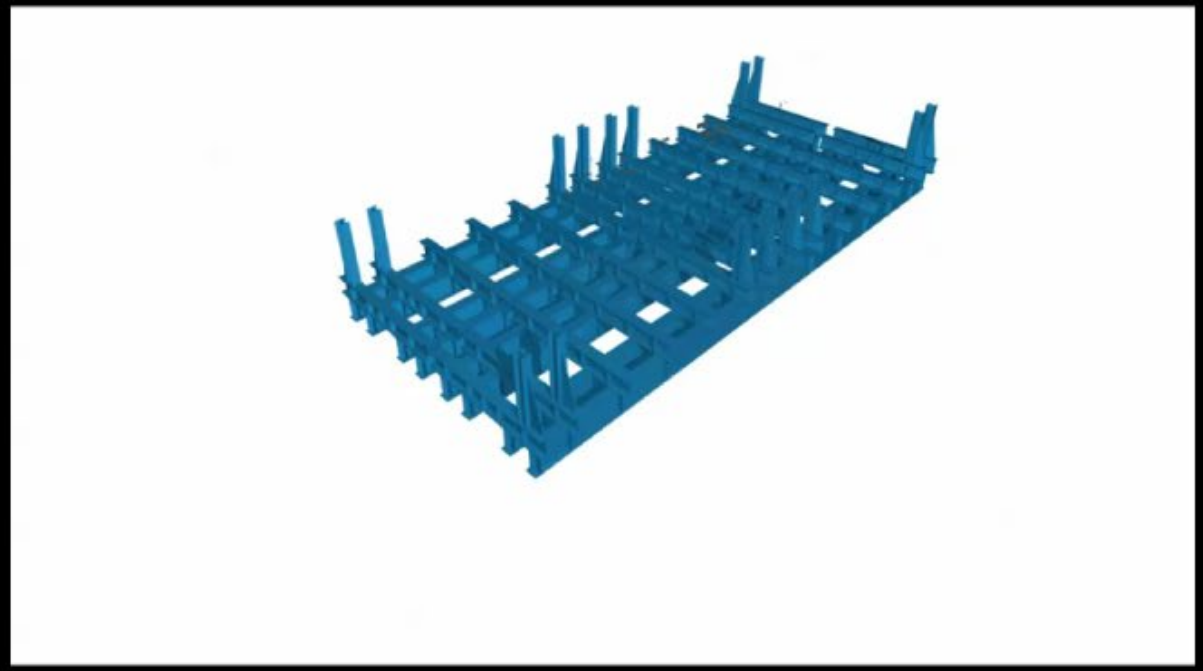


Digital Processing of Steel Structure Based on BIM

中国中铁

Steel structure model → Model optimization → Assemble simulation → Output digital control file → Automatic layout → Intelligent digital controlled cutting → Excess stock management

The fabrication process of components is visualized through simulation, thereby helping creating precise processing techniques.



Digital Processing of Steel Structure Based on BIM

中国中铁

Steel structure model → Model optimization → Assemble simulation → Output digital control file → Automatic layout → Intelligent digital controlled cutting → Excess stock management

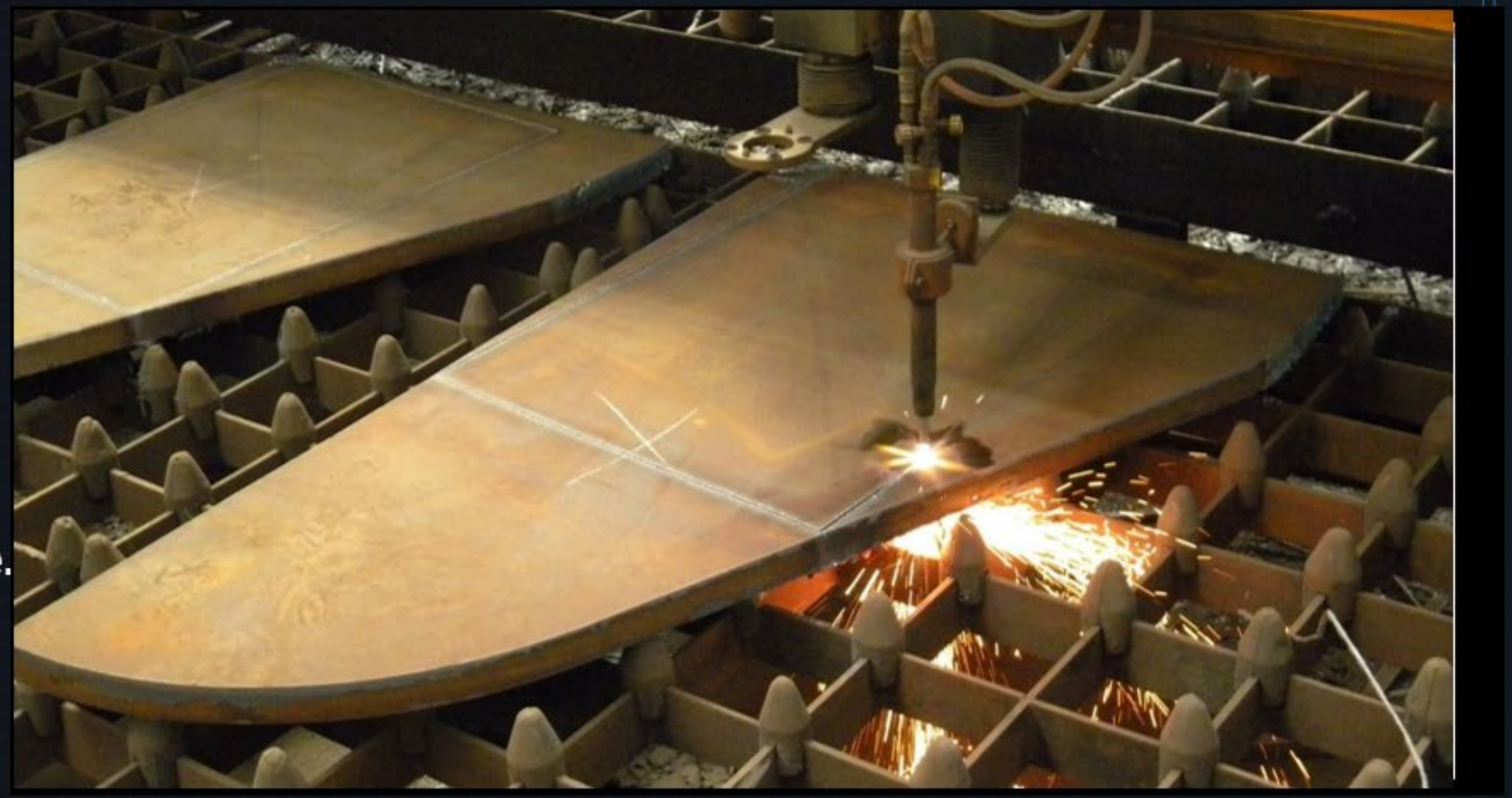
Cutting lead is added automatically, the best cutting path is simulated to ensure saving the consumable material.

Digital Processing of Steel Structure Based on BIM

中国中铁

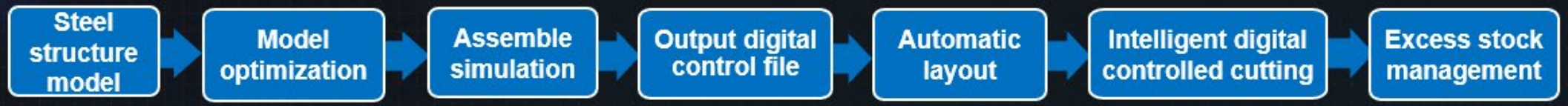
Steel structure model → Model optimization → Assemble simulation → Output digital control file → Automatic layout → Intelligent digital controlled cutting → Excess stock management

Monitor the parts processing progress, material usage in real-time. Take priority in using residual material to reduce material waste.



Digital Processing of Steel Structure Based on BIM

中国中铁



- Material loss reduced by 1.8%
- Waste reduced by 2%
- Typesetting efficiency increased by 280%

Informatized Logistics Transportation Management

中国中铁

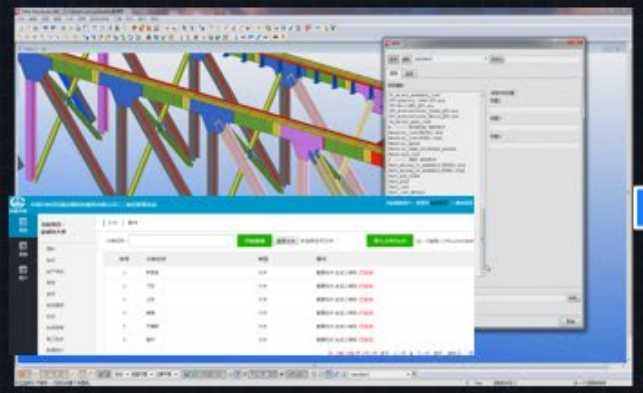
QR Code Management System Application

The QR code management system of **China Tiesiju Civil Engineering Group CO.,LTD** takes QR code as the carrier and BIM model as the foundation, integrates informatization, Internet of Things, big data analysis and other means. It is used for raw material warehousing in workshop, component inspection, finished product protection, delivery, receiving, on-site acceptance among other series of operational processes, thereby realizing the tracking and control of the whole process of steel components from manufacturing to installation.

Informatized Logistics Transportation Management

中国中铁

QR code management system application



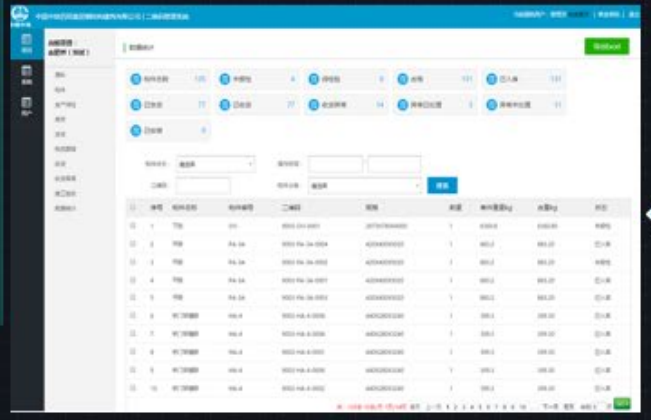
Entering component information

Inspecting and putting in storage

Delivery management

Logistics tracking

Receiving and acceptance checking

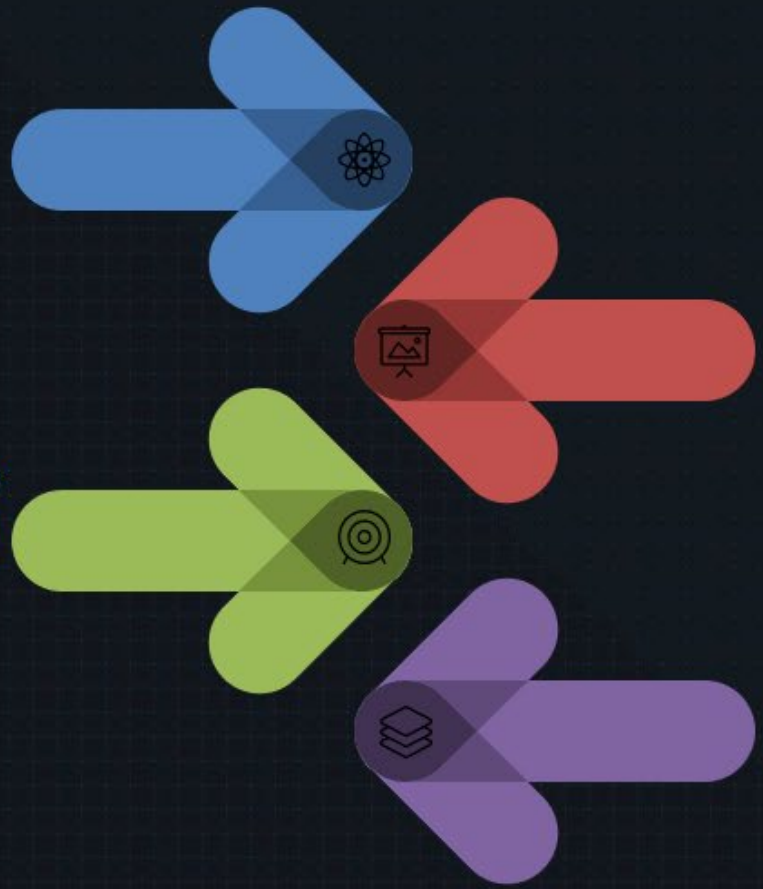


Data statistics

Informatized Logistics Transportation Management

中国中铁

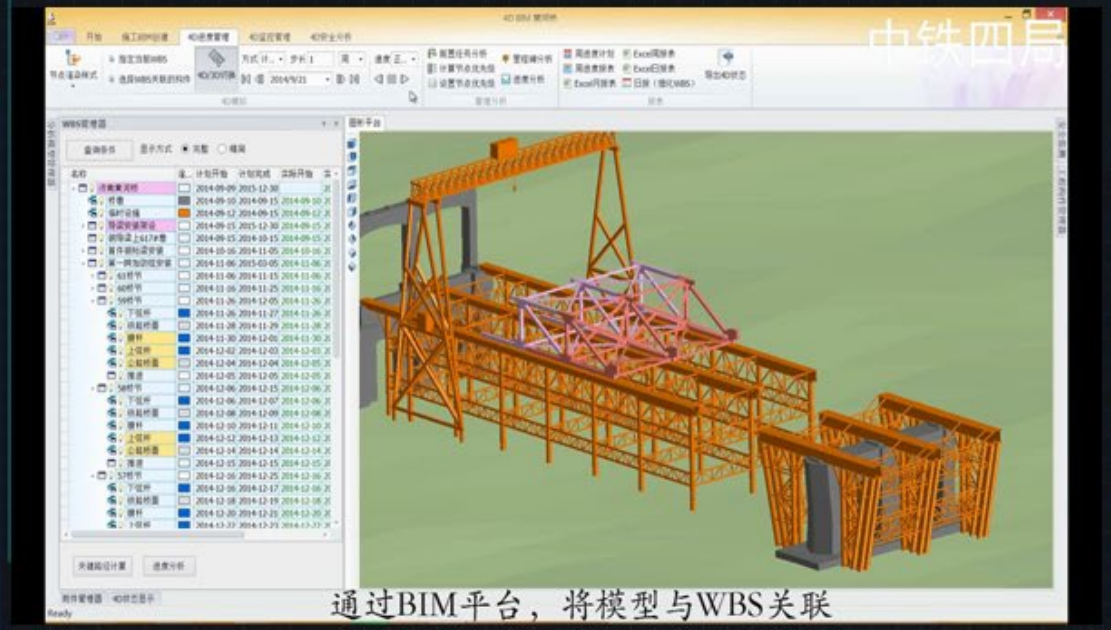
- Improve production management efficiency 200%
- Reduce the error rate of component production and transportation 86%
- Improve the efficiency of logistics vehicle transportation scheduling 120%
- Realize production process informatization



Fabricated site construction management

construction simulation

Constructors can use BIM to simulate construction



Progress simulation of jinan Yellow River railway bridge

Steel beam hoisting simulationof yancheng bridge


THANK YOU
中国中铁