

BIM based Code Compliance Checking using AI in Korea

International Technical Symposiums on
*the Application of BIM Technology in the Collaboration
of Design, Construction and Real Estate Enterprises*

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Member, Board of Director / Fellow



buildingSMART Korea

Founder, Chief Vice President



Society for Computational Design and Engineering

Next President (from Feb 2020)



Korea Construction IT Convergence Institute

Vice President

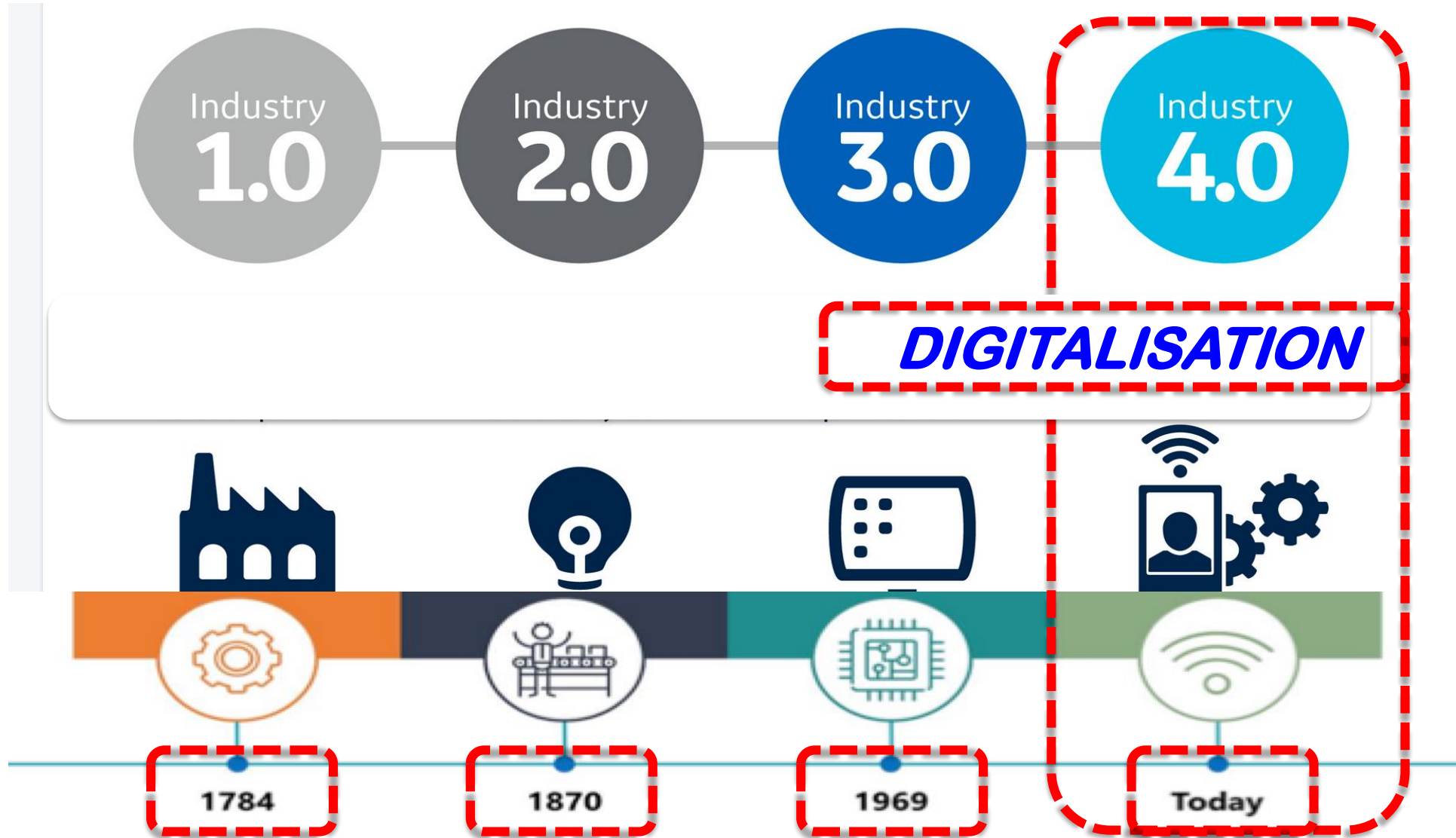


i3CDE2019 Congress Chair

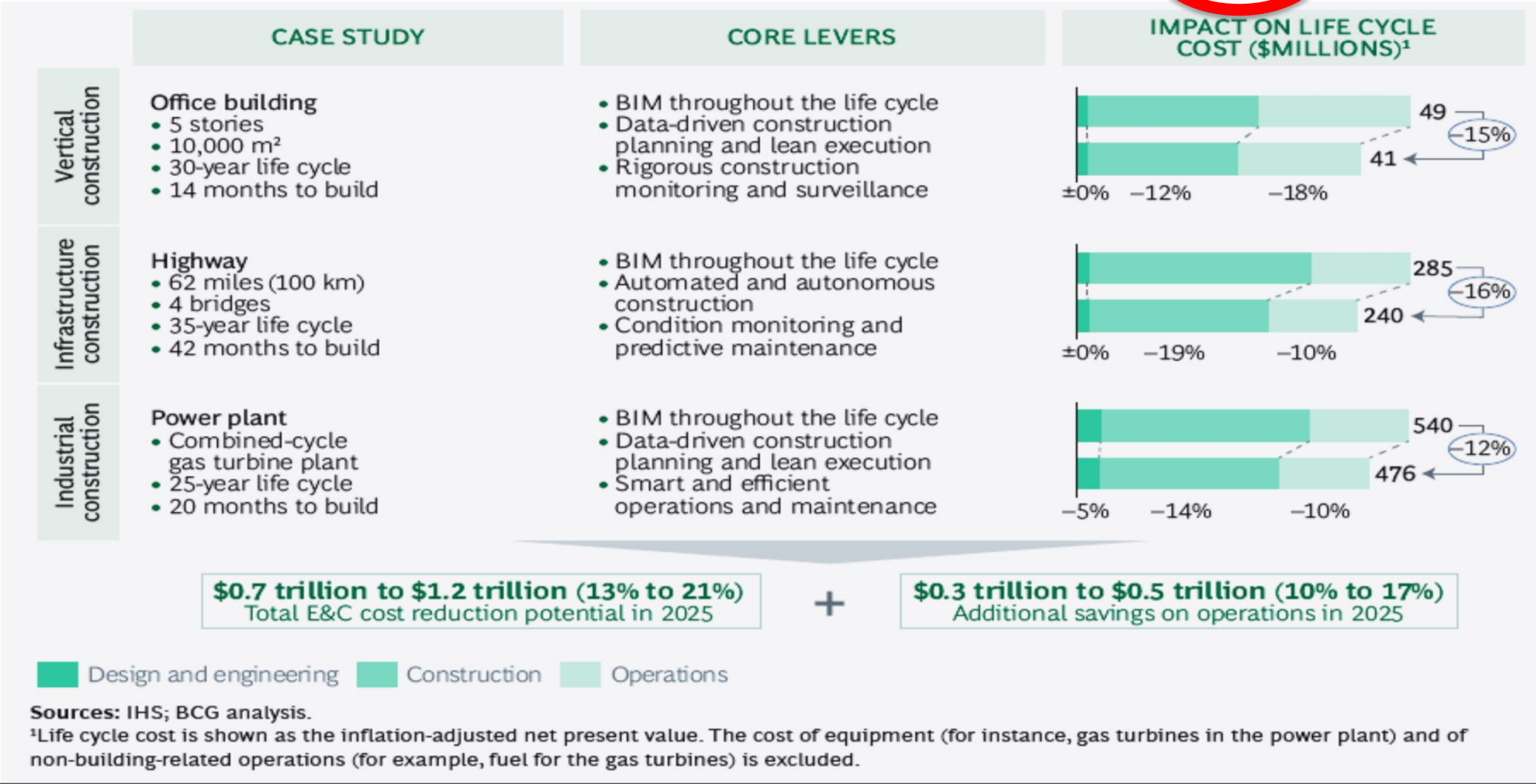
- With the advent of the fourth industrial revolution, the application of IT technology in the field of AEC has also increased dramatically. BIM technology has recently received extensive attention and application.
- Ensuring the quality of BIM model and meet the different kinds of requirements has become the trend and theme of recent research. In Korea, AI technology to check BIM data to improve the quality of BIM model has been applied. In this presentation, various efforts in Korea to develop BIM based automated compliance checking using AI and its related projects will be illustrated.
- In the future, the use of BIM in design will be a necessary way of work. By introducing AI into the process of BIM based code compliance checking, the design environment and building approval process will be greatly improved. The high quality BIM data obtained will provide a strong building data base for the era of big data. We should always be ready for the innovation of BIM technology.

CONSTRUCTION SITE

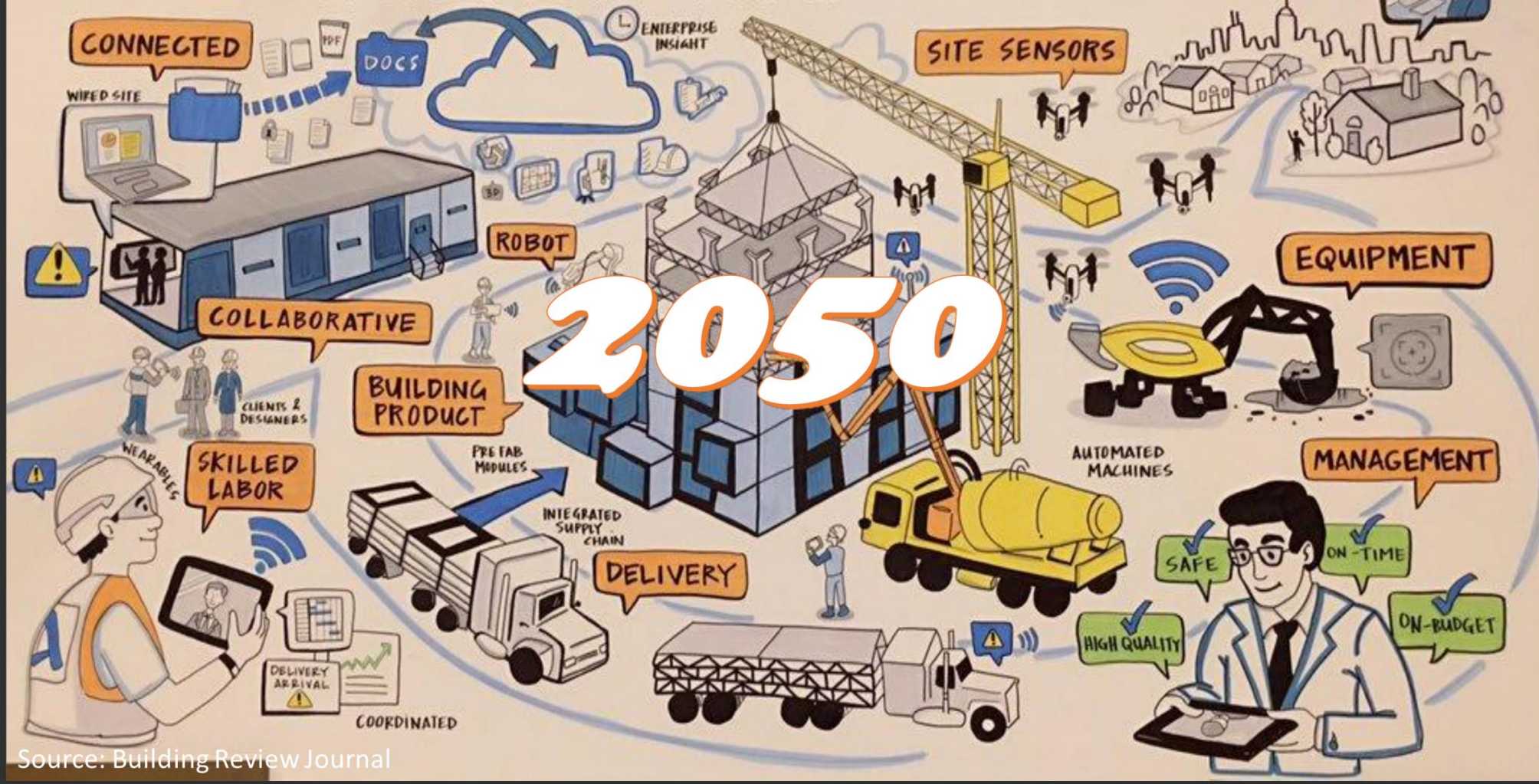




Digital Transformation could reduce **> \$1T** / year

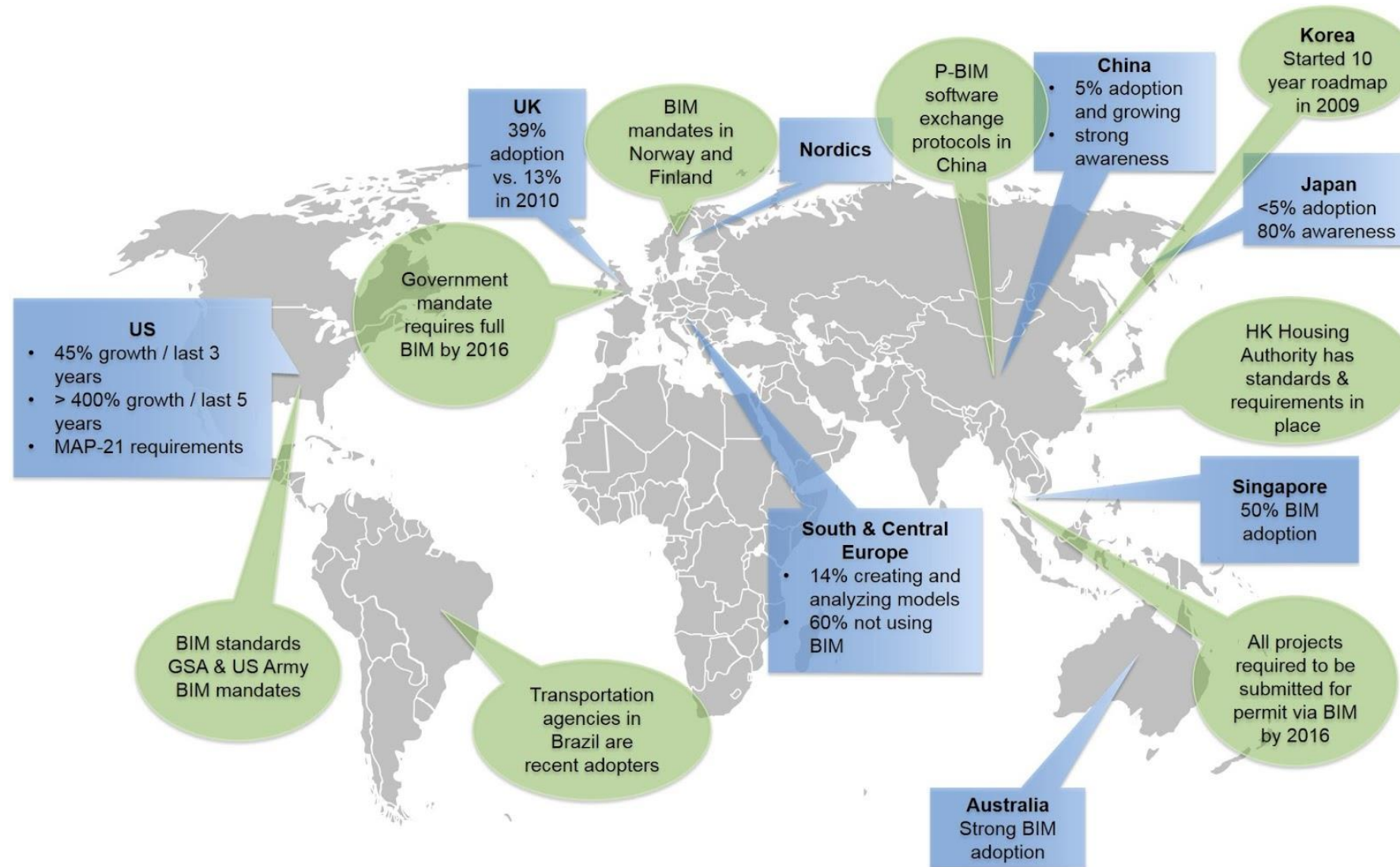


CONSTRUCTION SITE OF THE FUTURE



Source: Building Review Journal

The adoption situation of BIM around the world

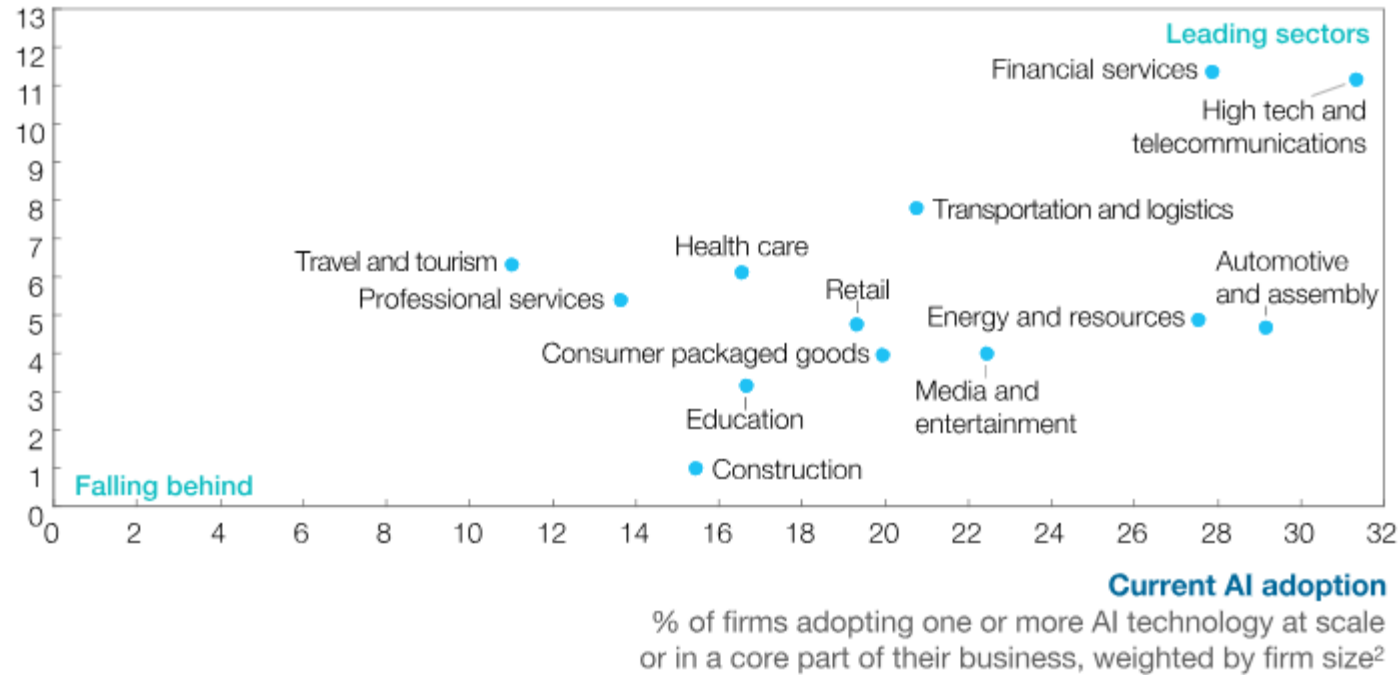


Source: James Holloway 2015

AI Technology Application Status by Industry

Future AI demand trajectory¹

Average estimated % change in AI spending, next 3 years, weighted by firm size²



1 Based on the midpoint of the range selected by the survey respondent.

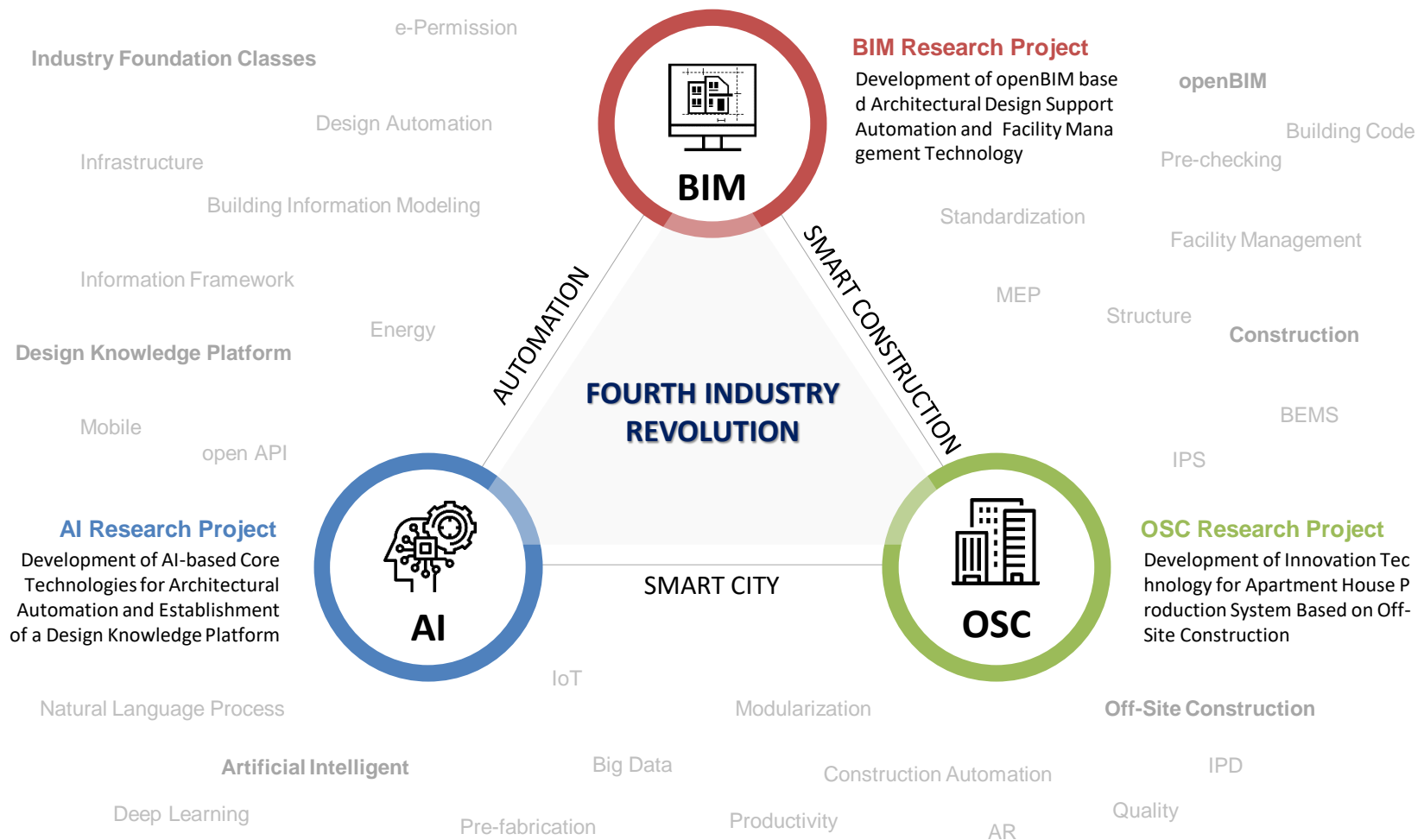
2 Results are weighted by firm size. See Appendix for an explanation of the weighting methodology.

Source: Michael Chui, James Manyika, and Mehdi Miremadi, "What AI can and can't do (yet) for your business," *McKinsey Quarterly*, January 2018, McKinsey.com

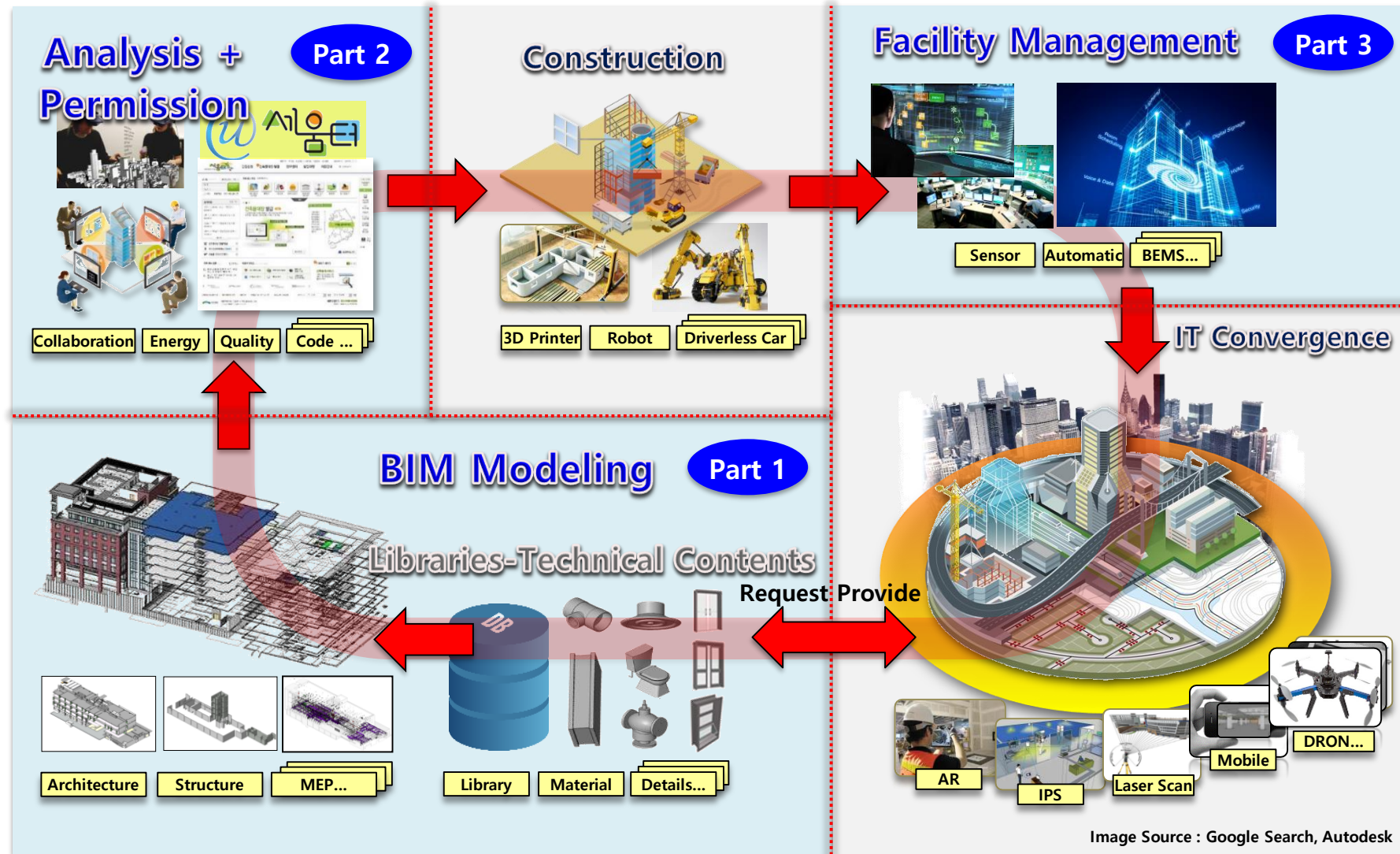
McKinsey&Company

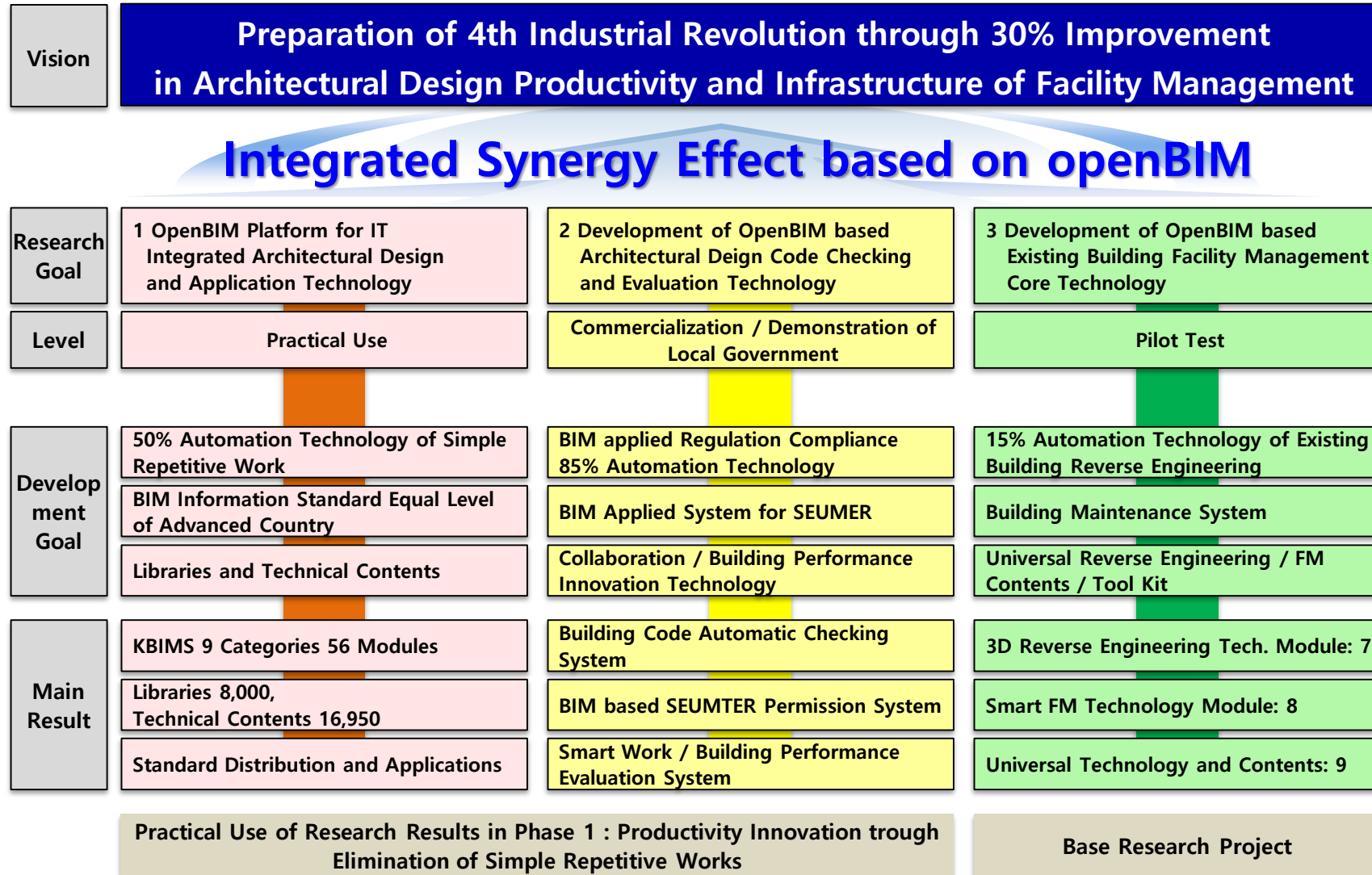
BIM and e-Permission Related Research in Korea

Research Projects Overview in Korea



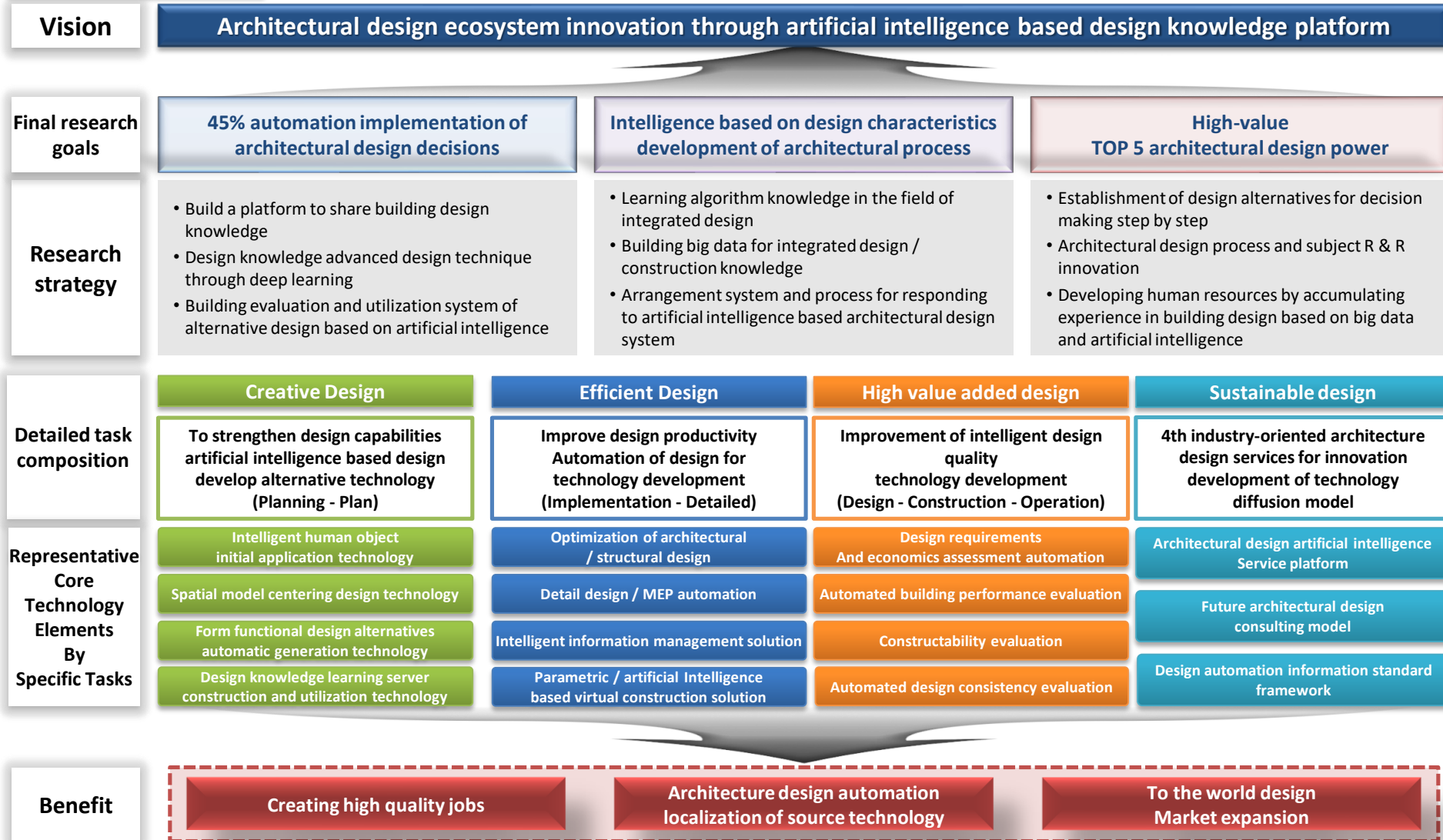
BIM : Building Information Modeling



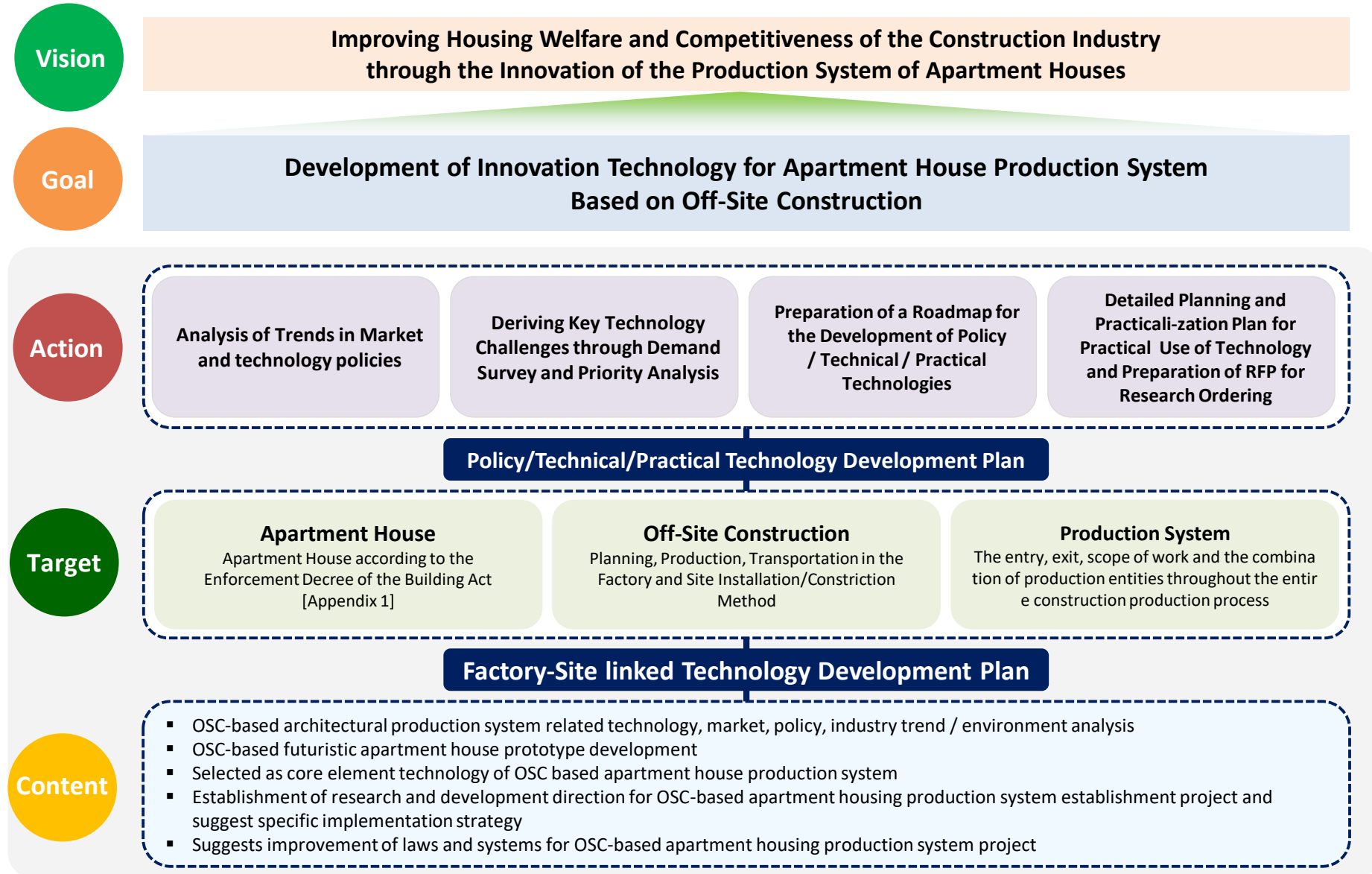


Development of AI-based Core Technologies for Architectural Automation and Establishment of a Design Knowledge Platform

Vision and Goal



Development of Innovation Technology for Apartment House Production System Based on Off-Site Construction



Automated Code Compliance Checking Project

Goals and Vision

Vision

Innovative quality enhancement to strengthen competitiveness in construction industry 提升创新品质来增强在建筑业的竞争力

Strategic Goal

50% reduction of Permit Documenting time
许可文件制作时间减少50%

30% reduction of Permit processing period
许可流程时间减少30%

50% reduction of energy analysis time
能源分析时间减少50%

Key Strategy

Standardization
Standard

Logic & Rule Processing
Rules

Automation
Auto Verification

Optimization
Optimized Environment

Integration
Integrated Process

Implementation
application

Applied Technology

Assess criteria and modeling guide

Automated BIM data assessment

Rules and Rule set management

Purpose driven BIM data Quality Assurance and evaluation

Automated Governmental Permit system and Quality verification technology

Optimized drawing standard and guideline

Precedent projects and templates for BIM standards

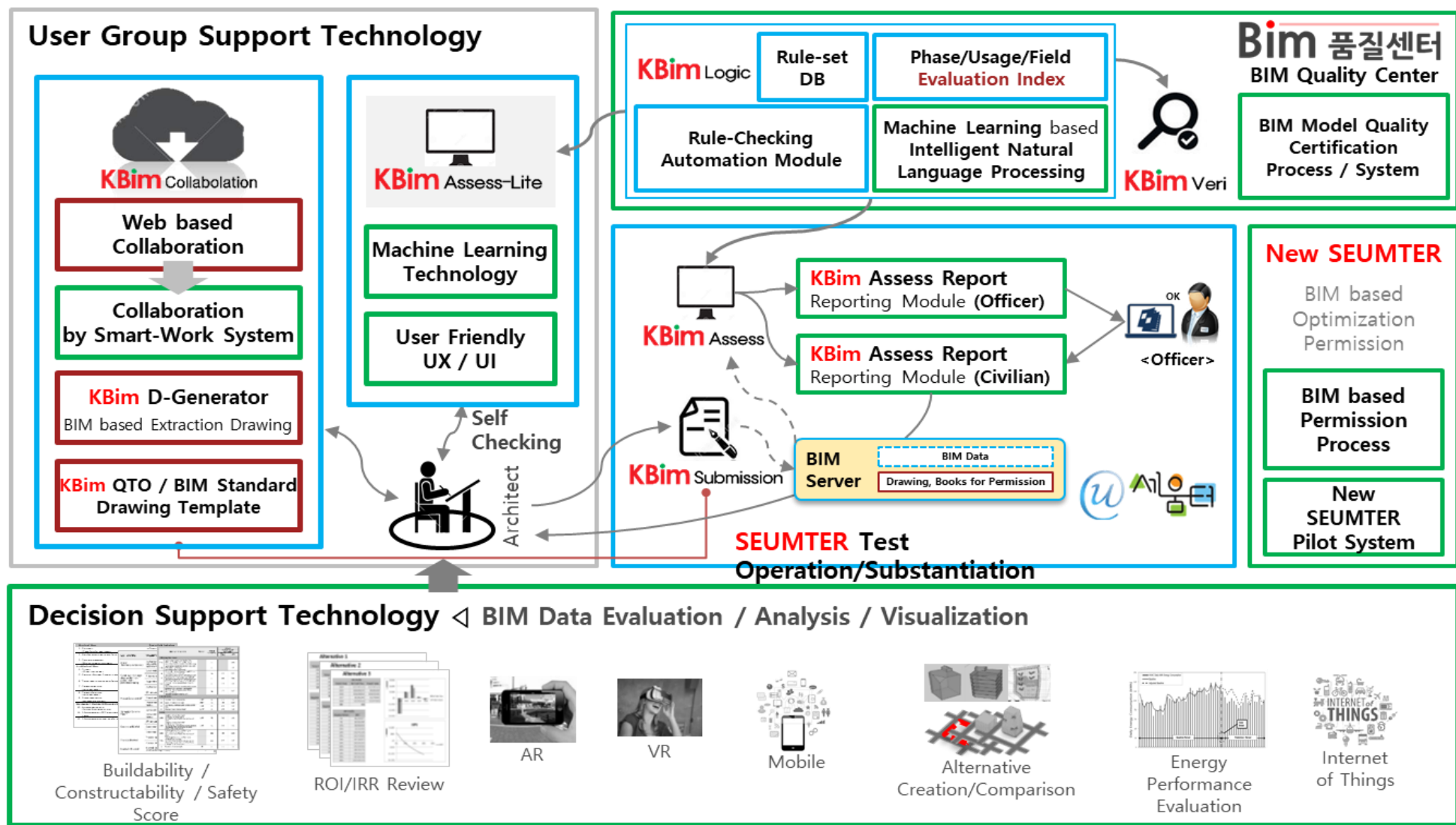
extracting and utilizing BIM derived information

Integration of Permit Documenting work between Arch-Eng

Open BIM based Integrated work flow

Open BIM Derived information mgmt system for permit process

Project Concept



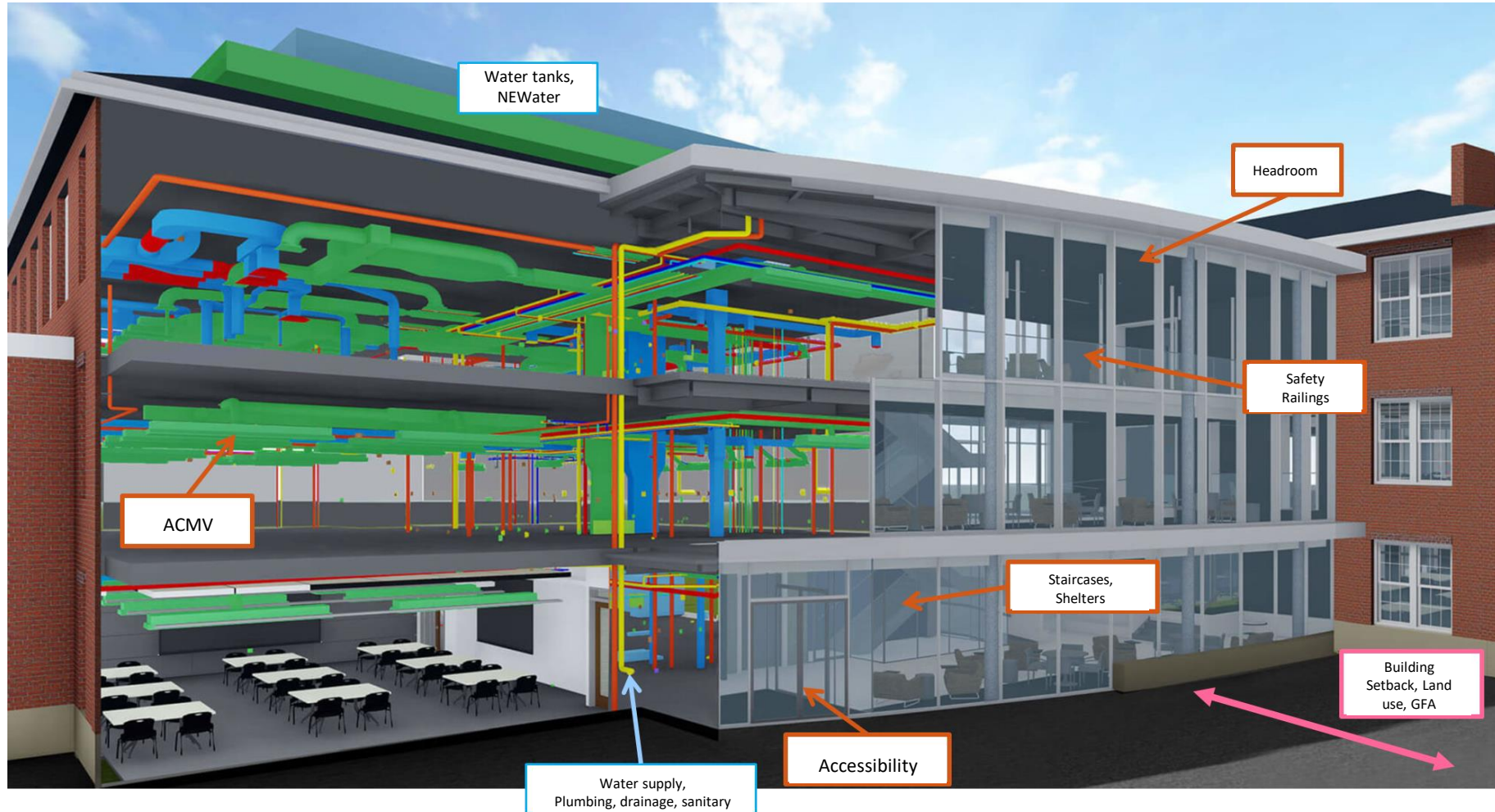
* SEUMTER (Korean Building Permission System)

Phase 1

Phase 1 + Phase 2

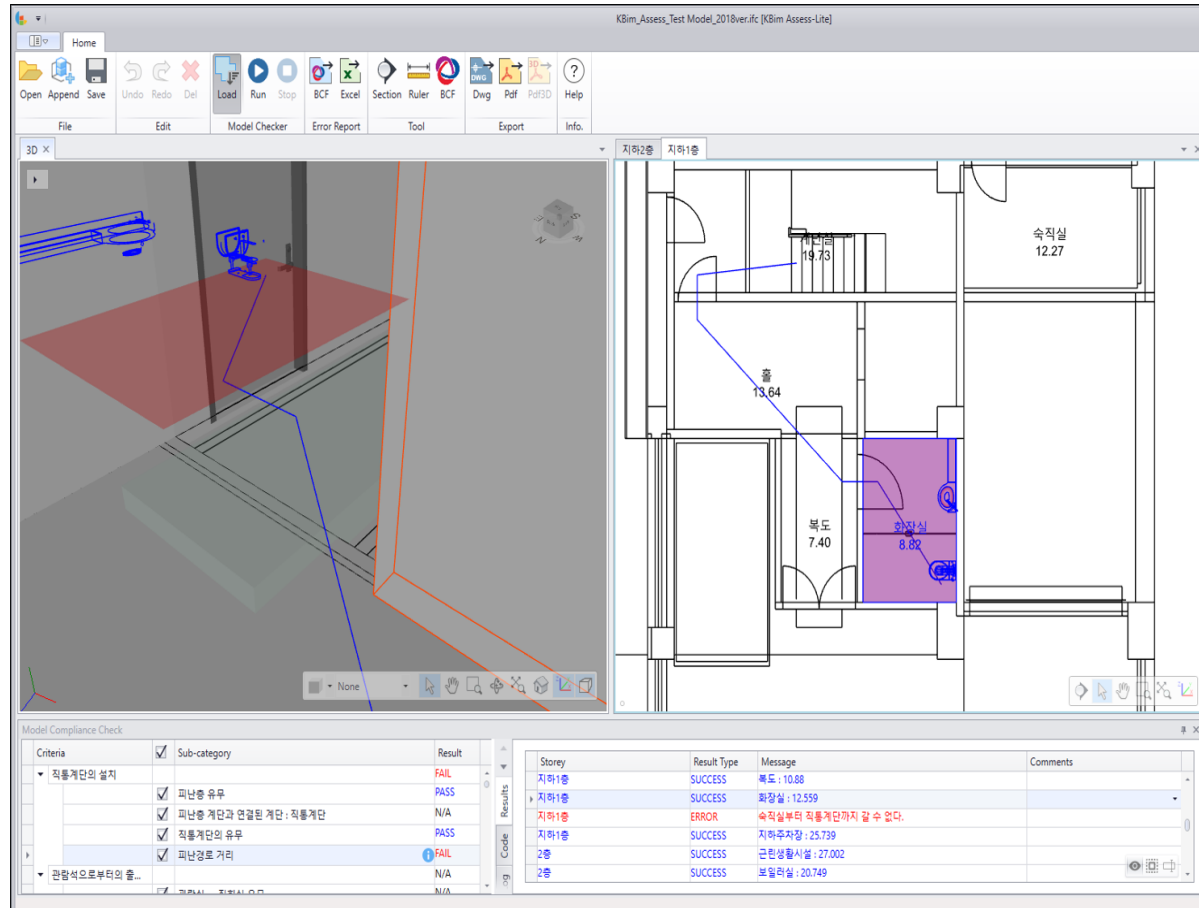
Phase 2

Examples of Code Compliance Checking

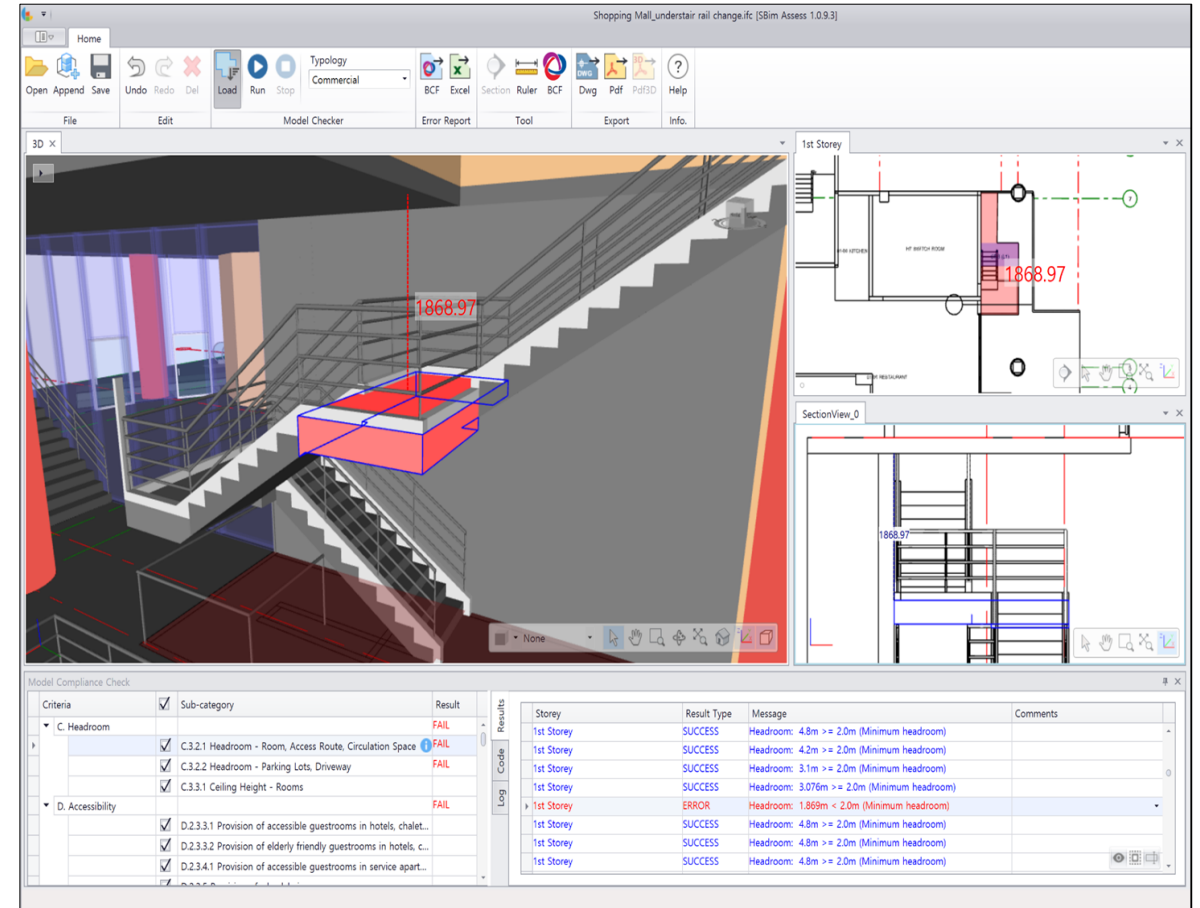


Singapore BCA Project by BIM Services Ltd.

KBim Assess (Automated Code Compliance Checking Application)



Checking for Evacuation Route




Checking for Headroom

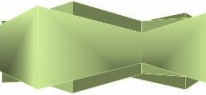
BIM-based Buildability Evaluation Technology

Buildability Evaluation Technology Flow


Overseas Cases

LSI(Labor Saving Index)


CODE OF PRACTICE ON Buildability
2017 Edition

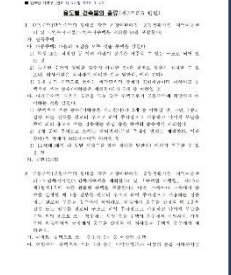





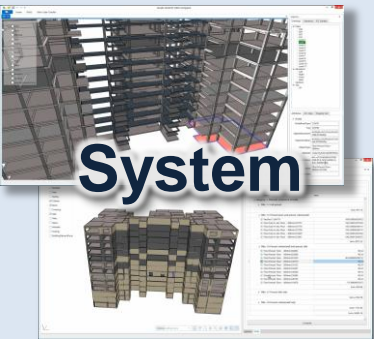
BI(Buildability Index)


THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學



Domestic Cases

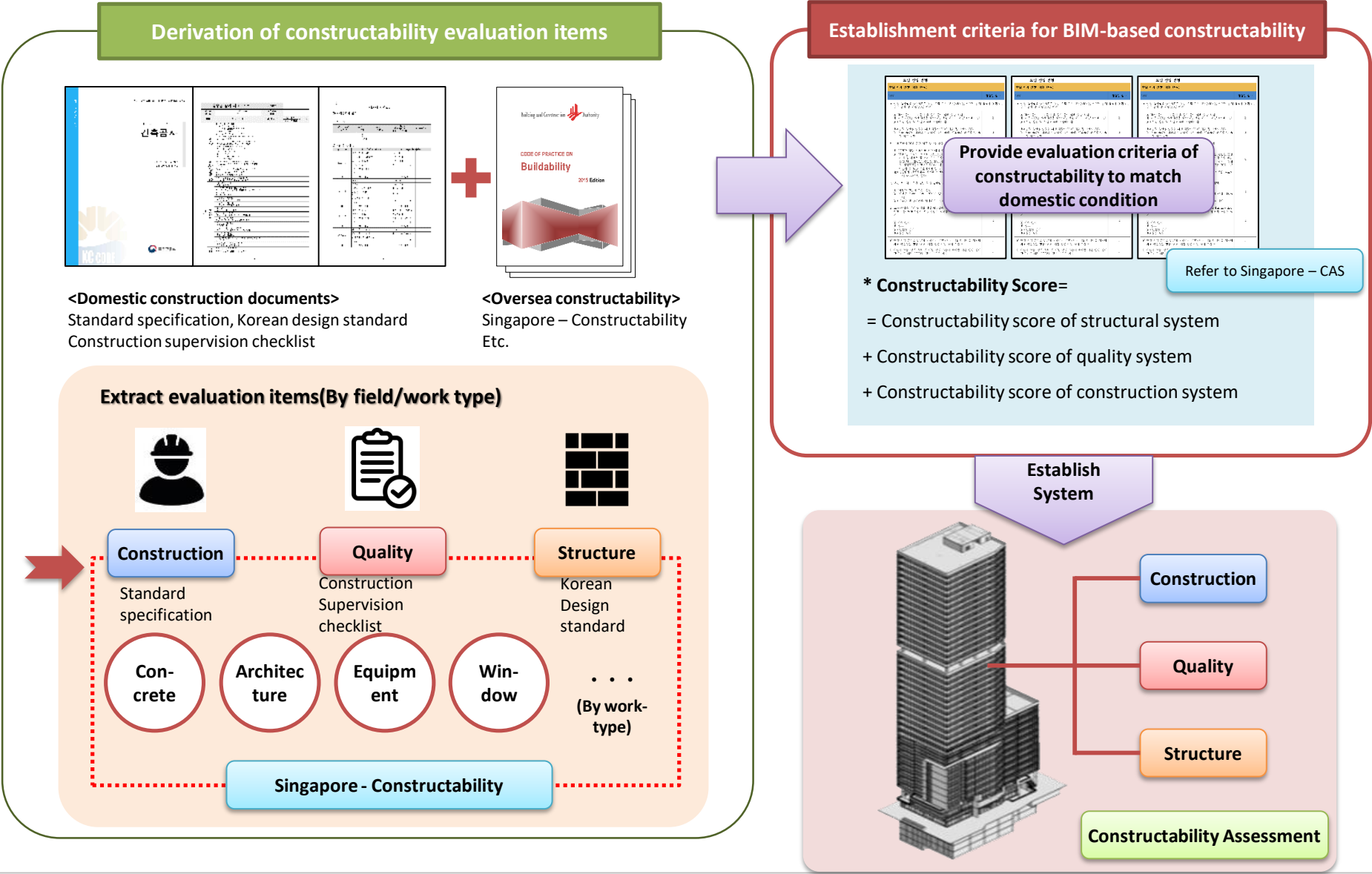
Enforcement Decree of Building Law	Rules for Structural Standards of Buildings, Etc.	KDS Code (Korean Design Standard)	Architectural Structural Design Criteria
			



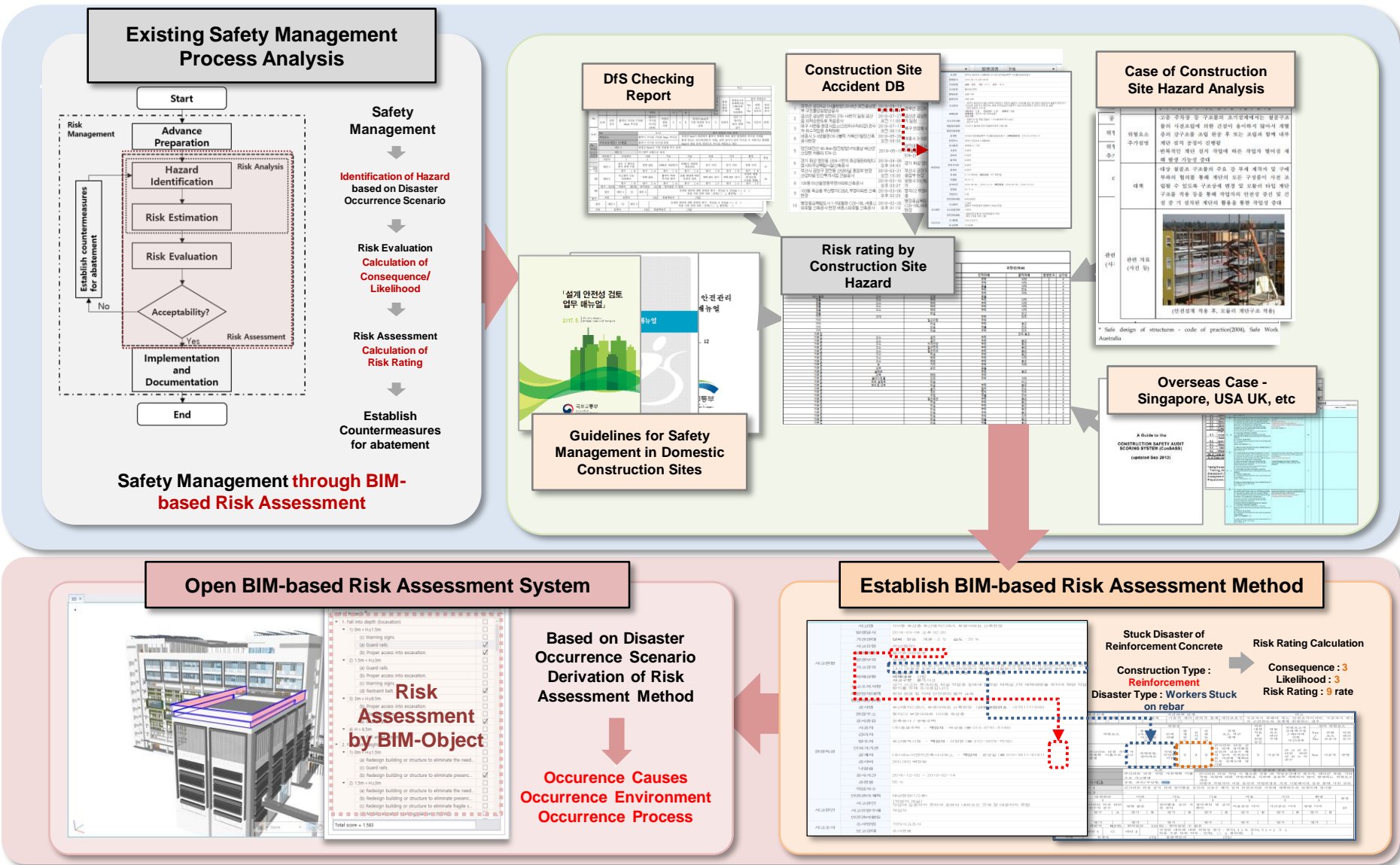
Extracting Buildability New Main Categories

Structural System		Wall System		Other Buildable Features	
Concrete Structure	Wood Structure	General Panel	Concrete	Building Service Aspects	Site Specific Factor
Base Structure	...	Masonry wall	...	Building Feature	...
Structural System Total : 6 Main Categories		Wall System Total details : 27 Main Categories		Other Buildable Features Total details : 00 Categories	

BIM-based Constructability Evaluation Technology



BIM-based Pre-evaluation Technology for Improving Building Safety and Defects



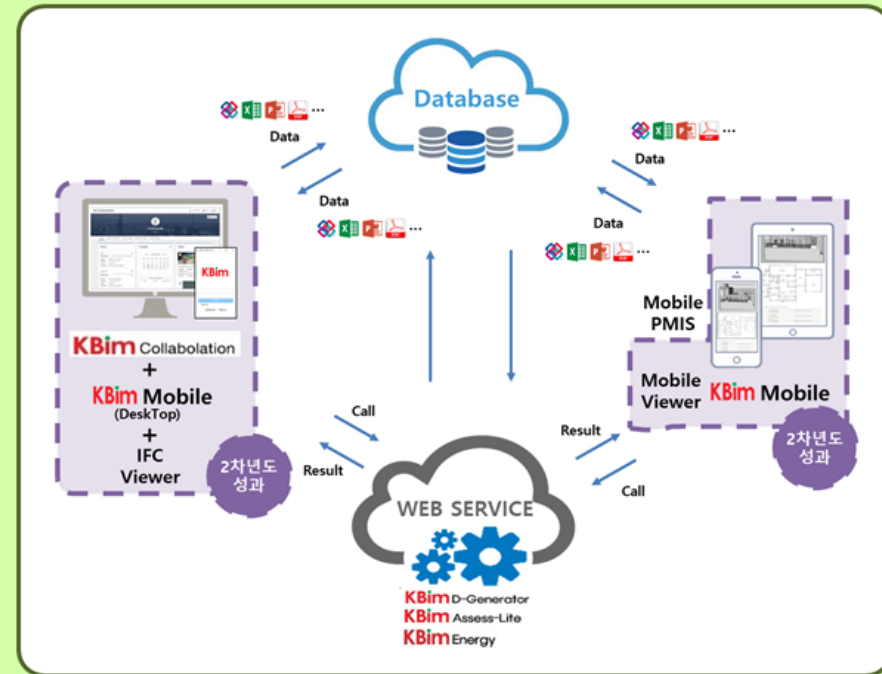
Smart Work Technology for Automatic Building Code checking

KBim Mobile(Smart Work platform)

Software (Desktop version and Android version)

KBim Mobile development (Smart work platform)

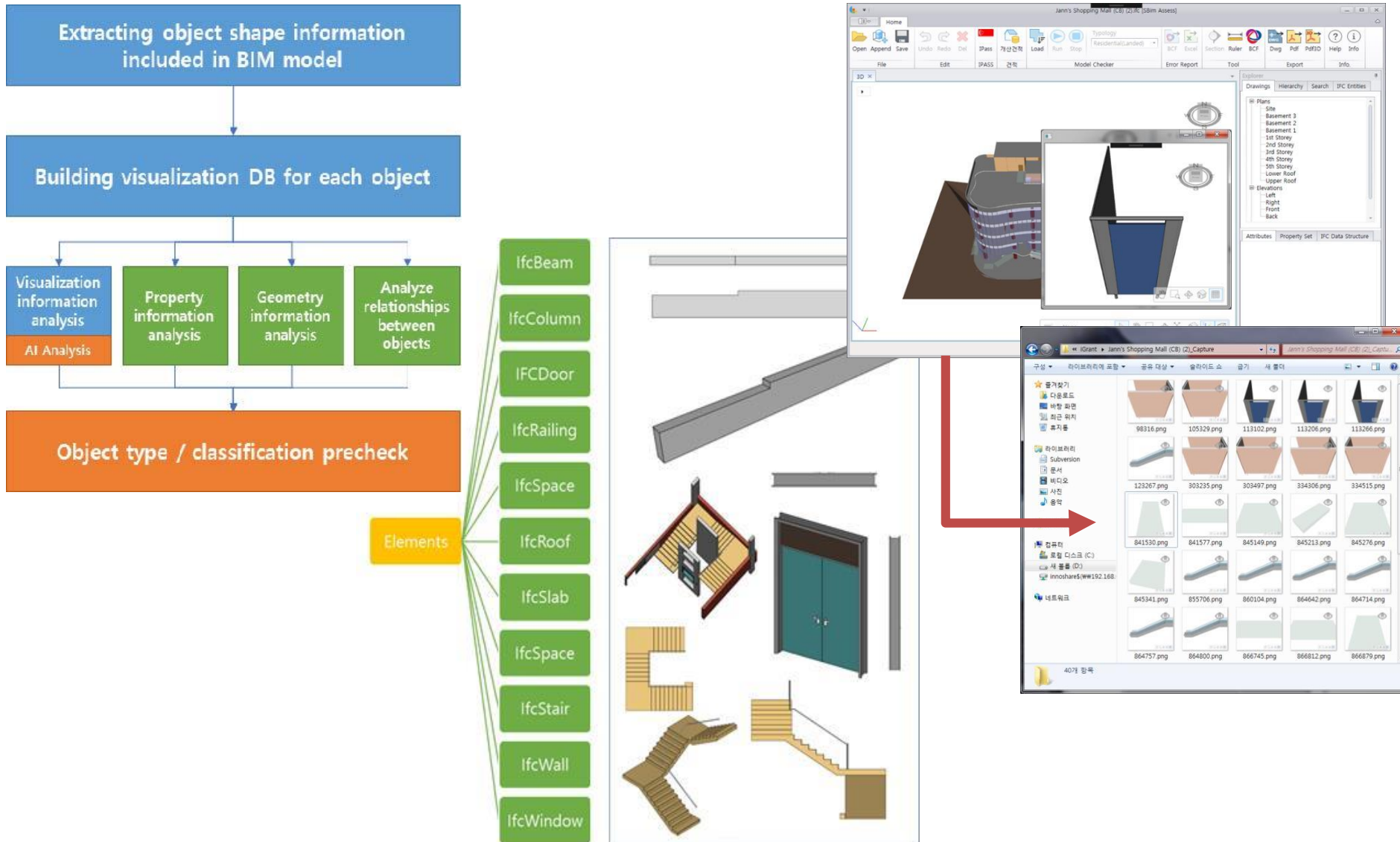
- Making mobile systems for the workers who has more face-to-face and mobile field work.
- Achieving the basic communication(chatting) and file transfer function
- Developing and loading the OpenBIM support viewer (PC, Mobile Viewer) suitable for construction project
- Later complete the platform used for loading the KBim application used for building code checking



- Loading communication and BIM format files viewing for smart work system suitable for collaboration between construction participants in different stages of construction project.

AI Based Code Compliance Checking

Development of BIM Data Visual Analysis Interface Technology



Development of BIM Data Visual Analysis Interface Technology

The screenshot displays the KBIM Assess-Lite software interface for 'Jann's Shopping Mall (CB) (2).ifc'. The interface includes a ribbon menu with tabs for File, Edit, IPASS, Construction, Model Checker, Error Report, Tool, Export, and Info. The main workspace is divided into three panes: a 3D model view on the left, a 2D floor plan view in the center, and an Explorer panel on the right. The 3D model shows a corridor with a door. The 2D floor plan shows a layout with labels for 'FC3-1 AMBULANT', 'MC3-2', 'FC3-2', 'FC3-3', 'FEMALE TOILET 3', and 'SMOKE ST'. The Explorer panel shows a hierarchy of elements including Plans, Elevations, Sections, and 3Ds. The Model Compliance Check results table is visible at the bottom.

Criteria	Sub-category	Result
Pre-check on BIM Mo...		FAIL
직통계단의 설치	형상 분석	FAIL
	피난층 유무	FAIL
	피난층 계단과 연결된 계단 : 직통계단	N/A
	직통계단의 유무	FAIL
	피난경로 거리	FAIL
관람석으로부터의 출...		N/A

Storey	Result Type	Message	Comments
3rd Storey	ERROR	형상:Door, 신뢰도:1.0	
3rd Storey	ERROR	형상:Door, 신뢰도:0.999	
3rd Storey	ERROR	형상:Door, 신뢰도:1.0	
3rd Storey	ERROR	형상:Door, 신뢰도:0.87	
3rd Storey	ERROR	형상:Wall, 신뢰도:0.997	
3rd Storey	SUCCESS	형상:Door, 신뢰도:0.437	
3rd Storey	ERROR	형상:Slab, 신뢰도:0.997	
3rd Storey	ERROR	형상:Slab, 신뢰도:1.0	

Attributes Property Set IFC Data Structure

Filter

^ IfcBuildingElementProxy

CompositionType:

Tag: 1098956

ObjectType: Toilet Cubicle - Amb.

GlobalId: 0YW9_7MLv7wAsaXVTt64y

Name: Toilet Cubicle - End Adjacent

Description:





buildingSMART International Standards Summit

Toronto 2014, London 2015, Singapore 2015, Benelux 2016
Jeju 2016, Barcelona 2017, London 2017, Paris 2018,
Tokyo 2018, **Dusseldorf 2019**



Regulatory Room

to promote Automated Code-Checking

Since October 2014, founded according to Prof. Inhan Kim's proposal
Co-chair Kyung Hee University Professor Inhan Kim,
Norway Øivind Rooth

Nation Participation in 12 Countries
Next Meeting Beijing International Standards Summit

Development of International Standardization of process, technology, guide for **openBIM based Automated Code Checking**
as the international authority, to discuss the technical development of automated code checking focused on this study



Document	Title	Organization	Author	Date	Status
Regulatory Room	Regulatory Room	buildingSMART	Inhan Kim	2014	Final

Time	#	Activity	Chair
09:00	1	Regulatory Room meeting opening session	Inhan Kim
09:30	2	Regulatory Room meeting opening session	Inhan Kim
10:00	3	Regulatory Room meeting opening session	Inhan Kim
10:30	4	Regulatory Room meeting opening session	Inhan Kim
11:00	5	Regulatory Room meeting opening session	Inhan Kim
11:30	6	Regulatory Room meeting opening session	Inhan Kim
12:00	7	Regulatory Room meeting opening session	Inhan Kim
12:30	8	Regulatory Room meeting opening session	Inhan Kim
13:00	9	Regulatory Room meeting opening session	Inhan Kim
13:30	10	Regulatory Room meeting opening session	Inhan Kim
14:00	11	Regulatory Room meeting opening session	Inhan Kim
14:30	12	Regulatory Room meeting opening session	Inhan Kim
15:00	13	Regulatory Room meeting opening session	Inhan Kim
15:30	14	Regulatory Room meeting opening session	Inhan Kim
16:00	15	Regulatory Room meeting opening session	Inhan Kim

Regulators Room to promote automated code checking

Latest addition to buildingSMART rooms

What if a project owner could know at once if a project design meets the country's building regulations? What if a designer could get instant, automated feedback to successive changes as the design is iterated and improved? What if the information in a project BIM could be understood and checked by software within a local planning authority?

The reality today is more than a series of 'what ifs'. Building code-checking systems, based on the IFC standard, are taking shape around the world. But it is early days, and only a small number of countries have started to explore the use of these automated code-checking procedures. Clearly, there are many more countries that could benefit.

This is where the buildingSMART Regulators Room comes in. 'We want to provide a room for open discussion of regulation and open BIM,' explains Inhan Kim, a professor at Kyung Hee University and chief vice-chairman of buildingSMART Korea, who leads the room. 'We want to bring together government building regulators, researchers and implementers to promote open BIM-based building permissions and code-checking processes, and explore the collaborative issues.'

Although building codes – also known as building regulations – differ from country to country, automated code-checking systems have much in common, whatever the country of operation. 'Accordingly, international collaborative research is necessary,' says Inhan.

The first step will be to form a team with members drawn from a core group of seven chapters who are interested in the project. Norway, Singapore, Australia, US, UK, Finland and Korea. The group will share information on the progress that has been made on automated code-checking in the different countries – some of the countries are well advanced – and seek out opportunities for technical co-operation.

The Regulators Room is still in formation and has its first meeting in Toronto during buildingSMART week in October. The creation of this new room to meet industry needs underpins the strength of buildingSMART's flexible approach to creating and maintaining these special-interest working groups.

The Regulators Room would like to hear from anyone interested in taking part in the activities of the room. Please contact Inhan Kim, inhan@khu.ac.kr

Richard Petrie confirmed as CEO



Speaking of the strategic changes at bSI, he says, 'We are developing a clearer way to deliver standards, more structured certification and closer links between the regional chapters and bSI. I want to see buildingSMART become the premier forum for identifying and executing projects for better interoperability.'

Role of the Regulators Room

The Regulators Room has yet to define its mission but first indications are that it will...

- encourage the early adopters of e-submission systems to share their experiences and boost interest
- compare maturity of development among participating countries
- consider the technical issues of language and syntactic code translation; how a code-checking system can accommodate BIM designs; and how to

Activity of Building Code Checking Overview

State	Topic
Korea	Automated Code Compliance Checker(Kyung Hee University)
Japan	Application for building confirmation by digital data(Nikken Sekkei)
France	Digital Transition in the Building Industry(CSTB)
Sweden	Digital application of the Planning and Building Act(Boverket)
China	The BIMChecker(Tsinghua university)
Norway	Common services for Construction Government services for building applications(Øivind Rooth)
Italy	BIM Code Checking(ACCASOFTWARE)
Singapore	Updates Singapore BIM/VDC efforts (Cheng Tai FattBuilding & Construction Authority)
Estonia	Estonian e-Permit solution (Head of Digital Construction of Estonia)
UK	Specification for collaborative sharing and use of structured Health and Safety information using BIM(PAS 1192)
Finland	ePermit(KIRA-digi)



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for your attention!**