S&E

Space & Environment
is a quarterly English magazine intended to disseminate research output and international activities of Korea Research Institute for Human Settlements

Vol. 96
DECEMBER 2023

Current Issues of Construction Economy in Korea

ISSN 2671-9037
9 772671 903003 34

Published by Korea Research Institute for Human Settlements (KRIHS, http://www.krihs.re.kr/)
Publisher Gyo-Eon Shim
Edited by Global Development Partnership Center (GDPC, http://gdpc.kr/)
Editorial Team Youn Hee Jeong (Editor), Hye Jung Park, Jeong Yun Hwang
Tel. +82-44-960-0429 Fax. +82-44-211-4772
Designed and Produced by Goryeo C&P Co., Ltd. Tel. +82-2-2277-1508~9

5 Gukchaegyeonguwon-ro, Sejong-si, 30147, Korea

01 Greenhouse Gas Reduction Effects of Digital Construction Technology: Focused on BIM

Chijoo Lee

1. Need for Implementing BIM to Reduce Greenhouse Gases

■ **Over 39% of global carbon emissions are attributed to the operation of buildings and the production of building materials and construction phases (World Green Building Council 2019).**

The operational phase contributes to 28% of carbon emissions, encompassing activities such as heating, cooling, lighting, cooking, and equipment operation, while the production and construction phases account for 11%. While the operational phase continuously emits carbon for over 40 years, as noted in the Enforcement Rules of the Corporate Tax Act of 2022, carbon emission due to the construction phase typically spans 2–3 years. Despite this shorter duration relative to the operational phase, it is crucial to implement carbon-neutral strategies during the construction phase, given its significant greenhouse gas (GHG) output. This importance is heightened when factoring in the potential increase in GHG emissions from the construction phase due to waste management associated with rework.

■ **GHGs in the construction phase are emitted from building material production, transportation, equipment use, and waste management processes resulting from rework.**

The building life cycle is segmented into planning, construction, operation, and demolition phases. To curtail GHG emissions during construction, selecting building materials that produce low emissions during their production and disposal stages is crucial. Additionally, it is important to implement measures that enable waste mitigation by preventing rework.

During building construction, prioritizing materials with diminished GHG emissions and minimizing design inaccuracies and modifications is crucial. Enhancing the completeness of the design can lead to reduced rework, which in turn can reduce GHG emissions. To this end, the government has been consistently promoting the use of Building Information Modeling (BIM) since 2018. BIM revolves around constructing a 3D virtual model of a facility and developing an information model based on the derived facility details, as stated by the Ministry of Land, Infrastructure, and Transport in 2022a. This modeling method offers advantages such as reducing mismatches and design errors compared to traditional 2D CAD drawings and facilitates diverse design modification alternatives (Eastman et al. 2009).

■ **This study aims to analyze the level of GHG reduction, as realized via the application of BIM, a key technology in the digital transformation of the construction industry, and propose measures for its promotion.**

2. GHG Reduction Policies of Building

■ **The centerpiece of South Korea's carbon-neutral policy in the building sector involves promoting green construction for low-carbon buildings (Park Jong-soon et al. 2022).**

Most strategies for carbon neutrality in the building sector focus on reducing GHG emissions during the operational phase, thus making it essential to establish reduction strategies for the construction phase, where large volumes of GHGs are emitted in a short period. Carbon-neutral strategies include improving building energy efficiency; developing and spreading high-efficiency, low-cost construction materials, equipment, and devices; constructing smart energy management systems; improving behavior; promoting renewable energy facilities and electrification in buildings.

■ **The government is implementing schemes, such as the GHG emissions trading system, offset system for GHG emissions trading, and GHG target management system.**

Major policies include the GHG emissions trading system, offset system for GHG emissions trading, and GHG target management system. The GHG emissions trading system involves allocating annual emission allowances to businesses by the government and permitting the trading of excess or shortfall allowances between businesses. The offset system for GHG emissions trading allows businesses not allocated emission allowances to apply their recognized GHG reduction achievements toward the emissions trading system. The GHG target management system designates businesses emitting at least 50,000 tCO_2eq or facilities emitting at least 15,000 tCO_2eq as managed entities. Furthermore, the system sets and oversees their GHG reduction targets.

3. GHG Reduction Effects from BIM Implementation

■ **Reducing GHG Emissions via BIM's "Design Support During Construction" Feature**

The BIM feature of "Design Support During Construction" is applied during construction to reduce GHG emissions, particularly focusing on reducing design errors and rework. This feature includes design change and alternative review and use of construction details and fabrication drawings. Among these, the design change and alternative review function contributes toward reducing design errors, rework, and GHG emissions. Table 1

■ **Method for Analyzing GHG Emissions After BIM Implementation**

The method proposed in this study to examine the changes in GHG emissions resulting from BIM application involves four stages: ① data collection, ② review of design errors and the need for rework, ③ analysis of the reduction in material volume due to reduced rework, and ④ analysis of the reduction in GHG emissions due to reduced material volume. When applying BIM, it is possible to analyze the reduction rates of construction material usage, material transportation distance due to decreased construction material usage, and waste material recycling. The assessment of design errors and rework necessity are based on the judgment of industry experts, with fuzzy theory and fuzzy hierarchical analysis applied to mitigate differences in expertise and reliability among these experts.

■ **GHG emissions were reduced by approximately 113,211 $kgCO_2$ during the construction phase due to the application of BIM to a case-study building**

The analysis shows that GHG emissions could be significantly reduced by reducing concrete waste (90,474 $kgCO_2$, 79.9%), as well as recycling waste concrete (11,377 $kgCO_2$, 10.0%) and reducing truck transportation distance (8,304 $kgCO_2$, 7.3%). For rigorous analysis, the calculated reduction in GHG emissions during the transportation process is based on the shortest distance assumption; therefore, the actual reduction in GHG emissions during the transportation phase could be even greater. Table 2

■ **Significance of the Reduced GHG Emissions corresponding to 113,211 $kgCO_2$**

The 113,211 $kgCO_2$ is equivalent to the GHG emissions from approximately 64 passenger cars and vans with 10 or fewer occupants traveling 20,000 km—based on the 2025

Table 1. BIM Features Applicable During the Construction Phase

Design Support During Construction	Construction Management	Off-Site Construction (OSC)	Cost Management
Process Management	Safety Management	Integration and Application of Smart Construction Technologies	…

Source
Based on Ministry of Land, Infrastructure and Transport (2022b), authored by the researcher

Table 2. Reduction Level of GHG Emissions Due to BIM Application (Unit: %)

Recycled Materials		Transportation	Production of Construction Materials						
Waste Iron Metal Recycling	Waste Concrete Recycling	Trucks	Paving Blocks	Gypsum board	Sump	H-Beams	Tiles	Rebar	Concrete
0.0	10.0	7.3	1.0	0.2	0.2	1.3	0.1	0.0	79.9

Source
Created by authors

GHG emissions limit of 89 g/km for passenger cars and vans with 10 or fewer occupants (Ministry of Environment 2021). To offset approximately 113,211 $kgCO_2$, pine trees in the range of 12,441–13,977 would be required—based on the annual absorption rates of GHG emissions by 30-year-old pine trees in the central region (9.1 $kgCO_2$) and in the Gangwon region (8.1 $kgCO_2$) (Lee Sun-Jeong et al. 2019). Figure 1

■ **Although the GHG reduction effects of BIM implementation have been proven, to date, the technology is not in a stable phase**

A survey conducted between December 14–21, 2022, which targeted 11 BIM managers in public procurement agencies, revealed that the stage of BIM implementation was deemed unstable. However, certain functions—including coordination among various construction types, constructability review, derivation of construction drawings from BIM models, visualization of the construction progression, 4D simulation, and generation of estimates and quantities—were recognized for their effectiveness.

■ **Need to Establish Strategies for Promoting BIM from the Perspective of Reducing GHG Emissions**

In the UK, decisions related to the planning, construction, and operation of infrastructure prioritize social values, including regional balanced development and carbon reduction, as highlighted by the Infrastructure and Project Authority in 2021. Meanwhile, South Korea's main goal in promoting BIM is to enhance the construction industry's competitiveness, particularly focusing on reducing construction period and costs.

4. Strategies to Promote BIM for Greenhouse Gas Reduction

■ **As part of the initiatives to promote BIM for eco-friendly construction, we propose the establishment of a "Digital Eco-Friendly Building Certification" system and present the following detailed recommendations for both clients and construction companies**

■ **From the Owner's Perspective**

The certification target is the building itself, with the certification criteria corresponding to the levels of GHG emission reductions achieved by applying BIM during the construction and operational phases. Incentives, including reductions in building acquisition and registration taxes, as well as relaxed building regulations, such as floor area ratios, should be contemplated. Additionally, integrating this approach with existing green building certifications (G-SEED) to enhance the associated benefits should be considered.

■ **From the Contractor's Perspective**

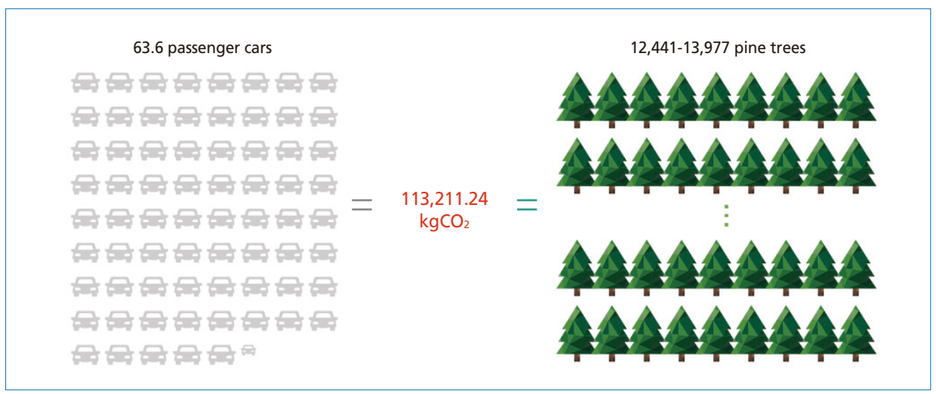
The certification target is the contractor, with the criteria applied differently at the business planning stage and construction execution stage. During the business planning stage, the interconnection between BIM application and GHG emission reduction is evaluated along with the appropriateness of the GHG reduction targets. In the construction implementation phase, contractors that have successfully secured projects through bids will be assessed based on whether they have met the objectives outlined in their business proposals upon submitting their completion documents; those that fall short of their targets may face penalties in subsequent bids. Drawing on the offset system within the GHG emissions trading scheme, we propose applying incentive measures for projects where no bid points are awarded based on the reduction of GHG emissions.

■ **Areas Requiring Support**

Supporting both owners and contractors is essential in obtaining "Digital Eco-Friendly Building Certification." This study proposes five areas of support: First, it is necessary to establish quantified criteria for evaluating the level of GHG reduction. Second, there is a need for the expanded development of the national LCI database. Third, the development of an automatic calculation program for changes in GHG emissions is required. Fourth, support is required to use construction materials with low embedded carbon. Fifth, support is necessary for construction methods that produce less waste and for using construction materials with high recyclability. Figure 2

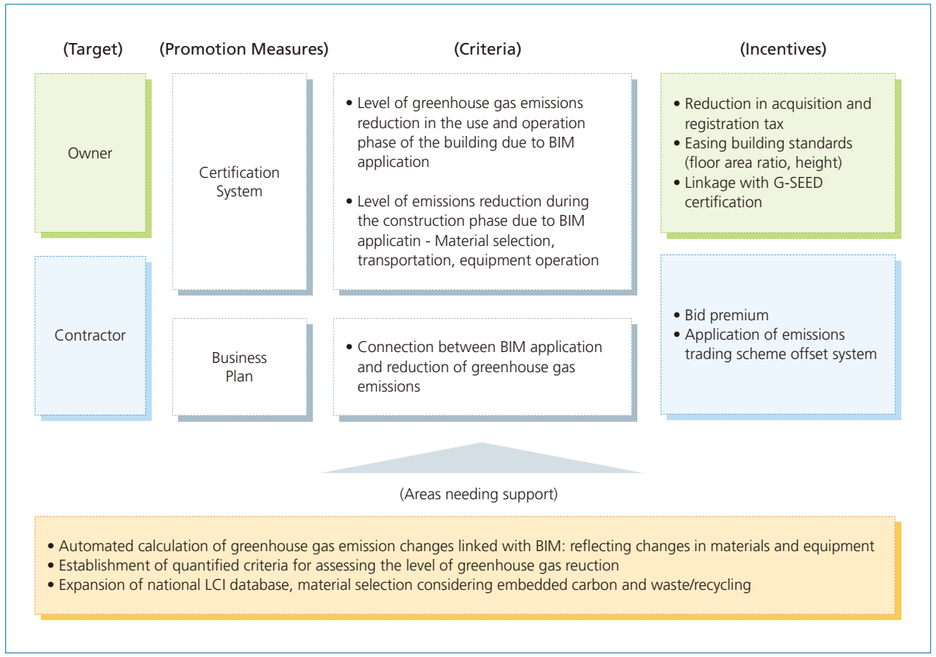
Chijoo Lee
Associate Research Fellow
cjlee@krihs.re.kr

Figure 1. Comparison of GHG Emission Reduction Effects: Passenger Cars vs. Pine Trees



Source
Created by authors

Figure 2. Strategies for Promoting BIM for GHG Reduction



Source
Created by authors

“An establish strategies for promoting BIM from the perspective of reducing GHG emissions is needed because the GHG reduction effects of BIM implementation have been proven in this study.”

* This article is an overview of “An analysis of Digital Construction Technology’s Impact on Greenhouse Gases and an Activation Plan: Focus on BIM” by Chijoo Lee, Seola Bang, Eunju Yun and Hyeonji Yu. 2022. Sejong: Korea Research Institute for Human Settlements.

References

- Eastman, C., Teichqlz, P., Sacks, R., and Liston, K. 2009. BIM Handbook: BIM Guide for Building Owners, Architects, Engineers, and Construction Workers. Translated by Lee Kang, Moon Hyun-jun, Kwon Soon-wook, and others. Seoul: Sigong Munhwasa (original study published in 2008).
- Enforcement Rules of the Corporate Tax Act. 2022. Ministry of Economy and Finance Ordinance No. 896 (partially revised on March 18). [Appendix 5] Standard Useful Life and Useful Life Range Table of Buildings, etc. (related to Article 15, Paragraph 3).
- Infrastructure and Projects Authority. 2021. Transforming Infrastructure Performance: Roadmap to 2030. UK: Infrastructure and Projects Authority.
- Korea Environmental Industry & Technology Institute. National LCI DB. https://www.greenproduct.go.kr/epd/lci/lciIntro01.do (retrieved June 25, 2022).
- Lee Seon-jeong, Lim Jong-soo, and Kang Jin-taek. 2019. *Standard Carbon Uptake of Major Forest Tree Species.* Seoul: National Institute of Forest Science.
- Lee Chijoo, Bang Seolah, and Yoon Eunju. 2022. *Greenhouse Gas Reduction Effects and Promotion Measures of Digital Construction Technology: Focused on BIM*. Sejong: Korea Research Institute for Human Settlements.
- Ministry of Land, Infrastructure and Transport. 2018. Smart Construction Technology Roadmap. Sejong: Ministry of Land, Infrastructure and Transport.
- _____. 2022a. Construction Industry BIM Implementation Guidelines: For Designers. Sejong: Ministry of Land, Infrastructure and Transport.
- _____. 2022b. Construction Industry BIM Implementation Guidelines: For Constructors. Sejong: Ministry of Land, Infrastructure and Transport.
- Ministry of Environment. 2021. Confirmation of 2030 Automobile Greenhouse Gas Standards Toward Carbon Neutrality by 2050. February 16. Press release. http//www.me.go.kr/home/web/board/read.do?page rOffset=0&maxPageItems=10&maxIndexPages=10&searchKey=&searchValue=&menuId=286&orgCd=&boardId=1431450&boardMasterId=1&boardCategoryId=39&decorator (accessed on September 26, 2023).
- Park Jong-soon, Kim Yu-mi, Lee Eun-seok, Park Sang-joon, An Yehyun, et al. 2022. *Establishment of the Land, Infrastructure and Transport 2050 Carbon Neutrality Promotion Strategy.* Gyeonggi: Korea Agency for Infrastructure Technology Advancement.
- World Green Building Council. 2019. Bringing Embodied Carbon Upfront. https://worldgbc.org/advancing-net-zero/embodied-carbon (accessed on November 13, 2022).

02 Application of Public-Private Partnerships to Infrastructure Management

JongWuk Ahn, JongSo Lee

1. Background and Purpose

■ **Insufficient Studies on Current Status Analysis Despite the Importance of Infrastructure Management**

With infrastructures built during the economic growth period in Korea aging rapidly, the need for improving the performance and operation of existing facilities has been emerging as a major issue in the infrastructure sector rather than the construction of new ones. However, the lack of detailed and comprehensive studies on the current status and challenges in facility maintenance, mainly due to the large number and variety of infrastructures, remains one of the biggest obstacles in this sector.

■ **Need to Promote Public-Private Partnerships (PPPs) in Infrastructure Management that Cannot be Supported by National Finances Alone**

As the national financial burden is expected to grow further in the infrastructure sector, it is not feasible to infrastructure maintenance to ensure public safety and promote convenience with government budget only.

It is necessary to attract investors to public-private partnerships (PPPs) for infrastructure management; especially specific measures are urgently required, such as proposals of PPPs as infrastructure service aiming at performance improvement and maintenance of old infrastructures.

2. Infrastructure Management Status

■ **Management Framework under the Infrastructure Management Act**

The Infrastructure Management Act is a law stipulating the overall management system of national infrastructure. Instead of establishing regulations on maintenance, the Act aims to provide a framework for integrated and systematic infrastructure maintenance, covering existing safety management and individual facility laws.

The Infrastructure Management Act adopts the definitions of infrastructure as stipulated in the National Land Planning and Utilization Act (“NLPU Act”), but only applies to specific types of infrastructure requiring systematic management and budget support among those under the NLPU Act.

■ **Safety and Maintenance Framework**

Facilities under the Infrastructure Management Act are subject to the provisions of individual applicable laws for maintenance and to the provisions of safety-related laws and regulations, such as the Special Act on the Safety Control of Facilities and Special Act on Underground Safety Management, for safety control. Applicable laws pertaining to maintenance include the Road Act, Railroad Construction Act, Harbor Act, Fishing Villages and Fishery Harbors Act, Airport Facilities Act, River Act, Agricultural and Fishing Villages Improvement Act, and Sewerage Act.

According to the Infrastructure Management Act, management agencies are classified into management supervisory agencies and management entities, among which 6 central administrative agencies and 17 regional collectivities constitute the supervisory agencies. Management entities include central and local governments, public institutions, local public enterprises, and private entities owning infrastructure that may affect public safety.

■ **Aging and Safety Status of Infrastructure**

Facilities over 30 years old accounted for approximately 17.3% in 2021, but this share is expected to keep increasing in the future. Based on the current number of registered facilities, it is projected that the number of facilities ≥ 30 years old will increase to 72,171 (45.2%) 10 years from now and to 118,592 (74.2%) in 20 years (see <Fig. 1>). Figure 1

Analyzing the relationship between safety grade and

age of service, we found that, unsurprisingly, D- or E-grade vulnerable facilities accounted for the largest share of facilities over 30 years old (see <Fig. 2>). Figure 2

3. Road Facility Management Analysis

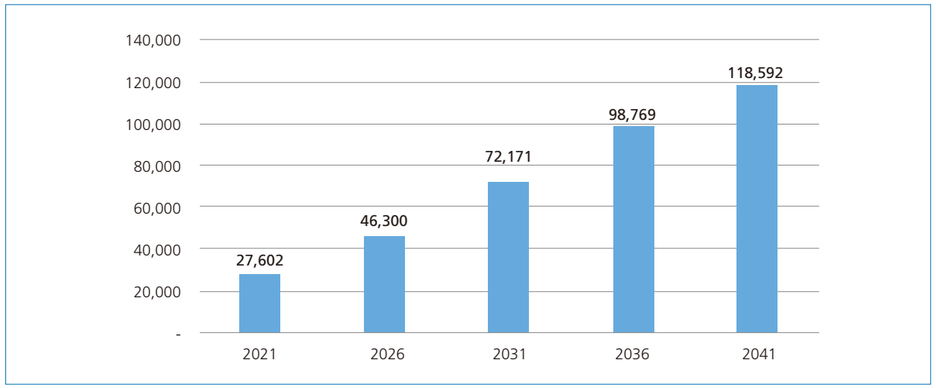
■ Need for In-Depth Analysis of the Roads Facility

Road facilities are large-scale and they have various types and different management entities, making it hard to assess accurately the management status of all facilities. There is no comprehensive status data including information on road management entities and statistics on aging, and the only available information is on national roads and facilities covered by the Facilities Safety Act. However, national roads account for only 18% of all roads, with a small percentage of facilities covered by the Facilities Safety Act (e.g., only 58% of all bridges are subject to the Facilities Safety Act). Accordingly, a comprehensive management plan for road facility is limited to the extent possible by the existing status data.

■ Maintenance Status

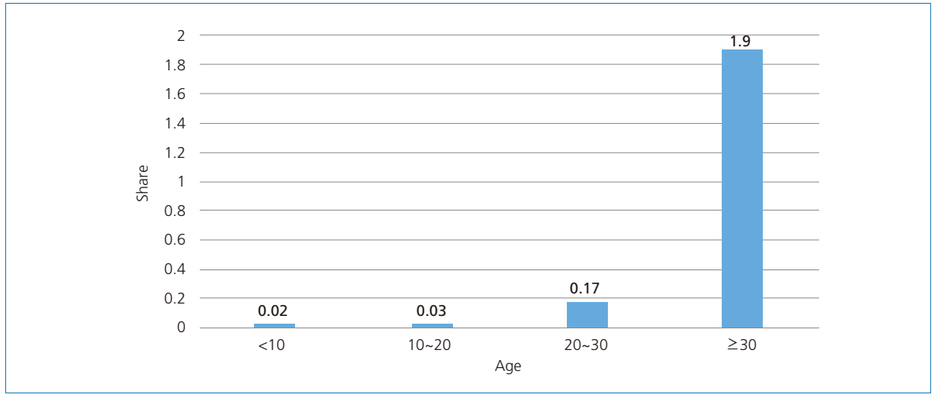
Road maintenance is regulated by the Road Act, the Facility Safety Act, and the Infrastructure Management Act; note that the target facilities and management details differ depending on the purpose and regulations. The facilities subject to the Infrastructure Management Act are roads stipulated in the Road Act; the management entity is regulated under the Road Act, and the management supervisory agency, under the Infrastructure Management Act.

Figure 1. Number of Facilities Over 30 Years Old



Source
KALIS (2022: 13)

Figure 2. Share(%) of Facilities with Safety Level D or E



Source
KALIS (2022: 17)

Road infrastructure is aging across the board, with more than half of the roads over 30 years old. In particular, about 80% of local government-managed roads—which account for 82% of all road miles in Korea—will exceed 30 years of age in 2030: the aging of local government-managed roads is one of the biggest concerns.

Roads are the infrastructure with the highest maintenance investment by central and local governments, accounting for 41% (KRW 24 trillion) of the KRW 59 trillion in infrastructure maintenance from 2014 to 2019. Management costs keep increasing while national road investment budgets are shrinking; especially for local government-managed roads, the proportion of repair costs is smaller (43-50%) than that of road extension (82%), leading to concerns about the aging and safety of road facilities in the future.

Different road types have different maintenance entities; expressways, national highways, and local roads are managed by professional institutions, but local governments delegate their tasks to general administrative agencies whereas private roads are managed by individual operators. National and local roads have clearly defined systems and tasks for each management entity, but all different and unclear for city, county, and district roads.

■ Problems of Infrastructure Maintenance

As road facilities age faster in the future, management costs are expected to rise sharply; especially for local government-managed facilities making up 82% of the total road miles, measures for fund raising are needed.

The Infrastructure Management Act aims to ensure safety through proactive response, but reactive management is common due to budget and management capacity constraints. For example, potholes are very common on local roads, but it is difficult to carry out maintenance such as frequent inspection, immediate response to complaints, and immediate repair due to lack of budget and manpower.

4. PPPs for Infrastructure Maintenance

■ Review on Applicability of PPPs

PPPs can be a solution for several challenges of infrastructure maintenance. Financial viability is essential for promoting PPP projects, which can help ease the financial burden because it is necessary to improve business efficiency by shortening time and reducing costs. Safety assurance on private roads can be realized by evaluating the implementation of maintenance plans performance and implementing timely measures based on the results of safety inspection and diagnosis. In other words, PPP projects can ensure the safety of users through timely maintenance. Private operators are required to establish and approve maintenance and operation plans for their facilities every year, and these procedures improve the quality of infrastructure maintenance and user safety. Based on the accumulated experience and expertise of private operators, it is possible to achieve advanced infrastructure maintenance quickly and efficiently, which in turn can lead to improved public convenience.

The categories of facilities eligible for PPP projects stipulated by the Private Investment Law have also been expanded with the transition from a positive system to a negative one in 2020. Only 54 existing infrastructure facilities are designated as excluded from the eligibility deliberation, wherein the possibility and process of PPP projects are different from new types of facilities (i.e., subject to eligibility deliberation). In conclusion, most infrastructures can be subject to PPP projects, and it is necessary to activate PPP projects for infrastructure maintenance.

■ Cases of Infrastructure Maintenance with Private Finance Initiative

There are many cases of public-private partnerships both at home and abroad to introduce PPP projects into infrastructure management. In Korea, private investment has been introduced to build libraries, sports facilities, and parks, which are necessary infrastructure for daily life (i.e., life SOC), and a daycare center for employees of the National Police Agency can be recognized as a typical successful case of bundling. Finance-Operate (FO) is a model wherein the responsibility for finance and operation of already built government facilities lies with the private sector party based on the case of Australia. The North East Regional Water Authority (NERWA) in Australia has awarded the retrofit (expansion of capacity) and long-term (10-year) maintenance/operation of the existing wastewater plant to a private contractor. The PRBR project in the US is a design-build PFI for 558 bridges in Pennsylvania over three years old to be maintained for 25 years and is one of the best examples of bundling for aging infrastructure management.

■ Proposal of PPPs as Infrastructure Service

By collecting domestic and foreign cases, PPP projects

for infrastructure service (+ maintenance) can be classified into the following three categories: First is FO PPP, which is described as "Expansion/Renovation + Maintenance"—a private entity is awarded a contract to take responsibility for operation as well as improvement and/or expansion of existing infrastructure. Second is "Additional Facilities + Maintenance"; new, improved, and expanded amenities are constructed for additional services to enhance the feasibility of business. Third is "Bundling + Maintenance," which is the joint maintenance of a number of substantially same or similar facilities for ensuring feasibility and efficiency. If PFIs can be promoted in a manner that makes them bear obligations of long-term maintenance in addition to various business elements, proactive and efficient infrastructure management is possible.

For small infrastructure where users are not likely to pay fees, however, contracts should be adjusted to introduce public funds if necessary according to various factors, such as maintenance status and performance and maintenance level, similar to AP (availability payment) in concessions in the US. This is expected to utilize the advantages of PPP projects without departing from the intention of the Infrastructure Management Act.

■ Expected Effects and Limitations in Land Development

Although the importance of infrastructure maintenance is being emphasized by enacting the Infrastructure Management Act, the financial burden is too great to be borne by the government. We presented new types of PPP project driven by the need to introduce private capital into infrastructure management.

In times of economic growth, there is a tendency to emphasize the construction of new national infrastructure and neglect preparation for the maintenance burden that will come later. It is necessary to build a database for the integrated management of national infrastructure from the early phase of infrastructure construction and to establish infrastructure management plans considering life-cycle costs. Note that we can only achieve national growth with the safety and convenience of the people through the sustainable management of national infrastructure, in terms of both quantity and quality.

JongWuk Ahn
Research Fellow
jwahn@krihs.re.kr

JongSo Lee
Associate Research Fellow
jslee@krihs.re.kr

* This aricle is an overview of "Application of Public Private Partnerships for Infrastructure Management" by Ahn JongWuk, Yoo Hyunji, Lee JongSo, Suk Jaesung and Park SoYoung. 2022. Sejong: Korea Research Institute for Human Settlements.

References

- Ahn Jongwuk, Yoo Hyunji, Lee Jongso, Suk Jaesung, Park Soyoung. 2022. *Application of Public Private Partnerships for Infrastructure Management.* Sejong: Korea Research Institute for Human Settlements.
- KALIS. 2022. Statistical Yearbook of 2021. Jinju: Korea Authority of Land & Infrastructure Safety.

03 Research on the Supply of Living SOC through Public-Private Partnership

Seongsoo Kim, Hyunji Yoo

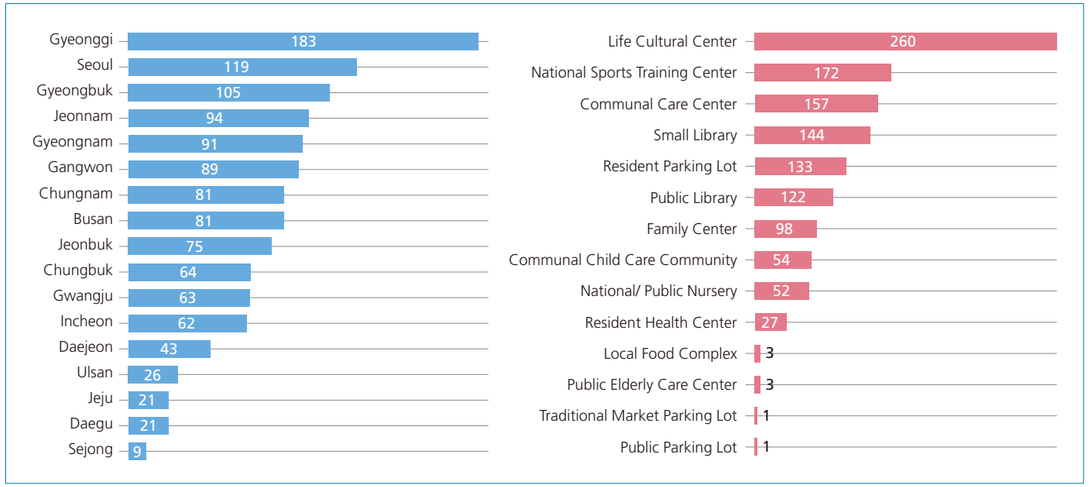
1. Progress of Living SOC projects

■ Establishment of *Living SOC Three-Year Plan*

Living SOC refers to essential infrastructure for daily life, including facilities that promote convenience in people's lives (basic infrastructure such as water, sewerage, gas, and electricity as well as cultural, sports, welfare, and park facilities) and safety facilities that are the basic prerequisites for life (The Office for Government Policy Coordination Living SOC Promotion Committee 2019). The government established the *Living SOC Three-Year Plan* for the early expansion of and systematic investment in Living SOC and has invested a total of KRW 30 trillion over three years (2020–2022) to build nationwide core living infrastructure above the national minimum level by 2022. By selecting three major areas of the Living SOC project (e.g., leisure activities, life care, and safety and security), priority was given to expanding Living SOC based on criteria such as the population demanding services and accessibility to facilities.

By promoting a single complex project, rather than constructing individual facilities per ministries and projects, the issues of securing locations, shortening project duration, saving on budget, and improving synergies were solved. If a complex project included two or more complex-eligible facilities, it received policy support in the equivalent of a 10%-point increase in the government subsidy rate received by a single facility. Living culture centers were the most common type of complex project under Living SOC, with a total of 260, among which 183 are located in the region of Gyeonggi-do (Fig. 1). However, it is necessary to supply various types of Living SOC in addition to the 13 types of complex facilities included in the *Living SOC Three-Year Plan*, which calls for the need to explore diverse business methods that consider profitability, urgency, and operational effectiveness. Figure 1

Figure 1. Living SOC implementation status (by region and type) of *'Living SOC Three-Year Plan'*



Source The Office for Government Policy Coordination, Living SOC Promotion Committee 2021. Guideline for selection of living SOC complex facility

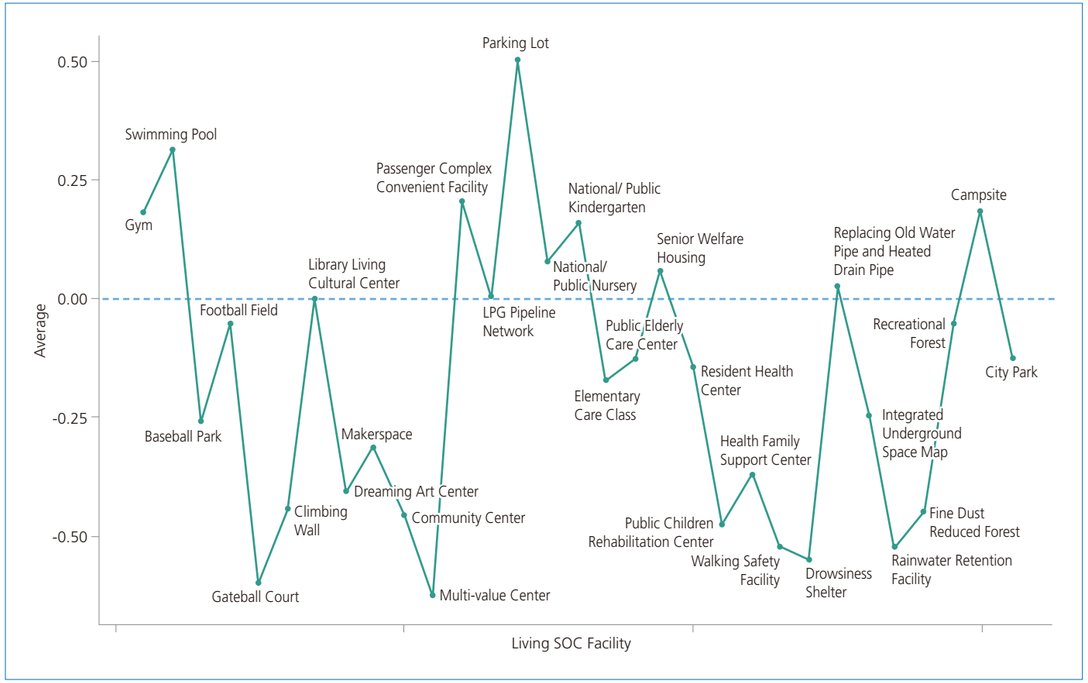
■ **Current status of Living SOC private-public partnership projects**

Some public infrastructures, such as roads and railways, were implemented as public-private partnership (PPP) projects utilizing private financial resources, and the Build-Transfer-Operate (BTO) was mainly applied, in which the private sector and state agency determine the business profit rate and recover the project cost by charging the facility's users. However, since many Living SOC projects are for public purposes such as social welfare and cultural tourism, it is nearly impossible to recover business costs by collecting user fees from facility users. In general, unprofitable businesses are conducted through the Build-Transfer-Lease (BTL) whereas profitable businesses are pursued through the BTO. Previous Living SOC ppp projects were mostly implemented through the BTL where private companies and state agencies fixed the business profit rate, and the state agencies paid facility usage fees with government payments. Through such a method, state agencies are responsible for operating the facility but usually outsource the operation because they lack the capabilities to run the Living SOC facility. In this case, problems with defect repairs and facility maintenance may arise due to the dualized system between the facility management entity (private business) and the operating entity (outsourced contractor). Hence, to pursue Living SOC as PPP projects, it is necessary to comprehensively consider profitability and operation methods.

2. A survey on utilizing private investment in Living SOC projects

A survey was conducted with local government officials in charge of Living SOC about the potential of carrying forward with private investments in each type of Living SOC in the *Living SOC Three-Year Plan*. According to the survey results, Living SOC projects that showed high likelihood of private investments are parking lots, swimming pools, and gymnasiums. Conversely, multi-value centers, gate ball courts, and rainwater retention facilities were identified as Living SOC projects of low likelihood of private investments (Figure 2). Regarding the appropriate rate of profit for private investors in such projects, the most common response was found to be in the range of 3% and 4%. The rate of profit of PPP projects (especially BTO projects) has been declining since 2000; compared to historical yields of more than 5%, the decline indicates that the profit structure of PPP projects is becoming low-risk and low-profit. The survey also examined difficulties when implementing Living SOC projects (such as lack of budget, lack of operational capabilities, and limitations in utilizing national public lands) and how to overcome them. According to the survey, the following measures were recognized as means to overcome budget shortfall of local governments: expanding state subsidies (58.5%), attracting private capital (14.6%), and creating crowdfunds (2.4%). In addition, the following the measures were identified as ways to overcome the lack of operational capabilities: expanding local government operational staff (29.3%), entrusting private companies to operate facilities (19.5%), entrusting social economic organizations to operate facilities (17.1%), and implementing training to strengthen local government operational capacity (2.4%). Furthermore, utilizing private land through private financing (14.6%), extending the period of state-owned property use permits (7.3%), and reducing state-owned property use fees (4.9%) were indicated as measures to address the limitations of using state-owned land. Figure 2

Figure 2. Survey results on feasibility of private investments in Living SOC and appropriate rate of return



Source Seongsoo Kim et al. (2021: 43, 49).

3. The need to promote Living SOC private-public partnership

■ **Ensuring the sustainability of supply policies for Living SOC**

The *Living SOC Three-Year Plan* only lasted from 2020 to 2022 and thus lacks a long-term perspective of delivery. As a rolling plan, the *Living SOC Three-Year Plan* may establish additional plans if a project is confirmed or the scale of investment is expanded. Since PPP projects may be implemented without a set deadline and large-scale budget execution, they may be executed in case of no additional policies related to Living SOC.

■ **Funding Living SOC: Easing the financial burden on local governments**

It is necessary to find ways to ease the financial burden on local governments in the future as the burden is expected to increase once the government subsidy rate decreases after 2022, when the *Living SOC Three-Year Plan* ends. If Living SOC projects are realized via the private investment the financial burden on local governments will lessen by utilizing private capital, and the projects can be carried forward more quickly by reducing the time required to secure a project preparation budget.

■ **Improving operational efficiency and profitability of Living SOC**

To solve the deficit problem of public facilities and enable the efficient operation of Living SOC, it is necessary to utilize private capital and expand the operation of private organizations. According to *Local Finance Integrated Open System 365: A Report on the Operational State of Public Facilities* published by the Ministry of Public Administration and Security, among the 863 facilities operated by local governments, only about 11.2% (96) are in the black (as of 2019). The operation of public facilities by private entities is expected to improve the operating profit by enhancing efficiency. In addition, the quality of service is also expected to increase when entrusting the operation to a social economic organization that has operational expertise rather than having local governments directly run them.

■ **Improving the flexibility to pursue Living SOC: simplifying legal procedures**

Utilizing national public lands has advantages if the Living SOC projects are realized through the private investment based on the *Act on Public-Private Partnerships in Infrastructure*. When executed as PPP projects, facilities can be constructed permanently; the usage license period can be extended up to 50 years, and legal restrictions in terms of charging fees to secure profitability are fewer. Table 1 shows a comparison between the provisions related to the utilization of state property in the *State Property Act and the Public Property and Commodity Management Act* and those related to the utilization of state property in the *Act on Public-Private Partnerships in Infrastructure*. Table 1

4. Measures to stimulate private investment in Living SOC

■ **Diversification of business methods**

This study proposes three project methods depending on the circumstances. First, the BTO is suggested for Living

SOC projects that are profitable, taking into consideration the provider of the core services of Living SOC, status of fee collection, cost of fee, and bearer of demand risks. Second, the BTL is recommended for projects with low profits and deemed to be more efficient when operated by the government. Lastly, the 'BTL + Private operation' method is proposed for projects with low profits and deemed to be more efficient when operated via the private sector. For example, in the case of parking lots, the application of the BTO is appropriate to recover private investment costs by collecting fees from end users. Conversely, the BTL is suitable for resting shelters on highways as it is difficult to collect fees from end users, and it is more efficient for the government, rather than the private sector, to operate them directly. For rainwater retention facilities, the 'BTL + Private operation' is fitting because fees cannot be collected from end users and can be more efficiently operated by the private sector than the government.

■ Improvement of profitability

The incentive for private operators may be increased by expanding the scale of total project budget through 'Bundling'. The business profits of Living SOC projects with low profit expectations may be compensated through affiliated businesses. As an example of bundling, the childcare center at the National Police Agency (NPA) was built as a BTL project by integrating 22 projects of individual districts (NPA, 2012). As an example of utilizing affiliated businesses, the Gyoha Library in Paju City attracted parking lots, shops, vending machine facilities, and restaurants as affiliated projects, where profits were split in half between the government agency and the project operator. (Paju City Hall, 2006). Furthermore, regarding projects to improve decrepit infrastructure, such as replacing water supply pipes that are over 30 years old, the land in use is already secured—unlike new projects; this facilitates preliminary feasibility research as it is possible to exclude items for land compensation costs from the calculation of total project costs.

Seongsoo Kim
Research Fellow
sskim@krihs.re.kr

Hyunji Yoo
Senior Researcher
hjyoo@krihs.re.kr

Table 1. A comparison of provisions related to the use of state property

Law	Category	Related Information	Details
State Property Act	Construction of permanent facilities	X	An exception is allowed in the case of the donation and the installment payment for the sale prices.
	Permitted time period	Within Five Years	-
	User fee	○	The user fee shall be reduced by fifty percent if local government and public institutions use for the purpose of public domain·government property·public utilities.
Public Property and Commodity Management Act	Construction of permanent facilities	X	An exception is allowed if the permanent facilities are donated to the to the local government upon the completion.
	Permitted time period	Within Five Years	An exception is allowed for up to 20 years of use for property donated to a local government.
	User fee	○	-
Act on Public-private Partnerships in Infrastructure	Construction of permanent facilities	○	In regard to national·public property, project operator's donation is not premised.
	Permitted time period	Within Fifty Years	The facility can be used (to make profits) free of charge for a period of time after its completion.
	User fee	X	

Source
Summarized by authors based on State Property Act (Act No. 117758, revised March 31, 2020); Enforcement Decree for the Public Property and Commodity Management Act (Act No. 32074, revised December 22, 2020); and Act on Public-Private Partnerships in Infrastructure. (Act No. 17799, enforced March 31, 2021).

> "Private-public partnerships can be an alternative to promoting living SOC, and measures such as diversification of business methods and improvement of profitability are needed."

* This article is an overview of "Research on Means to Drive Private Investment to Deliver Living SOC Projects" by Kim Seongsoo, Hwang Euchan, Yoo Hyunji and Suk Jaesung. 2022. Sejong: Korea Research Institute for Human Settlements.

References

- Kim Seongsoo, Hwang Euchan, Yoo Hyunji, and Suk Jaesung. 2022. *A Study on the Supply of Living SOC through Public and Private Partnership*. Sejong: Korea Research Institute for Human Settlements.
- *Local Finance Integrated Open System 365: A Report on the Operational State of Public Facilities* https://lofin.mois.go.kr/websquare/websquare.jsp?w2xPath=/ui/portal/stat/local/settle/sd002_se403.xml (search date: December 15, 2021).
- National Police Agency. 2012. A Survey Report on the BTL Business Eligibility of Childcare Center of Police Headquarters.
- The Office for Government Policy Coordination Living SOC Promotion Committee. 2019. *Living SOC Three-Year Plan*. April 15, Press release.
- The Office for Government Policy Coordination Living SOC Promotion Committee. 2021. Guideline for selection of living SOC complex facility.
- Paju City Hall. 2006. Paju Gyoha Library Initial Implementation Agreement.
- [Law] State Property Act (Act No. 117758, revised March 31, 2020).
- [Law] Enforcement Decree for the Public Property and Commodity Management Act (Act No. 32074, revised December 22, 2020).
- [Law] Act on Public-Private Partnerships in Infrastructure. (Act No. 17799, enforced March 31, 2021).

KRIHS (Korea Research Institute for Human Settlements) was established in 1978 in order to contribute to the balanced development of national territory and the improvement of the quality of life of people by conducting comprehensive policy-oriented research in the efficient use, development, and conservation of territorial resources.