

Society 5.0 Housing and Building

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1. Introduction

The term “Society 5.0” is starting to attract the attention of society.

Society 5.0 is the first concept advocated as the ideal future condition of the society of Japan in the fifth Science and Technology Basic Plan. It refers to the following ideas:

- Human-centered society where systems based on advanced integration of cyberspace (virtual space) and physical space (actual space) will realize economic development and solution to social problems
- A new society that comes after the hunter-gatherer society (Society 1.0), farming society (Society 2.0), industrial society (Society 3.0), and information-based society (Society 4.0)

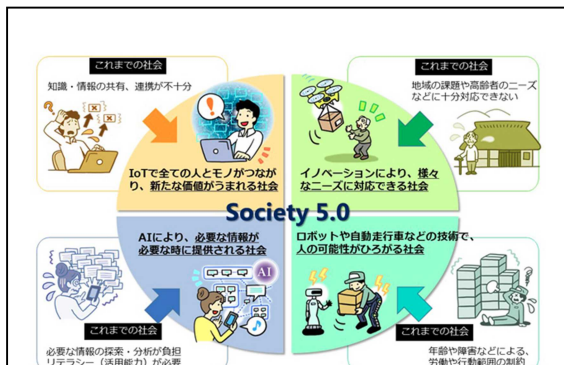


Figure 1 A society realized as Society 5.0¹

In the information-based society so far (Society 4.0), the sharing of knowledge and information and the cooperation beyond the boundaries of individual fields are said to be the challenge for reasons, such as the difficulty in finding necessary information among overwhelming amounts of information due to the limitation in human ability and the difficulty in properly processing discovered information.

Another challenge was the use of information in actual spaces. A major issue was to reduce the workload of humans due to the social background with declining birthrate and aging population, depopulation in rural areas, and economic disparity.

In Society 5.0, the following aspects are going to be

realized:

- Connecting all humans and things through the Internet of Things (IoT) to share various knowledge and information
- Supplying and processing necessary information when necessary using artificial intelligence (AI)
- Using information in actual spaces using technologies such as robots and self-driving vehicles

By realizing the above, the goal is to overcome challenges of a declining birthrate and aging population, depopulation in rural areas, and economic disparity and to realize a society where people can respect each other beyond the boundary of age groups and generations and individual people can live comfortably and actively.

This article discusses challenges in realizing Society 5.0 in housing and building field based on the current state of IoT and AI technologies used in housing and building.

2. Current state and challenges of IoT and AI technologies used in housing and building

(1) Investigation to identify current conditions

The authors studied cases of the use of IoT, ICT, and AI technologies in housing and building published on the web to identify current usages.²

This study found that most frequently used technologies were ones related to building operations used after the use of a building had started. Specifically, diversified technologies were introduced on the web, such as the operation management of buildings and building facilities (BEMS [Building and Energy Management System] and HEMS [Home Energy Management System]) based on IoT, AI, and other technologies designed to improve energy efficiency, comfort, health, and convenience, systems to accumulate the information of building, and the demand-response of power load.¹

Based on this finding, the authors selected targets of the study mainly focusing on technologies related to the operation of buildings after the start of the use of the building. The authors then conducted hearing investigation targeting academics, experts, general

contractors, building facility subcontractors, and manufacturers. The hearing investigation asked them of the advantages and technical and social challenges in system development, installation, and operation from the eyes of developers.²

2) Challenges

Based on the findings of the above investigation, the authors found following challenges for the use of IoT and AI technologies in buildings to generate great social benefits as follows:

- ① Housing and building dependent on IoT technologies are vulnerable to the disruption of power supply. To ensure resistance of cities and buildings against natural disasters, ensuring continuity even with the disruption of power supply will become a major challenge.
- ② The hurdle for installing IoT-related devices in housing and building has become drastically low as their prices have lowered. Yet, while the prices of IoT devices have lowered, the ratio of the cost of cabling for IoT devices (for power supply and communication) and associated construction costs have kept rising. Therefore, the commercialization of cable-less IoT^{*2} will become a major key in promoting the use of IoT devices especially in already available buildings. (This is also effective as a solution to ① above.)
- ③ In the current IoT-based systems that are now becoming commercialized, no coordination is available among groups constituting and supplying systems; they are becoming similar to individual silos without mutual compatibility and connectivity among individual systems. The task is to develop technologies and social systems by evolving from the silo-like technologies and realizing technologies that are mutually connectable and operable.
- ④ In comparison to the life cycle of IoT-based systems, the service life of housing and building will be much longer. Thus, another task is to realize systems of which parts and components with different service lives are replaceable (the issue of generation management in systems).
- ⑤ In relation to ④ above, another task is to clarify responsibilities over overall systems when system components and parts are replaced and to establish rules concerning the boundary of the responsibilities.
- ⑥ With regard to AI, deep learning technology and

image recognition based on deep learning are progressing at a significant pace. Some researchers and scholars consider the appearance of so-called machines with eyes as a great innovation comparable to the Cambrian explosion, in which the first appearance of an organism with complex eyes explosively accelerated the evolution of organisms.³ No method to evaluate the effectiveness of AI has been established at this point; however, the challenge is to develop technological and social framework to evaluate the effectiveness.

3. Summary

There is a need to overcome various challenges and difficulties listed in 2 above and to make these new technologies truly beneficial to society.

The NIMLM also needs to actively examine the following aspects.

- Establishment of technological and social framework to mutually connect silo-like systems
- Establishment of social rules concerning the problem of generation replacement and boundary of responsibilities
- Elimination of regulations that inhibit the introduction of new technologies
- Establishment of social rules to ensure safety and the development of beneficial new technologies such as cable-less IoT

*1: Demand-response: To enable the stable supply of electricity by controlling electricity on the consumer side by responding to the request from power companies to conserve electricity (with economic benefits as compensation)

*2: Cable-less IoT: System that enables wireless communication without external supply or electricity Installed using environmental power generation technology (energy harvesting) + energy efficient wireless communication technology such as LPWA

☞ For more information:

- 1) Website of the Cabinet Office
https://www8.cao.go.jp/cstp/society5_0/index.html
- 2) “Application of ICT, IoT, and AI technologies for disaster prevention and disaster risk reduction for housing and buildings”, NILIM document No. 1055, January 2018
- 3) “Can AI exceed humans? - What awaits ahead of deep learning -” Yutaka Matsuo (The University of Tokyo), memorial lecture at the 100th Anniversary Ceremony of the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan, December 1, 2017