

The Possibilities for Collaboration with China based on the Strengths of Japan and its Industries through CPS

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Introduction

CPS (Cyber Physical Systems) can save labor, improve operational efficiency, and increase sophistication in the manufacturing and non-manufacturing sectors. These systems are already beginning to be used in advanced nations like Japan and China and are expected to be used worldwide in the future.

We first provide an overview of CPS in Chapter 1, and then in Chapter 2, introduce measures that leverage CPS as solutions to Japanese companies' challenges, accompanied by specific examples of corporate initiatives. Finally, Chapter 3 and Chapter 4 will consider winning strategies by Japan and its industries and the possibilities for collaboration with China through each strategy.

1. An Overview of CPS

CPS stands for Cyber Physical Systems, a general term for systems that merge the physical and virtual worlds. The specifics of this concept can be seen in Figure 1. It involves (1) Collecting diverse data in the physical space using sensors and cameras. (2) Transferring this to virtual spaces. (3) Performing large-scale data processing and simulations for deeper analysis. (4) The valuable insights obtained through this process then enable attempts at solving issues in the physical space or provide new added value. (5) CPS, therefore, refers to a class of systems in which computed results from the virtual space are fed back in a way that improves the real world. The benefits of CPS include improved production efficiency using digital twins, enhanced workforce productivity through remotely operated robots, and the creation of new experiential value using VR (Virtual Reality) or AR (Augmented Reality).

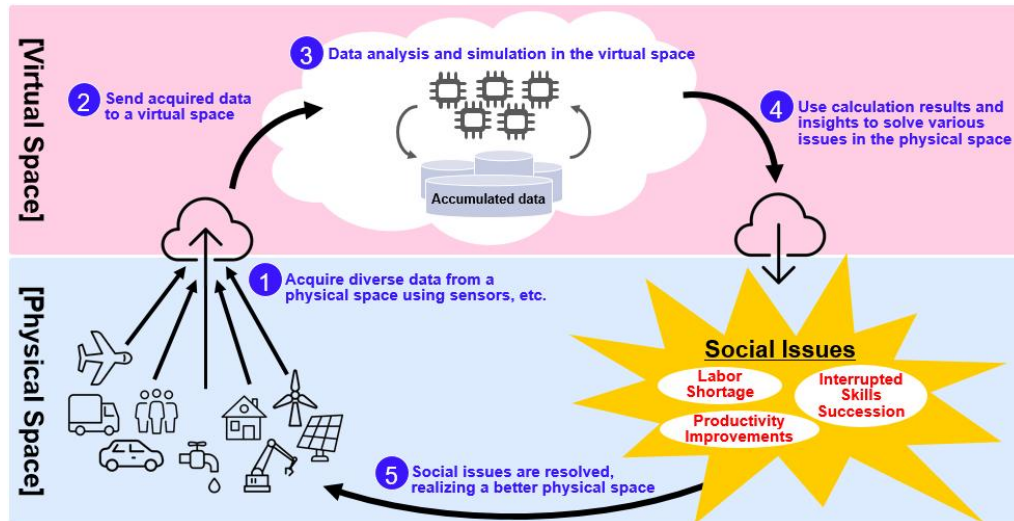


Figure 1 Conceptual Diagram of CPS

Source: Created by Mizuho Bank Industry Research Department

The main issues currently facing Japanese industry include interrupted skills succession, labor shortages, and low labor productivity. CPS's benefits could be a key to solving these issues. The next chapter describes examples of how Japanese companies have used CPS to address these issues.

2. Examples of CPS Utilization by Japanese Companies

This chapter introduces examples of how Japanese companies currently use CPS to address these various issues from the perspectives of interrupted skills succession, labor shortages, and low labor productivity.

2.1 Examples of Utilization for Addressing Interrupted Skills Succession

First, we will examine examples of using CPS to resolve interrupted skills succession by the optical equipment manufacturer Olympus and the food service chain Royal Host. At Olympus, a system has been introduced that detects and digitizes the hand movements of veteran technicians using sensors. Specifically, measuring devices are attached to areas such as the hand joints of skilled technicians to detect their bone structure. The ways in which they move their bodies are then recorded as coordinate data in a 3D space, for example, how they wrap cables. Once digitized, these movements can be reviewed anytime using VR goggles and can be used to shorten training periods. Similarly, the restaurant chain Royal Host has introduced a system in collaboration with the National Institute of

Advanced Industrial Science and Technology to provide training in customer service tasks in the virtual space. Training participants become staff in a virtual store and need to handle a series of tasks from customer arrival, menu, and dish delivery to table cleaning simultaneously at each table, gaining experience close to actual work.

2.2 Example of Utilization for Addressing Labor Shortages

Next, as an example of using CPS to solve labor shortages, we will examine the efforts of Asahi Kasei, a general chemical manufacturer. Asahi Kasei is constructing a digital twin environment at its hydrogen production plant. It is difficult to standardize the series of responses needed when equipment abnormalities occur at the plant, requiring individualized responses by veteran technicians in many cases. For this reason, it previously took time to respond to abnormalities if these technicians were not in the area. However, with the use of digital twins, they can now respond remotely as if they were on-site, thus shortening the time from alert generation to problem resolution.

2.3 Examples of Utilization for Addressing Low Productivity

Finally, to provide examples of using CPS for resolving low productivity, we will examine use cases at air conditioning manufacturer Daikin Industries, and Toyota Motor Corporation. Daikin Industries has introduced a production management system using digital twin technology. By acquiring data through cameras and sensors installed in the plant, it has reproduced processes such as assembly, pressing, and painting in the virtual space. This enables it to predict equipment anomalies and subsequent line stagnations, reducing time and cost losses by over 30% compared to before the system's introduction. Toyota Motor Corporation, toward the completion of Woven City (a smart city being built by the company in Susono City, Shizuoka Prefecture), has recreated people, mobility, streets and other infrastructure in virtual space. By simulating traffic conditions, human flows, and risks associated with accidents during automated driving, the company is improving productivity in the promotion of this project.

The above examples are summarized in Figure 2.

Figure 2 Examples of CPS Utilization by Purpose in Japanese Companies

Social Issue	Corporate Name	Examples of Solutions Using CPS
Interrupted Skills Succession	<i>Olympus (Optical Equipment Manufacturer)</i>	<ul style="list-style-type: none"> ➤ Uses CPS to digitize veteran technicians' movements and utilize them for skills succession ✓ Implemented a system to save veteran technicians' movements as data using sensors ✓ For example, digitized how to tie cables and used this data for training and human resource development
	<i>Royal Host (Food Service Chain)</i>	<ul style="list-style-type: none"> ➤ Provides customer service training from veteran employees in a virtual space ✓ Trainee staff members work in a virtual space to receive training from veteran employees ✓ Training includes all tasks from welcoming customers to providing menus and dishes, and cleaning tables
Labor Shortage	<i>Asahi Kasei (General Chemical Manufacturer)</i>	<ul style="list-style-type: none"> ➤ Using remote technologies to solve shortages of veteran technicians ✓ Constructed a digital twin environment at a hydrogen production plant, allowing remote staff to respond as if they were on-site ✓ This enabled just a few veteran technicians to resolve many anomalies in plant equipment
Low Productivity	<i>Daikin Industries (Air Conditioning Manufacturer)</i>	<ul style="list-style-type: none"> ➤ Predicting equipment anomalies in advance to prevent stagnation in production lines ✓ Has reproduced assembly, pressing, painting, etc., in a virtual space using a digital twin ✓ Is able to predict equipment anomalies in advance to prevent productivity declines due to stagnation in production lines
	<i>Toyota (Automobile Manufacturer)</i>	<ul style="list-style-type: none"> ➤ Uses simulations in a virtual space to efficiently assess traffic conditions ✓ Recreated the human, mobility, and infrastructure elements of a smart city (Woven City) being built by our company in a virtual space ✓ A simulation in that environment is used to efficiently assess traffic conditions during automated driving

Source: Created by Mizuho Bank Industry Research Department

3. The Possibilities for Collaboration with China based on the Strengths of Japan and its Industries

Chapter 2 introduced examples of CPS that are already being implemented. Chapter 3 will present the medium to long-term vision and future path that Japan and Japanese industry should take. More specifically, we will examine the possible winning strategies that Japan and its industries could realize through leveraging CPS. Additionally, we will consider the possibilities for collaboration with China for each strategy.

3.1 The Winning Strategies of Japan and its Industries

We believe that the winning strategies for Japan and its industries can be broadly divided into three categories: (1) Winning Through Components, which treats the global spread of CPS as a business opportunity; (2) Winning Through Experiential Value / Content, which drives the utilization of CPS; and (3) Winning Through Solving Social Issues.

(1) Winning Through Components refers to capturing the spread of CPS, especially in China and advanced countries, significantly raising Japan's presence in the domain of components (parts and materials). As mentioned above, CPS is a

system that merges physical and virtual spaces in a sophisticated manner. For it to function fully, it requires sensors that can quickly and accurately capture data from objects and events in the physical space, computers for processing and analyzing vast data quickly in a virtual space, and actuators for correctly feeding back the insights and calculation results obtained in a virtual space to the physical space. Therefore, CPS's global spread and utilization is expected to create a massive demand for high-quality, high-functioning components. By responding to this demand, Japan can significantly expand its business.

(2) Winning Through Experiential Value / Content refers to the shift from functional value to experiential value, in other words, the acceleration of the shift from product consumption to experience consumption. This involves leveraging the strengths of Japan's content industry while enhancing UX (User Experience) through CPS or creating new UX. By utilizing CPS, we believe a more personalized UX can be provided to each customer than traditional content. We also believe that entirely new UX using virtual spaces such as VR (Virtual Reality) and AR (Augmented Reality) can be realized.

Finally, (3) Winning Through Solving Social Issues refers to leveraging CPS to solve social issues that Japan faces ahead of other countries, improving the competitiveness and sustainability of Japanese industries, and extending solutions to resolve social issues overseas. Many social issues that Japan faces, such as its aging population and declining birthrate, are more advanced than in other countries. This means that Japan already holds a wealth of data, know-how, technologies, and products related to this social issue. Facing a social issue ahead of other countries may seem negative at first glance, but it can be an opportunity to transform from a country with advanced social issues to one that is advanced in solving them. Chapter 2 introduced examples of CPS utilization for addressing various issues Japan is facing, such as interrupted skills succession and solving labor shortages, and this winning strategy can be seen in these initiatives.

3.2 Possibilities for Collaboration with China

The three winning strategies also provide opportunities for collaboration with China. In this chapter, we will discuss the possibilities for collaboration presented through each strategy.

First, we will explore the potential for collaboration with China in (1) Winning Through Components. The utilization of CPS is more advanced in China than in Japan, with examples including the use of robots in medicine. Supported by government subsidies in medical insurance reimbursement and regulatory flexibility, the introduction of surgical support robots is progressing in China's urban areas. We believe that the spread of CPS utilization in China is leading to an

increased demand for high-quality, high-capability components (parts and functional materials) for precise medical and industrial robots. Since the utilization and sophistication of CPS are expected to progress even more, Japan and China can leverage each other's strengths to nurture their respective domains of components and finished products (robots, etc.).

Next, we will examine the possibilities for collaboration in (2) Winning Through Experiential Value / Content. Japan maintains a strong presence in consumer game hardware and software, holding the top market share among developed countries. Additionally, Japan boasts strengths in creating globally popular characters and their associated IP (intellectual property). Numerous Japanese works occupy top positions in the cumulative revenue rankings generated by IP. However, China has a significant presence in mobile games. As of 2023, China has the world's top mobile game market size. Mobile game titles distributed by Chinese companies have also recently enjoyed high popularity, even in Japan.

Thus, by leveraging the fact that Japan and China each have strong presences in different gaming industry segments, a form of collaboration in which each side develops popular IP through its respective strengths and channels becomes conceivable. For example, Chinese companies could purchase the merchandising license rights for popular consumer game titles or beloved characters originating in Japan, convert them into mobile games, and sell them in the vast Chinese market. Similarly, Japanese companies could purchase the license rights for popular Chinese mobile game titles, convert them into consumer games, and sell them in developed countries, potentially leading to expanded business for both Japanese and Chinese companies.

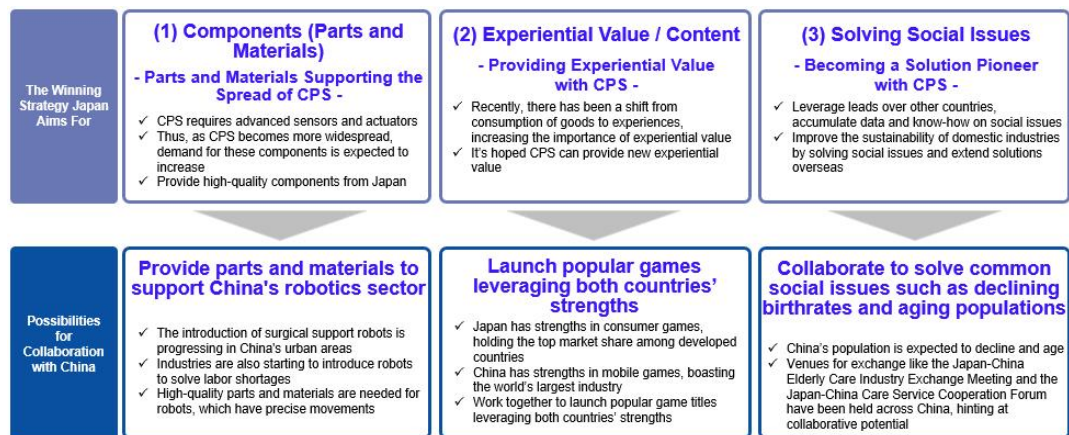
Finally, we will envision a future of Japan-China collaboration in (3) Winning Through Solving Social Issues. Currently, China's working-age population is declining, and it is expected that the aging of its population and the decline in its birthrates will progress even faster than in Japan. Thus, China shares social issues with Japan, such as an aging/declining population and associated labor shortages and caregiving challenges. It is, therefore, entirely feasible to envision a future where Japan and China collaborate to develop solutions.

Indeed, to date, venues for exchange—such as the Japan-China Elderly Care Industry Exchange Meeting and the Japan-China Care Service Cooperation Forum—have been held across China through JETRO (Japan External Trade Organization), facilitating opinion exchange and business matching that hint at the emergence of collaborative potential.

These three points represent the possibilities for collaboration with China in each of Japan's and its industries' winning strategies using CPS (Figure 3). With its

progressive utilization of CPS, the world’s largest mobile game market, and advanced content environment—and as a country sharing social challenges such as a declining birthrate, aging population, labor shortages, and caregiving issues—China is believed to be an excellent partner for Japan that can provide mutual benefits.

Figure 3 Winning Strategies for Japan and its Industries Through CPS and Subsequent Possibilities for Collaboration with China



Source: Created by Mizuho Bank Industry Research Department

4. Winning Strategies for Solving Social Issues – Addressing Labor Shortages in the Care Sector

As the final chapter, we will delve deeper into the third winning strategy, “Winning Through Solving Social Issues”, from among the combinations of Japan’s winning strategies and collaborative possibilities with China discussed in Chapter 3.

The chapter focuses on one particular social challenge: labor shortages. Labor shortages are among the most critical issues affecting economic and social activities, as adequate human resources are essential for economic growth and the maintenance and management of the infrastructure needed to sustain society.

According to data published by the United Nations, the populations of both Japan and China are on a declining trend; Japan’s population growth rate turned negative in 2010, while China’s did so in 2022 (Figure 4). Consequently, both countries are seeing progression in low birth rates and aging populations. When the aging rate exceeds 21%, a society is classified as super-aging; Japan has been classified as such since 2007, with its aging rate continuing to rise (Figure 5). The same projections indicate that China will become a super-aging society by 2034, after

which its aging rate is expected to keep rising.

Thus, Japan and China are rapidly facing severe aging trends accompanied by labor shortages, yet a fundamental solution to this challenge remains elusive. In particular, there is a critical labor shortage in the care sector. The increasing demand for care, driven by the growing elderly population, is at the heart of this staffing issue.

While solving this problem is not easy, we aim to outline winning strategies for Japan and China that address labor shortages in the care sector through technology by focusing on the potential of technologies, including CPS.

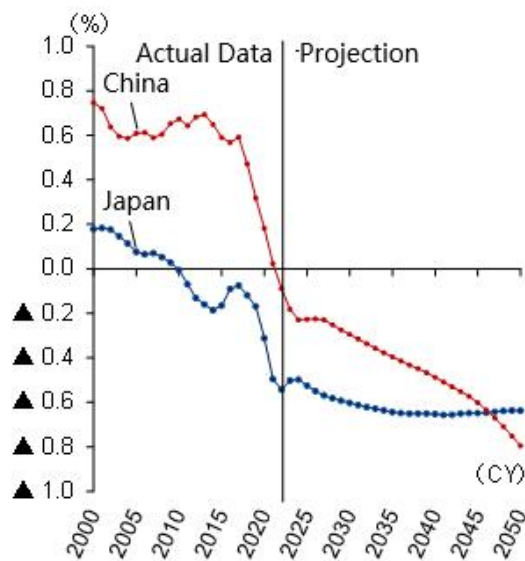


Figure 4 Trends in Population Growth Rate (UN Projections)

(Source) Both figures: Compiled by the Industry Research Department of Mizuho Bank from United Nations, World Population Prospects 2024

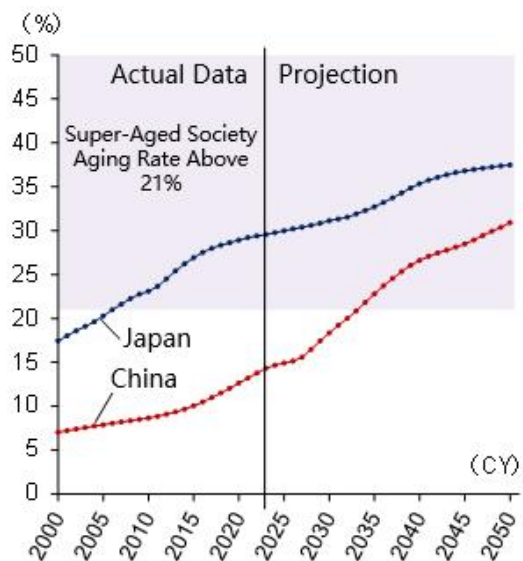


Figure 5 Trends in Aging Rate (UN Projections)

4.1 Addressing Labor Shortages in the Care Sector – The Strengths of Japan and China

Japan has a head start in the care sector, having experienced an aging population earlier than other countries. In 2000, a long-term care insurance system was introduced to support elderly care across society. Japan has since accumulated extensive know-how in various care-related operations and boasts strengths in its care services' high quality and diversity. These services include assisted living facilities for the elderly, nursing homes, hospice-style housing, day services, and

home care. Because Japan leads in many areas of the care sector, it attracts considerable international interest.

Furthermore, there has been a recent trend of Japanese companies seeking to expand into China's care market. For example, Panasonic Holdings of Japan, in collaboration with Yada International Holdings—which operates care, healthcare, and tourism businesses in China—developed a retirement city called “Yada Matsushita Community” in Yixing City, Jiangsu Province, China, a grouping of service-equipped senior housing projects. The apartments constructed in the community incorporate Japan's extensive know-how in the caregiving sector. They feature innovative lighting systems with automatic brightness adjustment in bedrooms, high-end toilets capable of monitoring health indicators like urine components and blood pressure while seated, and thoughtfully designed climate control and spatial layouts.

As exemplified by this community, smart caregiving solutions leveraging various technologies can simultaneously reduce the burden and stress on the elderly while achieving labor savings and providing sophisticated care and health monitoring. For instance, in nursing homes, in addition to equipping care-dependent residents with wearable devices, sensors can be integrated into fixtures such as toilets, floors, and bedding to monitor a range of vital signs in real-time. This setup can immediately trigger automated alerts to notify caregiving staff at the first sign of any abnormality, thereby establishing a safer and more robust care framework.

In China, there has been remarkable progress in developing humanoid and quadruped robots in recent times. For example, robot manufacturers such as UBTECH Robotics and Unitree Robotics have emerged, and the humanoid robots developed by these companies are already beginning to partially replace human labor in manufacturing settings. Various technological solutions are being introduced in caregiving scenarios—for instance, power-assist suits help transfer care recipients, and electric beds aid with mobilization. Currently, these advancements merely reduce the burden of tasks usually performed by human hands; it remains impossible to eliminate the need for caregivers entirely. However, moving forward—and notwithstanding issues of social acceptance—the continued progress of these robots may make the partial replacement of human caregivers a realistic prospect. In areas such as bathing or toileting assistance, some even suggest that robotic support might be preferable to human assistance from the perspective of maintaining care recipients' dignity.

4.2 Addressing Labor Shortages in the Care Sector – Collaborations Between Japan and China

To resolve the increasingly severe labor shortages in the care sector brought about

by declining birth rates and an aging population, two objectives must be achieved: (1) Reducing the number of individuals requiring care and (2) Minimizing the amount of human caregiving required per individual. Against these challenges, smart caregiving solutions and robotics—as described above—offer potential solutions.

(1) First, service-equipped senior housing incorporating smart technology can continuously monitor residents' health, helping prevent injuries, illnesses, and stress, thereby reducing the likelihood of transitioning into a state requiring care. Alternatively, even when care becomes necessary, smart caregiving can help maintain a lower level of care dependency. Either approach can contribute to reducing the overall number of care-dependent individuals.

(2) Second, no matter how extensively smart senior housing or other technologies are deployed, it is impossible to eliminate the need for human caregivers entirely; even when using power-assist suits or electric beds to ease caregiving burdens, there is a limit to how much labor can be reduced. Therefore, while human involvement in caregiving remains essential, robots can potentially substitute for a part of that labor. With continuous improvements in performance and versatility, robots will likely further reduce the need for human involvement in care.

If Japan and China can each leverage their respective technological strengths to (1) decrease the number of individuals requiring care and (2) reduce the amount of human labor needed per care recipient, the labor shortages in the care sector—intensified by aging and declining populations—could be significantly alleviated. In addition, by deploying smart senior housing and caregiving robots to countries that will soon face similar demographic challenges, it may be possible to establish a winning strategy for solving social issues led by East Asia.

We envision a promising future in which Japan and China take the lead in resolving the problem of caregiving labor shortages resulting from aging populations and declining birth rates—challenges that many countries are already facing or will soon face—thus providing solutions to the world.