

## 21st Century Public Infrastructure Systems that Coexist with People



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Graduated from the masters program of the Graduate School of Engineering at The University of Tokyo and appointed as a research associate to the Faculty of Engineering at The University of Tokyo in 1980. Received doctor of engineering (The University of Tokyo) in 1987. Appointed associate professor of Institute of Information Science and Technology at the University of Tsukuba in 1988. Appointed associate professor in the Faculty of Engineering at The University of Tokyo in 1992. Appointed professor in the Department of Systems Engineering at The University of Electro-Communications in 2006. Appointed to his current position in 2009. Professor Shin is a vice president and fellow of The Society of Instrument and Control Engineers, a trustee of the Manufacturing Science and Technology Center, and chairman of the Control System Security Task Force of the Ministry of Economy, Trade and Industry.



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Joined Hitachi, Ltd. in 1979. Appointed General Manager of Public & Municipal Systems Division, Industrial Systems Group in 2005. Appointed General Manager of Information & Control Systems Division, Information & Telecommunication Systems Group in 2006. Appointed Chief Strategy Officer, Chief Technology Officer, and General Manager of Strategy Planning & Development Office, Information & Telecommunication Systems Group in 2009. Appointed President & CEO of Information & Control Systems Company in 2009. Appointed Vice President and Executive Officer, President & CEO of Information & Control Systems Company in 2010. Appointed to his current position in 2012.

People are taking a fresh look at what form cities should take in our era of global environmental problems and the growing urbanization in emerging economies. The key to future urban development lies in finding ways of simultaneously achieving conflicting objectives, namely the pursuit of convenience and economic efficiency that are essential to societal progress while also reducing the growing burden that this progress places on the environment. Hitachi believes that the next generation of cities, smart cities, should maintain a relationship of harmony between the global environment and the people who live and work in them. Hitachi combines total engineering capabilities with diverse technologies and extensive experience built up over many years in the public infrastructures sector and the information and telecommunications sector. It is working to utilize these to establish a global capacity for achieving this relationship of harmony based on the information and control systems development technologies that have sustained the reliability of public infrastructures.

### Society in which People and Environment are in Harmony

**Saito:** Views on how to go about urban development and the provision of infrastructures are being rethought with the aim of realizing a sustainable society. Hitachi is working towards creating smart cities, the next generation of sustainable

cities, by bringing together our accumulated technologies for public infrastructures, with one field of increasing importance being that of system development technologies for public infrastructures. Today I intend to discuss the future form of system development technologies for public infrastructures with Professor Seichi Shin, a specialist in system engineering at The University of Electro-Communications.

**Shin:** In terms of factors such as the duration of power outages or ensuring that the trains run on time, it is clear that the public infrastructure in Japan is extremely reliable by global standards. While I believe that the distinctively high level of quality demanded in Japan is one reason for this, you can also point to the excellence of the control systems as well as fundamentally high product reliability. Technologies that make the parts of a system mesh together and interoperate correctly have kept system quality levels high. While scheduled power outages, restrictions on power use, and other disruptions following the Great East Japan Earthquake have impacted people's daily lives, it is likely that this has also had the effect of making many people realize just how good the infrastructure was prior to the disaster. Nevertheless, this does not mean that more progress is not needed and I feel that we need to work toward new public infrastructures by applying what we have learnt from the earthquake.

**Saito:** In the past, we have built systems and other products for different parts of public infrastructures with a view to continually raising standards and making improvements. However, I believe there is a sense in which the optimization of individual components has gone too far, with problems emerging in areas such as flexibility and coordination with other systems. Moreover, I believe that coordination with the people who actually use the infrastructure has been inadequate. The Great East Japan Earthquake exposed these issues. In my opinion, their resolution will also lead to the creation of smart cities.

**Shin:** The coordination with residents will be one of the key concepts in the future of this field.

**Saito:** For everyone to live happily on our finite planet, it is essential that we find forms of infrastructure that provide a harmonious balance between the global environment and convenience of living. This means we need to consider not only the infrastructures themselves but also to factor in the people who use them. "Considering the situation from the other person's perspective" has been a fundamental philosophy behind Hitachi's business and it will be necessary to construct future infrastructures from a perspective of overall optimization that takes account of everything from corporate activity to the consumers who use the services. When Hitachi thinks about smart cities, we mean the sort of cities that are supported by infrastructure like this.

To achieve this we need to make progress on using IT (information technology) for "transparency" (ways of making the actual situation visible). Transparency includes sharing of the places where interaction with residents takes place and I believe that the next generation of infrastructures will involve using these for the mutual publishing of knowledge as well as an ongoing search for improvements.

**Shin:** Transparency is certainly an important starting point. It is also needed for the interoperation of the various systems

that support infrastructures in optimum ways that go beyond their individual scopes. Also of importance is simulation technology for comparing different scenarios.

The greatest difficulty when building public infrastructure systems that include consumers is that it is impossible to manage all of the different things connected to the system. Building public infrastructures that are capable of dealing with this reality will require advanced architectures with even greater flexibility.

## System Development Technology for Public Infrastructures that Realize Symbiosis

**Saito:** Although they have ceased to be commonly remarked on in recent times, three keywords for system design are philosophy, concept, and architecture. What is needed in the construction of new public infrastructure systems, I believe, is to think about them in terms of philosophies and concepts and then to produce new architectures based on these thoughts. As you know, a Hitachi autonomous decentralized system is used as Japan's railway operation management system. Systems like this, in which the scope of future expansion was not delimited at the beginning and which undergo ongoing change, are difficult to implement using other than an autonomous and decentralized approach. The same applies to smart cities where the infrastructure must work in harmony with other systems and requires a sustainability in which continuing social change is a given. We call this system concept "symbiosis autonomous decentralization."

Here, "symbiosis" means a number of systems with different purposes working together in a mutually beneficial way. One example would be a regional electric power grid and household or building EMSs (energy management systems). To create advanced architectures based on this concept, as well as making the simulation and modeling technologies that are the basis of control more sophisticated, we are also developing technologies for the interoperation of various different systems.

**Shin:** You mean the balance between component optimization and overall optimization. I think people are also an important factor to consider.

From a system engineering perspective, half of system engineering involves mathematical approaches while the other half deals with how people behave. This is because unforeseen situations can arise in systems that include people and ongoing progress is being made in manufacturing toward adopting system designs that seek to achieve best practice. I believe that taking advantage of philosophies, concepts, and architectures like these in public infrastructure will also be important.

**Saito:** I agree. While symbiosis has the meaning I gave

earlier in the context of system engineering, consideration of symbiosis between systems and the people who use them is also important. From this perspective, we will not be able to create the next generation of public infrastructure systems unless we identify new architectures, by which I mean things like the overall structure of systems and their principles of operation, and use the PDCA (plan, do, check, and action) cycle to achieve growth.

**Shin:** Accountability is important to making the PDCA cycle work. For example, a major point about a railway operation management system is that it needs not only to ensure that the trains run on time but also to coordinate with mechanisms for disseminating information when delays do occur. In electric power, demand response can be seen as having greater accountability than mandatory rolling blackouts. Symbiosis is only possible by considering the situation from the other person's perspective, and to achieve this it is important that engineers too know more about their customers and about the outside world.

**Saito:** One of the things that was frequently reiterated when I first started work at one of our sites (what is now the Infrastructure Systems Company's Omika Works) was "always look outside." I was also taught to approach work with a spirit of taking not the easy road but the hard one to see it for myself. Although society is different now to when we were young, what has not changed is that well-balanced system designs cannot be achieved without considering not only the nature of work and processes and people's behavior but also everything up to and including materials and products. Because the global deployment of public infrastructures that coexist with residents requires an understanding of conditions in the field, I hope that young engineers will build up a diversity of experience including spending time working in China, India, or other foreign economies.

## Common Ground that Transcends Boundaries such as Nation or Industry

**Shin:** Because I see Hitachi as having an obligation to take Japanese technology to the world, I look forward to the global deployment of public infrastructures. Although it is often said that an obstacle to Japanese technology is that it is too advanced, does that not mean it can also be applied flexibly?

**Saito:** Hitachi is already participating in a number of smart city projects overseas, and since the basis of control system design is to produce what is best for the customer, it is possible to build systems to a different standard than would apply in Japan using the same approach, such as when implementing an autonomous decentralized system overseas, for example. Because of the experience and technologies we have built up in Japan, we are able to say "building something to such and such a standard will be enough to satisfy your

objectives." I believe this is a major advantage.

I understand you have had a longstanding involvement in international standardization through bodies such as the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC). I see international standardization of system development technology for public infrastructures as an important factor in their global deployment.

**Shin:** To make global progress on symbiosis, common foundations are required that transcend boundaries such as nation or industry. I see these foundations as being equivalent to the philosophies, concepts, and architectures that you referred to earlier. With a focus on ensuring things like reliability and safety, it is possible to standardize the form that these take, and then have the freedom to build infrastructure systems within these constraints. In other words, I believe that providing venues like the rakuichi rakuza economic policy of Nobunaga Oda (which allowed marketplaces to operate freely in areas under the control of feudal lords during 16th to 18th century Japan) is a factor in the standardization of public infrastructure systems.

**Saito:** We intend to enhance our technologies so that we can provide good quality infrastructures on top of this foundation.

**Shin:** Hitachi has been involved in public infrastructures since its formation and has contributed to maintaining quality not only in energy but also in fields such as transportation, telecommunications, water supply, and sewage. Making full use of the depth and breadth of your technical capabilities is needed not only for individual residents but for Japan as a whole. I always tell my students that system engineering is about bringing together the electrical, mechanical, and other technologies and making it all work together, like the conductor of an orchestra. While I recognize that control of smart city infrastructures represents a difficult challenge, because it involves a large number of players, I hope you will continue to approach it in the spirit of "taking the hard road to see it for yourself." From the perspective of an educator, I hope that this will lead to the nurturing of Japan's young people and its engineers.

**Saito:** Following your example of a conductor, I see system engineers as being like chefs who are able to wield a number of different high-quality knives. The era in which our generation grew up has been talked about as a golden age and if that is so then my view is that there is nothing to stop us making the era to come even better. The fact that the young people of today are living in an era of which we have no experience holds within it the potential for breakthroughs to be made. I see combining this youthful energy with experience and past success while building the society of the future through reconstruction in Japan and urban development overseas as a task for the Hitachi of today. Thank you very much for your time.