Let's Think Flexibly!

-- In Order to Lead Changes in Society / Technology --

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1. Introduction

I appreciate those who read the Annual Report of NILIM for their understanding of and cooperation with NILIM. I hope this report would be of help. In recent years, technologies represented by IoT and data science have rapidly progressed and, parallel to that, socio-economic activities have become more complicated and high-tech. Under such circumstances, I would like to talk about "flexible thinking" in my opening message. Flexible thinking is a topic that consistently draws my interest as an "attitude" required for engineers and researchers in the public capital/housing field.

2. How do you think?

What is "Flexible thinking"? Let me give you some examples. How do you think about the following themes?

(1) What is a digital twin in regards to maintenance?

The concept of a "digital twin" is at the core of "Society 5.0" and maintenance of social capital is often discussed as a field for which introduction is expected. We see the catchphrase of its ideal, such as "automatic perception of abnormality based on data, efficiency increase and advancement of maintenance by creating a virtual site." However, we rarely see discussions about the specific content of the technology.

What does it actually mean to detect abnormalities based on data? Roughly speaking, it might mean to "install sensors of the necessary performance in appropriate locations, consistently collect, transmit, record and accumulate abnormality data in the cloud, and detect abnormalities using AI." However, requirements should be clarified, such as sensor location and sensitivity. If AI analysis is conducted, the teaching data of abnormal behaviors will also be necessary. If asset management is developed, it will be necessary to set the deterioration curve of structures and target values of management. That is, knowledge as a structure is indispensable.

It would also be necessary to consider management of the IoT system itself, operating procedures for initial actions to take when an abnormality is detected, and the system, personnel, and skills appropriate for the virtual site.

Of course, establishment / verification of the system itself and issues concerning the hardware and systems should be addressed in parallel. However, there is no doubt that knowledge other than IoT is indispensable. Therefore, on the subject of how to use IoT as a tool, a broad view based on action and flexible thinking is required particularly for engineers and researchers who will be using it.

(2) What impact does climate change have on structures?

It is widely recognized that climate change will cause frequent natural disasters and devastating damage. So, won't other things be affected? The impact of intense heat on the labor environment of a site is well recognized. What is the impact on structures? Such indication has never been heard although I may not have learned. However, isn't there any relationship? For example, let us consider the impact on the durability of structures in a cold, snowy area. Isn't it possible that temperature could fluctuated around zero degrees and consequently increase in the risk of freezing and thawing even in areas where the temperature is normally below zero all day long in the winter, such as the mountainous areas of Hokkaido or Honshu?

New findings would be obtained by relating the knowledge that is common individually, such as global warming and freezing and thawing effect.

(3) What effect does i-Construction bring?

What is the expected effect of i-Construction ("i-Con")? Most people would say improvements in quality / work efficiency and solutions to labor shortages. However, this is how a builder sees things, and looks at construction sites in the narrowest sense. For the former, it is also important to discuss the effect of efficiency-enhanced construction management on the owner and the kind of business process / operation system desirable to the owner.

Regarding the latter, changes in work style are being reported by pioneering enterprises that adopted i-Con technology, even in part, such as very recently hired young employees operating heavy machinery or women employee who had previously been doing paperwork taking charge of data creation. These

examples suggest changes in the way young people view the construction industry as working opportunities are being created for women and inexperienced persons. Moreover, if it were possible to acquire skills in 3D data creation or IT heavy machinery operation at an industrial high school or technical college, young people would be more interested and could be put to work immediately. Development of a construction simulator for educational purposes would not be difficult, given the technologies available today. It would bring changes to job training by systematizing the skills that should be acquired for i-Con age and creating educational programs for acquiring them.

Various development ideas can be hatched by watching manifested events and being imaginative.

3. "Flexible thinking" is a sense of crisis turned inside-out.

The foregoing examples are some of the ideas I have been presenting in my daily work. Although the themes of discussion are different, what commonly underlies them all is "flexible thinking." In fact, this is a sense of crisis turned inside-out.

As I stated at the beginning, the world around us is becoming increasingly complicated and moving at an accelerating pace, all the while placing greater emphasis on performance and social implementation. Accordingly, there are not a few cases where we see the tendency of pursuing easy and fragmented results that are apparently easy to understand. This goes for science and technology in general, as well: there is an observable tendency towards superficial activities that sound good in theory. Of course, as the world of competition, skills for quick and skillful presentation will be necessary. On the other hand, there is actually a steady tendency in some data business, etc. that a highly sufficient system is created quietly to a certain extent and disseminated / implemented in society before people know it.

Under such circumstances, what value do engineers and researchers have in the housing and social capital fields? I think that these fields are characterized by physical existence including buildings, structures, rivers, and seas, real development of socioeconomic activity and citizens' lives on them, and the need of policy development and system construction for implementation.

The engineers and researchers who have been involved in these fields should have knowledge of all of this. Based on accurate technical capabilities, perceive the essence of things and see the future. Overviewing with a consistently high perspective, such as whole engineering system, social system including policies and systems, regions and land, and relationship with social life. Such idea and action are possible with flexible thinking. These might be the existence value.

4. Conclusion

In this paper, I have stated my personal opinion and some criticism. However, what is stated here is also expected of the concerned persons and readers, including the people in my organization.

I believe that, if more people in our organization practice "flexible thinking" based on proper expertise, knowledge, and experience, we can steer the engineering development towards what society truly needs and prove ourselves useful even in rapidly changing times, without being swayed by new technologies or requests. I also see pride and humility integral to flexible thought.