



**Program for Japan-DK-seminar, Copenhagen, September 13, 2019**  
**- Theme 4: i-Construction, ICT, VDC, robots, automation and 3D-print**

Japan have a growing population of old people and a shrinking construction workforce. The construction sectors in Japan and Denmark/EU are fighting for better productivity and to fulfil the growing demands for cheaper, better and sustainable buildings and infrastructures. However, we have only seen sporadic productivity improvements in practice. A small delegation from Japan led by Professor Kazuyoshi Tateyama will present their initiatives about i-Construction, and we will discuss related Danish/EU initiatives.

Theme 4 is an open session held September 13, 2019 at 14:00-17:00 in IDA-house, The Danish Society of Engineers, Kalvebod Brygge 31-33, 1780-DK Copenhagen V.

Theme 1-3 are closed sessions held earlier in the day about: 1) Challenges and visions, 2) Construction Kaizen and motivation and 3) A site visit at 'Postgrunden'.

**Program:**

14:00 Check in, coffee and networking  
14:30 Welcome to IDA-house by Chairman of IDA, Civil Engineer Thomas D. Petersen  
14:40 Introduction by Senior Researcher Nils Lykke Sørensen, SBi – Meeting moderator  
14:50 VDC, BIM, ICT and i-Construction in Denmark  
15:10 From i-Construction to FM: Linking Commissioning, BIM and IoT  
15:30 Robots and Construction Site Automation in Denmark  
15:50 Break  
16:00 Utilization and challenge of new technology by contractors in Japan  
16:20 3D-printed construction and example from North Copenhagen  
16:40 Discussion: Development and implementation of i-Construction.  
17:00 Closing, sandwich and networking.

**Background**

Information and Communication Technology (ICT) has found its way to design, construction and logistics processes. Building Information Modelling (BIM) use ICT and involves data input of physical object as 3D, 4D, 5D, 6D and 7D, which stands for geometry, time, cost, performance and facility management. Virtual Design and Construction (VDC) is the process of creating digital information, where the building is virtual build before it is really build in practice. Hereby designers and contractors transform requirements to product specifications and plans for the construction process.

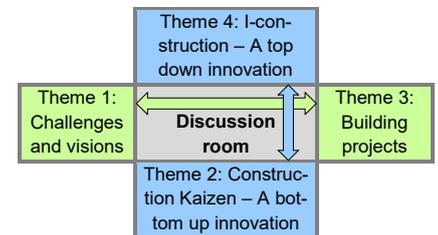
In 2016, the Japanese government formulated a new policy of i-Construction to improve productivity by high wage levels, sufficient holidays and safe work environment to be implemented in three steps: 1) Aggressive use of ICT in advanced construction technology, 2) Standardization specifications and avoiding single-item production and 3) Balancing order flow throughout the year. Hereby construction technology, labour focus, avoiding single-item production and marked regulation are included to improve productivity. More about i-Construction in IPA News Letter Vol. 2, June 2th, 2017. *A New Stage of Construction in Japan – i-Construction*. By Kazuyoshi Tateyama, Ritsumeikan University.

BUILDING TECHNOLOGY AND  
MANAGEMENT

A. C. MEYERS VÆNGE 15  
2450 KØBENHAVN SV  
DENMARK  
SBI.DK  
CVR 29 10 23 84

+45 9940 2525  
NIELS HALDOR BERTELSEN  
+45 9940 2353

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## **A brief profile of our guests from Japan**

**Professor Kazuyoshi Tateyama** [tateyama@se.ritsumeikai.ac.jp](mailto:tateyama@se.ritsumeikai.ac.jp)

Professor at College of Science and Engineering and an executive trustee of Ritsumeikan University, Japan.

He graduated from Kyoto University with Bachelor in Civil Engineering and took the Doctoral Degree in Kyoto University in 1988. He has taken on the research and development on the rationalization of construction for many years and engaged in a lot of committees of governments and academic societies. He is now the chairperson of the committee for construction robotics in Japan Society of Civil Engineers and Council for Construction Robot Research.

Article: *A New Stage of Construction in Japan – i-Construction – Special Contribution.*

Dr. Kazuyoshi Tateyama, College of Science and Engineering, Ritsumeikan University, Japan. IPA News Letter, Volume 2, Issue 2 June 2017.

**Dr. Eng. Takaaki Yokoyama** [t-yoko@fc.ritsumeikai.ac.jp](mailto:t-yoko@fc.ritsumeikai.ac.jp)

Lecturer at College of Science and Engineering, Department of Environmental Systems Engineering, Ritsumeikan University, Japan.

Expert of Precision construction, Soil mechanics, Tera-mechanics, Space Engineering.

**Dr. Hiroshi Furuya** [furuya.hiroshi@obayashi.co.jp](mailto:furuya.hiroshi@obayashi.co.jp)

Senior Chief Engineer at Technical Research Institute, Obayashi Corporation, Japan.

Expert of Utilization of ICT and system development in the construction field

Construction robot development and Construction of data model utilization system.

## **Introduction by Nils Lykke Sørensen – Meeting moderator**

Today we see a top down push from technology and research on the construction sector, which promise better houses and efficient processes. However, the reality is a limited practical application and an unbalanced bottom up pull from the construction in relation to the heavy push. Moreover, we have not seen widespread productivity improvements. However, according to studies of Danish construction ICT use in 2018, it is seen that 60 % of the larger contractors never or rarely reuse BIM and that only 30 % often or always reuse data. For SMEs, the figures are even more skewed. What is the cause of this, and can VDC become productivity enhancing in the current structure?

In theme 4 we will focus on the development of information, ICT, BIM, VDC and i-Construction in Japan and Denmark/EU. Presentations will be on principals and experiences of using VDC in design and construction planning, and how ICT is introduced in Facility Management (FM) and in advanced construction technology to develop construction robots, unmanned construction machines and 3D-printed buildings. We will discuss how construction can be automated (intelligent automation with a human touch), and how VDC and i-Construction can be implemented wider and faster in practise to improve productivity.

## **VDC, BIM, ICT and i-Construction in Denmark**

Client Advisor Andreas Kragh, Consulting engineers Niras A/S <https://www.niras.com/>

A. Kragh will present how VDC is applied in a cooperation between front running clients, consultants and construction companies to specify the building and construction planning, and how VDC and i-Construction are applied general among professionals in Denmark e.g. in relation to surveying, inspection and use of drones. He will show how requirements are specified in a common 3D-model for architects, engineers and contractors, and how it is divided in repeatable building parts as 'products' in construction. He will show how Location-based Scheduling (LBS) is executed in building projects, building parts and activities along and across the supply chain and used at different management levels. Finally, A. Kragh will tell about learning experiences of educating project manager and construction workers, and the impact on productivity, quality and work environment.

#### **From i-Construction to FM: Linking Commissioning, BIM and IoT Technology**

*Partner Nicki Blådal, CXweb an Engineer Technical IT-company <https://cxweb.dk/>*

Facility Management (FM) is the customer for construction and supports the end user in the daily application of the building. N. Blådal will present the BIM-linkages between design, construction and FM, and he will show how IoT-sensors are used in automation of commissioning tests and performance monitoring in FM. He will present results from an interdisciplinary FM-research project between Technical University of Denmark (DTU), Copenhagen School of Design and Technology (KEA) and CXweb. In the project, they installed IoT-sensors in the DTU Library, and he will show how FM-data automatically can controlling the indoor climate, the ventilation, the heating and the lighting system. Finally N. Blådal will give his assessment of the maturity of the IoT-sensor technic in FM and the linkages in BIM in design and construction.

#### **Robots and Construction Site Automation in Denmark**

*Co-Founder & CTO Finn Christensen, Robot At Work ApS <https://robotatwork.com/>*

Robot At Work has moved the RAW robots to the construction site, where they collaborate with the construction worker to perform simple and complex tasks more efficiently and less worn out for the worker. RAW is a user-friendly robot platform that can perform various tasks, which previously required human labour. Raw have applications for painting, milling, cutting, grinding & polishing, picking & placing and 3D-printing, which can be easy programmed directly from 2D or 3D drawings.

F. Christensen will present the different applications and practical examples on how construction workers are working with them, and how they are trained to program and install them in different tasks on construction site. He will present the impact on productivity, quality and work environment compared to manual processes, and how it fits to the philosophy of automation. Finally, F. Christensen will give his assessment of the maturity of using robots in construction, the relation to VDC and the competence of the construction workers.

#### **Utilization and challenge of new technology by Japanese contractors**

*Dr. Kazuyoshi Tateyama, Ritsumeikan University, Japan.*

*Dr. Hiroshi Furuya, Obayashi Co Ltd. (General contractor), Japan*

Handouts: Kazuyoshi Tateyama (2019). *Sophistication of Construction with ICT. Precise Management in Construction. Introduction of Construction Robots*. Japan-DK-Seminar, Copenhagen, September 13, 2019: Theme 4. i-Construction and new technology. 12 pages.

K. Tateyama has earlier in theme 1 presented the challenges and visions for Japan, and in theme 2 he and T. Yokoyama have presented: Utilization of video data on sites to improve of the construction covers. The following presentations are applied:

- Kazuyoshi Tateyama (2019). *A New Stage of Construction in Japan i-Construction*. Japan-DK-Seminar, Copenhagen, September 13, 2019: Theme 1. Challenges and visions for construction. 13 pages.
- Kazuyoshi Tateyama (2019). *A Notable Technology in Construction: 1. Visual Construction, 2. Work-style reformation*. Japan-DK-Seminar, Copenhagen, September 13, 2019: Theme 2: Construction Kaizen as a bottom-up-pull. 29 pages.

K. Tatyama and H. Furuya and will here present:

1. Contractor's approach to i-Construction.
2. From 3D to data model:
  - Example of on-site use of 3D models.
  - Utilization of IFC in the civil engineering field.
3. Construction robot development:
  - Application of remote-control technology (unmanned construction).
  - Development of disaster investigation robot.
4. Integration with new technologies (use of 5G in construction field).
5. Further developments and implementation of i-Construction in Japan.

In i-Construction there is an aggressive use of ICT through precise management and autonomous construction robots. Precise management accept some unexpected conditions and the margins between planning and real conditions, and it introduce flexible changes of the original plan to match the real conditions better to save labour and materials.

### **A Future with 3D Construction Printing**

*Project Manager, M.Sc. Ole Ellinghausen, COBOD International A/S <https://cobod.com/>*  
COBOD printed the first house in Europe in 2017. The project was intense, and they learned a lot about the technology. All this experience were put into the 2<sup>nd</sup> generation construction printer BOD2, and the first unit was installed early in 2019. COBOD writes: *"Printable construction must be the planner's ultimate dream."*

O. Ellinghausen will present the principles of 3D construction printing, and how the BOD2 printer works. He will present an example of 3D construction printing from North Copenhagen, and how the project cost can be calculated. Finally, O. Christensen will give his assessment on what construction parts will be first implemented, and how quickly the technic will penetrate the construction market and become part of an automated construction site.