i-Construction BIM Mandate for Infrastructure
Current Status and Future Plan

Yoshihiko Fukuchi, Ph.D
APAC Infrastructure Sales Development
What happens from 2012 to 2016?
MLIT BIM initiative from CIM to i-Construction

- i-Construction is a new MLIT BIM initiative for infrastructure (CIM)
- FY2016 - Japan’s infrastructure ministry mandates companies constructing over $3M public works projects with cut and fill to use cutting-edge technology such as drones and automated excavators.
- FY2020 – Requirement will extend to all projects. Companies will be asked to use advanced technology throughout process from surveying, design, construction to inspection.
One Big Step forward to MLIT CIM Mandate

- MLIT enforced CIM mandate for Cut and Fill construction over $3M road and levee projects from April 1, 2016 as one of i-Construction strategies.
- Deputy Minister, Ikeda of MLIT says to the newspaper, “Within FY2016 the mandate will be extended to tunnel and bridge projects, and required amendment of existing policies will be updated accordingly.”
- Survey and design projects are also strongly encouraged to submit 3D CIM models to support the mandate.
ICT-based Cut & Fill-type Construction
2D vs. i-Construction Workflow

Plan Design

Construction Cut & Fill as starter
Mandate to leverage 3D Data and ICT Technology

O&M

Past
2D Contract Doc
2D Cross Sections
Needed
Create 3D data

Contract

Survey

3D model as Contract Doc

From 2016

3D Survey

3D as contract doc thru Change Order

Design policy assurance meeting

Edit 2D drawings

3D data from 2D drawings

ICT Construction

2D Cross Sections

Work-in-progress Control

QTO

As-build submittals

Inspection

2D as-built drawings

Concession inspection with 2D drawings

Average Cross-section Method

QTO from 3D models

3D as-built data submittals

Concession inspection with 3D model

3D Survey

3D inspection guidelines

Average

±5cm

Create 3D data

Cut & Fill as starter

Mandate to leverage 3D Data and ICT Technology

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Productivity Optimization by Pre-fabrication

Construction productivity and Schedule Optimized leveraging technology and idea innovation

Conventional Method

<table>
<thead>
<tr>
<th>鋼筋組立</th>
<th>型枠設置</th>
<th>混コン打設</th>
<th>脱型</th>
</tr>
</thead>
</table>

Frame Structure
Productivity Optimization by Pre-fabrication
CIM Guideline Overview
Multi-year Project Contacting

Leveraging existing contract methods for multi-year agreement

- Leveling Income and Expense throughout a year
- Leveling usage of material and equipment
- Dispersion of project start and finish timing

Number of Contracts awarding by MLIT
# of CIM Design Pilot Projects as of Feb 2017

CIM Design Pilot Projects from 2012 to 2016

- **River**
  - 2012: 1
  - 2013: 4
  - 2014: 10
  - 2015: 16
  - 2016: 24
  - Total: 67

- **Road**
  - 2012: 11
  - 2013: 11
  - 2014: 6
  - 2015: 6
  - 2016: 12
  - Total: 46

- **Total**
  - 2012: 12
  - 2013: 22
  - 2014: 12
  - 2015: 12
  - 2016: 22
  - Total: 90

- **Conceptual and Preliminary Design**
  - River: 9
  - Road: 11
  - Total: 20

- **Detail Design**
  - River: 24
  - Road: 33
  - Total: 57
# of CIM Construction Pilot Projects as of Feb 2017

<table>
<thead>
<tr>
<th>Projects</th>
<th>Mandate</th>
<th>Proposal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>6</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>2014</td>
<td>8</td>
<td>20</td>
<td>28</td>
</tr>
<tr>
<td>2015</td>
<td>0</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>2016</td>
<td>6</td>
<td>81</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>176</td>
<td>196</td>
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</tbody>
</table>

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CIM Guideline 2017

Goal

- Decision making process change and process innovation based on information from 2D drawings to front loading using 3D CIM model

CIM Guideline

- Based on knowledge acquired through pilot projects based on 2D drawing-based current contract documentation
## CIM Guideline Configuration

<table>
<thead>
<tr>
<th>Vol 1 Common</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section 1 Overview</td>
<td>Common items of each phase of public works life cycle</td>
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<tr>
<td>Section 2 Survey</td>
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<tr>
<td>Section 3 Sub surface</td>
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</table>

<table>
<thead>
<tr>
<th>Vol 2 Cut and Fill Earth Works</th>
<th>Contents</th>
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<tbody>
<tr>
<td>Cut and fill type project of Roadway and Levee</td>
<td></td>
</tr>
<tr>
<td>UAV survey and inspection</td>
<td></td>
</tr>
<tr>
<td>3D CIM model creation for design</td>
<td></td>
</tr>
<tr>
<td>MC/MG data creation for ICT based construction</td>
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</table>

<table>
<thead>
<tr>
<th>Vol 3 River</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design based on CIM model of Levee and river structure</td>
<td></td>
</tr>
<tr>
<td>Construction management based on CIM design</td>
<td></td>
</tr>
<tr>
<td>O/M based on CIM based design and construction</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Vol 4 River Dam</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design based on rock fill dam and gravity dam</td>
<td></td>
</tr>
<tr>
<td>Construction management based on CIM design</td>
<td></td>
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<tr>
<td>O/M based on CIM based design and construction</td>
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</table>

<table>
<thead>
<tr>
<th>Vol 5 Bridge</th>
<th>Contents</th>
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<tbody>
<tr>
<td>Design based on CIM models of super and sub structure of steel and PC bridge</td>
<td></td>
</tr>
<tr>
<td>Construction management based on CIM design</td>
<td></td>
</tr>
<tr>
<td>O/M based on CIM based design and construction</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Vol 6 Tunnel</th>
<th>Contents</th>
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<tbody>
<tr>
<td>Design based on mountain tunnel</td>
<td></td>
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<tr>
<td>Construction management based on CIM design</td>
<td></td>
</tr>
<tr>
<td>O/M based on CIM based design and construction</td>
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</tr>
</tbody>
</table>
### CIM Models

<table>
<thead>
<tr>
<th>1. Alignment Model</th>
<th>2. Cut and Fill Surface Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. EG Surface Model</td>
<td>4. Structural Model</td>
</tr>
<tr>
<td>5. Geotech Model</td>
<td>6. Large-area EG Model</td>
</tr>
<tr>
<td>7. Integrated Model</td>
<td></td>
</tr>
</tbody>
</table>

#### CIM (3D Model + Attribute Information)

- ① 3D Model
- ② 3D Model with Direct Attribute Information
- ③ 3D Model Referencing External Attribute Information

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<table>
<thead>
<tr>
<th>LOD</th>
<th>Definition</th>
<th>Example</th>
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<tbody>
<tr>
<td>100</td>
<td>Simple shape using line and marker</td>
<td><img src="image100.png" alt="Example Image 100" /></td>
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<tr>
<td>200</td>
<td>Simple structural model</td>
<td><img src="image200.png" alt="Example Image 200" /></td>
</tr>
<tr>
<td></td>
<td>Assembly swept along region</td>
<td><img src="image200.png" alt="Example Image 200" /></td>
</tr>
<tr>
<td>300</td>
<td>Structural model without detailed connection and accompanying structure</td>
<td><img src="image300.png" alt="Example Image 300" /></td>
</tr>
<tr>
<td>400</td>
<td>Detailed structural model on top on LOD 300 model</td>
<td><img src="image400.png" alt="Example Image 400" /></td>
</tr>
<tr>
<td>500</td>
<td>Further detailed model that renders realistic shape</td>
<td><img src="image500.png" alt="Example Image 500" /></td>
</tr>
</tbody>
</table>
i-Construction Roadmap

2017
Step 1 Partial CIM Mandate – Consensus making and Front loading

2017-2020
Step 2 Policy making and system development

2020-2025
Step 3 O/M leveraging CIM model
MLIT Looks closely at UK BIM Mandate Process

**MLIT**

- Entering bidding documents, detailed specifications
  (request items to be considered for the 'rewiring' and recorded.)

- Bidding participation, tender

**Supply Chain**

- Bidding participation and tender

**Contract Pre-Contract**

- Business (construction) plan book, CIM implementation plan
  The confirmation and approval

- CIM plan content
  Agreement

**Contract Post-Contract**

- Business (construction) plan book and CIM implementation plan
  produce

- Main recording items
  - CIM account list (qualifications and experience included)
  - Construction plan (model creation period, attribute allocation period, delivery to construction)
  - Rewiring for the purpose of consultation
  - Use software
  - Information sharing method (ASP, cloud management)
  - CIM delivery file format
UK BIM Mandate Process
Who is asking for BIM?
Published BIM Requirements

AMER
- U.S. Army Corps of Engineers (USACE)
- U.S. General Services Administration
- U.S. National Institute of Building Sciences
- U.S. Veterans Affairs
- New York City Department of Design and Construction
- State of Ohio General Service Division State Architect’s Office
- State of Tennessee Office of the State Architect
- State of Maryland and Washington D.C. Public Schools
- NY School Construction Authority
- State of Wisconsin

EMEA
- Statsbyg – Norway
- Transport Agency - Finland
- Rijksgebouwendienst Ministry of the Interior and Kingdom Relations – Netherlands
- Cabinet Office – UK
- Department of Housing & Equal Territories – France
- Public Procurement Rules – Austria
- EU Public Procurement Directive – Brussels
- Bygst (National Property Agency) – Denmark
- BIM for tall buildings and Green Building Directive - Dubai
- BIM requirements for rail schemes - Qatar

APAC
- Hong Kong Housing Authority
- Building and Construction Authority - Singapore
- Chinese Ministry of Housing and Urban-Rural Development (MOHURD)
- Japanese Ministry of Land Infrastructure and Transportation (MLIT)
- Korean Ministry of Land Infrastructure and Transportation (MLIT)
- Australia National BIM Specification

This list includes Government BIM Policy Initiatives as of August 2014 with links to public-facing websites for more information.
Why did the UK adopt a BIM Strategy

- 50 yrs of reports cited industry inefficiency
- Financial crisis gave impetus for change
- 2011 target 20% cost savings using BIM
- Joint industry and Government initiative

Industry Supply Chain

Government Owner

PUSH

How can we make it easier for the supply chain to move forward?

But not force or distort the market?

• Contracts
• Training
• Technology
• Legal

PULL

How do we ensure we get the information we need to

manage the asset?

• Make it clear what we want
• When we want it
• Collect it electronically
• Keep it simple to start
UK – most developed BIM Mandate with 2016 target for BIM Level 2

Source: Mark Bew and Mervyn Richards
UK Government Level 2 BIM requirement summary

Level 2 BIM can be summarised by 6 key points:

1. Define what is needed
2. Create a plan to deliver it
3. Ensure all parties are capable
4. Generate the information
5. Manage the documents & data
6. Comply with the rules

You must address all 6 to be Level 2 BIM compliant
Signed Historic MOU for collaboration on BIM

- BIMTG and JACIC knowledge exchange activities with support of UK experts to facilitate the development and introduction of the UK BIM implementation strategy.
- BIMTG and JACIC knowledge exchange activities to facilitate the development and introduction of the BIM/CIM in Japan’s construction production system.
- BIMTG and JACIC knowledge exchange activities for technical information and experience by leveraging e-mail and teleconferencing system.
i-Construction Solution Development
Autodesk Working together with Technology Leaders Worldwide

Full automatic Aerial Survey by 3DR Site Scan
Super Easy Laser Scan Survey by Leica BLK360360 both together with ReCap and Autodesk BIM Solutions for Infrastructure
One Button to Start up and Scan

Take Photos and Create Point Cloud Model, Ortho Photo and Mesh
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>CMOS</td>
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<tr>
<td>Resolution</td>
<td>20MP</td>
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<td>Focus Mode</td>
<td>Autofocus</td>
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<tr>
<td>IOS Sensitivity</td>
<td>100 – 16,000</td>
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<tr>
<td>Image Sensor</td>
<td>APS-C 370mm²</td>
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<tr>
<td></td>
<td>13 x 1/2.3” &amp; 1.6 x 4/3”</td>
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<tr>
<td>Lens</td>
<td>16 – 50mm Zoom</td>
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<tr>
<td></td>
<td>20mm Prime Lens</td>
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</tbody>
</table>
3DR Solo w Site Scan™ - Autodesk® Workflow
Autodesk Working together with Technology Leaders Worldwide

Full automatic Aerial Survey by 3DR Site Scan
Super Easy Laser Scan Survey by Leica BLK360360 both together with ReCap and Autodesk BIM Solutions for Infrastructure
One Button to Start up and Scan

Scan to Registration to Mesh or Point Cloud
世界最小レーザー計測機 BLK360 + ReCap 360 Pro
i-Construction Future Plan
橋梁点検維持管理業務

3D点群データを活用した橋梁点検維持管理業務

Bridge inspection data (3D-model)

UAVが撮影した1000枚程度の写真から作成した3次元モデルに損傷写真をリンクした。
3次元モデルは簡易であり精度は高くない。
MLIT i-Construction Ecosystem
MLIT i-Construction Ecosystem

**Industry Associations**
- BMMC
- IAI (bSI)
- JFCC
- Light House
  - Nihon Sekkei
  - Nikken Sekkei
  - Shimizu
  - Obayashi
  - Yachiyo Eng

**Light House**
- Nihon Sekkei
- Nikken Sekkei
- Shimizu
- Obayashi
- Yachiyo Eng

**Industry Associations**
- BMCC
- IAI (bSI)
- JFCC

**Education & Society**
- JSCE
- Tokyo University
- Osaka University
- Kumamoto University
- JSCE

**Infrastructure Named Accounts**
- MLIT
  - Minister’s Secretariat (BIM/CIM)
  - Housing Bureau (BIM)
  - Policy Bureau (CIM)
- JR Group
- NEXCO
- JFCC
- JCCA
- CUG
- OCForum

**Local Governments**
- Tokyo Metropolitan Govt
- Yokohama City
- Kochi etc..

**Industry CIM Leaders**
- IAI (bSI)
- Infra Room
- NIPPON KOEI
- KAJIMA CORPORATION
- CTI
- UR
- OBAYASHI
- TATEYAMA

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NEXCO CIM

- Outer Ring Expressway Shield Tunnel as NEXCO CIM Designed-in
Japan Rail BIM
Full urban context and stakeholder engagement