BIM Issues & Value Analysis on the New HQ Construction Project of Korea Land & Housing Co.

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• Korea Land & Housing (LH) – Government-owned land and housing development company – about US$20 Billion revenue with 6,000 employees
• Hyundai E&C – 14th ’15 & 13th 14 of 2015 ENR Top 250 Contractors
• DoAllTech – Leading Construction IT company – FIATECH CETI Awardee 2007 w/ SKKU – BIM Partner of KAJIMA Corporation
LH HQ at Jin-Ju, Korea

- Korea government policy for co-development of the capital region and local areas
- Project type: 20 story office complex
- Project budget: ≈ US$260 million (incl. ODP US$ 38 mil)
- Total Area: 135,893 m² (≈ 1.46 million feet²)
2011.11  
Design Award to  
Moo Young & Tomoon

2012.1~8  
DD & CD

2012.10~12  
Technical Alternative  
Design-Build Award  
& CD II

2013.10.29 ~ 2015.03.01  
Construction

2012.10~12  
Construction BIM

2013.10~12  
As-Built BIM
Construction BIM Needs

- Short design period (< 1 year) & insufficient design information
- Short duration of construction (28M) compare to the scale
- Communication and collaboration among different work trades (200 subcons)

Tapered shape
Curved Facade
Curved Roof

Produced by ArchiCAD

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- Full Construction BIM @ LOD 300~400
- On-Site Resident BIM Implementation for 28 months with 6~10 people
Collaboration and communication using BIM room

- Owner
- Decision making
- Budget review
- Supervision

- BIM Consultant
- GC's BIM Team
- Neutral role between owner and GC

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Exterior Claddings and Roofs

- Multi-disciplinary construction team – ICP (Integrated Construction Process)

- Exterior Panel (KCC)
- Curtain Wall (Wonjin AL)
- Glasses (HanGlas)
- Spaceframe (Steel-Life)
- Struc. Steel (Kyungsoo Steel)
- Freeform Exterior Panel (Steel-Life)

Produced by ArchiCAD
Multi-Disciplinary Collaboration

- Main Auditorium
- Interferences among multi-disciplinary components

Produced by ArchiCAD

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Main issues were reviewed at the BIM room before owner’s approval for construction.
BIM Room Collaboration and Communication

Alternative study and decision making using BIM

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BIM Data Share with Subcontractors

**BIM Team**
- Construction BIM
- Issue Resolution & Revision of Const. BIM
- As-Built BIM

**Subcon A (Direct Use)**
- BIM Data, 3D Sections, Drawings, IFC, STEP, IGES
- Fabrication BIM for CNC

**Subcon B (Indirect Use)**
- Shop Dwg

- Steel, Curtain Wall, Metal Panel
- RC, MEP, Interior

*Survey*

*Product*
As-Built Pictures

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As-Built Pictures

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• Qualitative Value Analysis
  – Survey on Participants’ satisfaction through questionnaire and interview
  – 52 responses from LH, Hyundai E&C, subcontractors

• Quantitative Value Analysis
  – BIM Issue Analysis using 25 monthly BIM reports
  – Value analysis based on contract budget
  – Investigation on sensible value of subcontractors
Satisfaction Research

- Highest satisfaction from subcontractors (avg. 4.2/5)
- BIM as supplementation for Insufficient design information
- Reduction of construction risk
- Resolution of multi-disciplinary issues
- Improved productivity and error reduction in shop drawing development
- Less loss rate in production
- Tool for survival to subcontractors, such as steel and curtain walls
Quantitative Value Analysis

• How can we quantify BIM value?
  – Argue about cost savings from BIM
    • Cost savings during design phase, Waste protection during the construction phase
  – Value of BIM @ LH = Predicted waste prevention through BIM execution
  – Criteria for Quantification of Waste => Contract budget
BIM Issues by Work Trades

- 511 BIM Issues
- Multi-disciplinary Issues - 338 (66%)
- Total 1,094 Issues by work trades

<table>
<thead>
<tr>
<th>Work Trades</th>
<th>No. of Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>General/Temporary Works</td>
<td>8</td>
</tr>
<tr>
<td>Architecture/Interior</td>
<td>666</td>
</tr>
<tr>
<td>Civil</td>
<td>15</td>
</tr>
<tr>
<td>Electrical</td>
<td>86</td>
</tr>
<tr>
<td>Landscape</td>
<td>5</td>
</tr>
<tr>
<td>Mechanical/Plumbing</td>
<td>301</td>
</tr>
<tr>
<td>Communication</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,094</strong></td>
</tr>
</tbody>
</table>

- Architecture/Interior: 61%
- Mechanical/Plumbing: 28%
- Electrical: 8%
- Communication: 1%
- General/Temporary Works: 1%
- Landscape: 0%
## Issues by Types

- **Total 820 BIM Issues by Types**

<table>
<thead>
<tr>
<th>Area</th>
<th>%</th>
<th>Types</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Error</td>
<td>32%</td>
<td>Clash</td>
<td>154</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discrepancy</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Omission</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ambiguity</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of Info</td>
<td>37</td>
</tr>
<tr>
<td>Decision Making</td>
<td>56%</td>
<td>Alt. Study</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constructibility</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance/Quality</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quantity Take-Off</td>
<td>18</td>
</tr>
<tr>
<td>Documentation</td>
<td>11%</td>
<td>Fab. Model</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Approval Doc.</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
<td>820</td>
</tr>
</tbody>
</table>
Value Quantification Method

- 517 of Budget assignable issues were derived

- **BIM Issue-Related Unit Value (BIUV)**
  - Most detailed contract budget item for unit/floor/space where the Issue is located

- **BIM Issue Value (BIV) = (a/A) * BIUV**
  - a : Dimension of the Issue
  - A : Dimension of unit/floor/space of an issue location
Value Quantification Method

- **BIM Contribution Value (BCV) = BIV * α**
  - α: degree that BIM contributes to find the issue (%)
    - 0, 25, 50, 75, 100%

- **Sensible BIM Value (SBV)**
  - BIM value that participants think based on their contract value

- **BIM Delay Prevention Value (BDPV, analysis ongoing)**
  - Based indirect cost (21%)/total construction duration (28 months)
  - Liquidated damages
BIM Value Analysis Result

<table>
<thead>
<tr>
<th>Work Trade</th>
<th>BIV</th>
<th>BCV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PTC</td>
<td>Weight</td>
</tr>
<tr>
<td>Temporary Works</td>
<td>0.2%</td>
<td>82.2%</td>
</tr>
<tr>
<td>Architecture/Structure</td>
<td>13.6%</td>
<td>79.9%</td>
</tr>
<tr>
<td>Civil(Sewage, Water, Pavement)</td>
<td>0.0%</td>
<td>53.1%</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.6%</td>
<td>61.9%</td>
</tr>
<tr>
<td>Landscape</td>
<td>0.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>Mechanical/Plumbing</td>
<td>5.5%</td>
<td>65.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20.8%</strong></td>
<td><strong>74.9%</strong></td>
</tr>
</tbody>
</table>

BIM execution in the LH New HQ construction project has resolved construction risks as much as 21% of total construction cost.
BIM execution has contributed waste prevention value at least $US 23.2 million, which stands for 10% of total cost and 1,000 % of ROI.
Conclusion & Lessons-Learned

• Despite tough conditions, the new LH HQ construction project has been successfully completed with high quality.
• The earlier the better for BIM execution, but it is not too late with construction BIM
• Early involvement of subcontractors would have greater impact
• Need for new paradigm or innovative delivery system like IPD needs to be developed in Korea
• Value on BIM process with people, knowledge, and information

Thank you!

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