Unite! Innovative BIM Workflows for Industrialized Construction

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Steve DeWitt
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About the speaker

Soren Shen-Lung Lin
- Senior Architect at Nordic Office of Architecture
- Lead in Module Development for the New Stavanger University Hospital project
- M. Arch. and M. Sc. in Built Environment
- Specializes in built environment analysis and industrialization methodology
About the speaker

Bridget White
- Senior Architect / BIM Director at Nordic Office of Architecture
- BREEAM AP
- Uses a wide range of Autodesk products and implements new office workflows involving complex analysis, virtual reality, industrialization, integrated sustainability, and streamlining the flow of information between architects and the building industry.
About the speaker

Steve DeWitt

- 20 years of experience in design software
- Certified Autodesk Revit® professional
- A contributor to several AEC groups:
- A founder of KitConnect
The New Stavanger University Hospital
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Cras lacinia interdum odio, at cursus elit sagittis.
V.O.L.U.T.E. – A Step by Step Workflow
V.O.L.U.T.E.
A step by step workflow
Vision

One click or few clicks to rule it all
Opportunities

Analyze the opportunities in the project and systemize them.
Opportunities

Modules – For prefabrication
Opportunities

Design Repetitions – Not for prefabrication
### Module Type

<table>
<thead>
<tr>
<th>Module Type</th>
<th>Type Running Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>8+ Module Category</td>
<td></td>
</tr>
<tr>
<td>SB=Bathroom Module</td>
<td>01=Type 01</td>
</tr>
<tr>
<td>SC=Cabinet Module</td>
<td>02=Type 02</td>
</tr>
<tr>
<td>SD=Door Module</td>
<td>03=Type 03</td>
</tr>
<tr>
<td>SG=Guest Bed Module</td>
<td>04=Type 04</td>
</tr>
<tr>
<td>SH=H-Module</td>
<td>05=Type 05</td>
</tr>
<tr>
<td>SS=Vanity Unit Module</td>
<td>06=Type 06</td>
</tr>
<tr>
<td>SV=V-Module</td>
<td>...</td>
</tr>
</tbody>
</table>

### Deviation

- A=Standard, No deviation
- B=Deviation B
- C=Deviation C

### Orientation

- R=Orientation Right
- L=Orientation Left
- N=Orientation Neutral

### Material / Colour

- 001=Material / Colour 1
- 002=Material / Colour 2
- 003=Material / Colour 3

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**Language**

A logical and cross-disciplinary coding system
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8501.A.L.001</td>
<td>Vanity Unit Module 01_Patient Care_H=2400mm_Left</td>
</tr>
<tr>
<td>8501.A.R.001</td>
<td>Vanity Unit Module 01_Patient Care_H=2400mm_Right</td>
</tr>
<tr>
<td>8502.A.L.001</td>
<td>Vanity Unit Module 02_Administrative Area, WC_H=2400mm_Left</td>
</tr>
<tr>
<td>8502.A.R.001</td>
<td>Vanity Unit Module 02_Administrative Area, WC_H=2400mm_Right</td>
</tr>
<tr>
<td>8503.A.L.001</td>
<td>Vanity Unit Module 03_Operational Area_H=2400mm_Left</td>
</tr>
<tr>
<td>8503.A.R.001</td>
<td>Vanity Unit Module 03_Operational Area_H=2400mm_Right</td>
</tr>
<tr>
<td>8504.A.L.001</td>
<td>Vanity Unit Module 04_Bathroom_H=2400mm_Left</td>
</tr>
<tr>
<td>8504.A.R.001</td>
<td>Vanity Unit Module 04_Bathroom_H=2400mm_Right</td>
</tr>
<tr>
<td>8505.A.L.001</td>
<td>Vanity Unit Module 05_HCWC_H=2400mm_Left</td>
</tr>
<tr>
<td>8505.A.R.001</td>
<td>Vanity Unit Module 05_HCWC_H=2400mm_Right</td>
</tr>
<tr>
<td>8506.A.L.001</td>
<td>Vanity Unit Module 06_Patient Care with Manifold Cabinet_H=2400mm_Left</td>
</tr>
<tr>
<td>8506.A.R.001</td>
<td>Vanity Unit Module 06_Patient Care with Manifold Cabinet_H=2400mm_Right</td>
</tr>
</tbody>
</table>

**Language**

For Vanity Unit Modules and the variants.
Language

For Bathroom Modules and the variants
Unite

Unite with the professionals like programmer and software developer to overcome the defined challenges.
Technology needs what we need to be developed in a right direction.
• How to audit changes and update them in all the building models at the same time?
• How to control mirrored type of a module?
• How to make cross-disciplinary modules instead of linking elements from other disciplines?
• How to take better advantage of duplication?
• How to switch a set of elements within a module (group or nested family) for making new types?

Unite

The defined challenges
Test
Tests and discussions
2 Custom-Made Plugins
COWI Tools + KitConnect
COWI Tools
COWI Tools for Modules
COWI Tools for Design Repetitions
KitConnect
The Mockup
The Mockup

A test-ground for both modules and BIM workflows
Flat-Pack Modules

Exploded view
From model to product

Bathroom Modules in the Mockup model
From model to product

Bathroom Modules in the Mockup on-site
From model to product

Shaft Modules in the Mockup model
From model to product

Shaft Modules in the Mockup model and the Mockup on-site
From model to product

Workstation Module in the Mockup model and the Mockup on-site
From model to product

Guest Bed Module in the Mockup model and the Mockup on-site
The Progress
High Performance Housing Development
Architects’ Perspective
Base type examples

N1  N2  N3  N4
N4
Sub types

Carport

Kjeller (Basement)

Terrasse (Terrace)
Combinations
Deviating areas per house
Proposal to the client

**Opportunities** – find opportunities from evident duplication and identify areas that could be considered for industrialised construction or modulation.

**Language** – divide the different packages which were a result of the analysis phase. Find a robust system that can cope with eventual changes and developments in the project. Form a coding system that can be used to describe the duplicated design or industrial packages which can also tolerate new types and deviations.

**Unite + Test** – Working with software companies to fine tune our workflow, integrate and test proposed methodology for improving project workflows associated with design repetition and industrialisation. (in this case new technology – kit connect - for the cloud based handling of geometry and data).

**Evaluate** – Compare the new workflow with the original workflows used previously and evaluate to form a list of pros and cons. Conclude a recommended way forward.
Opportunities find opportunities in duplicated design and identify areas that could be considered for industrialised construction or modulation.
Photo credits:
https://mestergruppen.no/prosjektutvikling/
https://www.made-in-china.com/showroom/weizhengheng118/product-detailIKUx0mTGzr/China-Hotel-Use-Prefab-Modular-Bathroom-Pod.html
Bathroom
Interior + kitchen
Carport + basement + terrace (roof)
Language - divide the different packages which were a result of the analysis phase. Find a robust system that can cope with eventual changes and developments in the project.
Language - make a code system that can be used to describe the duplicated design or industrial packages and which can tolerate new types and deviations.
Presets
SHARED + SWAPABLE
Example:

Module _ Preset

S01 _ VSv

module name type size deviation

MODULE

S: Shell
S01 Shell module level 1

T: Tak
TF Flat roof

B: Bathroom
BA Bathroom module type A

P: Stairs

J: Kitchen

DESIGN REPETITION

I: Interior
I01 Interior layout level 1

K: Basement

C: Carport
Example: S01

Presets
**Unite and Test**—Integrate and test proposed methodology for improving project workflows associated with design repetition and industrialisation. (in this case new technology – kit connect - for the handling geometry and data).
One source of truth

Publish to cloud Cross discipline development in module editor

Make presets Bill of materials list and 3D visualisation

Quantative calculations for example CO2

N4, N1
N1, N2
N2, N3, N4
N1, N2, N3
Early visualization and simultaneous development

+ can choose volumetric vis or detailed vis
+ can swap modules in and out based on 0 point
Modules
Presets
Project formation
Customisation

materials

quality

https://nordicarch.com/projects/living
Project analysis + comparison

Cost: $ X,000,000

Bill of materials: XXXXX

CO2 emission: XXXXXXXXX
Evaluate— Compare the new workflow with the original workflows and evaluate. Conclude a recommended way forward.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>LINKS</th>
<th>GROUPS</th>
<th>DESIGN OPTION</th>
<th>KIT CONNECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>One source of truth</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Needs also a regenerated model from contractors</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>n</td>
</tr>
<tr>
<td>Can work within one revit file</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>y/n</td>
</tr>
<tr>
<td>Other disciplines can also work directly in the same model</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Works well with repetition (smart updating - one updates all update)</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Works well with deviations - flexible</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Works well with alternatives (swap in swap out)</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>Can be shown at different levels of detail (volume vs elements)</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Easy to export to IFC</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Extra costs involved</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Needs a coding structure and strategy for repetition</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>Visual library of parts</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Can isolate modular information</td>
<td>y (parameter)</td>
<td>y (parameter)</td>
<td>y (parameter)</td>
<td>y</td>
</tr>
<tr>
<td>Can attach special information for the use of contractors</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>The system works well long term (team swapping new team members)</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Needs additional education (aside from revit usual use)</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>Extra time used in start up process to build up a system</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
<tr>
<td>Time saving in a long term sense (configuration on the site)</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
</tr>
</tbody>
</table>

*positive answer based on usability*
Software Developers’ Perspective
Internal tools were built at Project Frog to aid in our I.C. process.

Thanks to the Forge fund we were able to dedicate internal recourses to build outward facing I.C. tools. The first team and project Autodesk wanted us to start with is our friends in Norway which kicked off our discovery process.
<table>
<thead>
<tr>
<th>Problem</th>
<th>Project Frog</th>
<th>Nordic Cowi</th>
<th>Customer x</th>
<th>Customer y</th>
<th>Customer z</th>
<th>Customer..</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing arranged elements (KoP)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>Xxxxxxx</td>
</tr>
<tr>
<td>Audit arranged content</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Xxxxxxx</td>
</tr>
<tr>
<td>Constrain arranged content</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>XXX</td>
</tr>
<tr>
<td>User roles to edit content</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>Communication to non-Revit users</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Xxxxxxx</td>
</tr>
<tr>
<td>Part and configuration optioning</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Multi trade collaboration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>XXX</td>
</tr>
<tr>
<td>BOM/s</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XXX</td>
</tr>
<tr>
<td>I.C. logistics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>Level of Detail/Development</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>XXX</td>
</tr>
<tr>
<td>....</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Xxxxxxx</td>
</tr>
</tbody>
</table>
How to begin

A KITCONNECT PROJECT IS CREATED (PROJECT OR ENTERPRISE LIBRARY)

Either the content is created from scratch or it’s cloned from another library (via Content Manager)

Kit Roles

- Kit Manager – they can do everything
- Kit Designer – they can do everything but delete from the library
- Kit Participant – no editing right, insert content, exercise rules enforced by KitConnect and created by KM/KD

REVIT FILE/S (.RVT) ARE CONNECTED TO THE KITCONNECT PROJECT LIBRARY

As many Revit files as a project needs can be connected

There are several ways to set up projects and KitConnect can work with all of them
Loadable families from each team participating

Users publish family's and system family's to be used

Building your content

Arrange elements, apply rules and constraints

Arch system types

 MEP system types

Arch design team (Kit Manager or Kit Designer)

MEP design team (Kit Manager or Kit Designer)

KitConnect Cloud
Using Your Content

Web app

Building 2.rvt
Building 1.rvt
BUILDING X.rvt
Shop drawing 1.rvt
Future state of KitConnect

We will continue reduce AEC workflow fragmentation by promoting manufacturing best practices in design

Improved data-exchange from BIM to manufacturing workflows with enhanced BOM support

Extend our tools for suppliers and manufacturers to share data up-stream in design

Really drive the “I” in BIM by connecting data across all AEC stakeholders, both BIM and non-BIM users – extend the data-flow beyond the file
Conclusion
Unite!

And then you smile :)

[Images of group photos and construction site]