Collaborative Object Libraries

Supporting the Facility Lifecycle

There are over 20,000 design firms within the construction industry in Australia. Each firm maintains its own library of products to use in CAD tools in their projects. Much of the information within each CAD library is developed to support only the processes within the specific firm that maintains it; uses non-standard naming conventions; and becomes out of date. This is an inefficient process in itself and impedes the sharing of data through the design, construction and operation of construction projects. This decreases the efficiency of the whole industry.

An obvious solution is to have a national library that contains objects that meet the needs of entire project teams—regardless of organisational affiliation—and can be embedded directly into current software tools. The contents of such a library would follow nationally agreed naming conventions and would be maintained to suit evolving product specifications, standards and regulatory requirements. It would contain publically available, standardised object definitions that included the ability to attach all of the information that needs to be shared throughout the lifetime of a built asset.

The major stumbling block to this proposal becoming a reality is the lack of compatibility between major software vendors to the construction industry.

A solution to the technical problem of sharing library objects between software from different vendors is a method used in software engineering called ‘software transformations’. This method provides an automated system of mapping data and structures between different representations.

An on-line object library developed by this project stores a generic description of an object that can be accessed from a standard web browser or downloaded directly into Autodesk Revit and Graphisoft ArchiCAD using predefined software transformations. Work is underway to extend this support to Bentley AECOsim Building Designer and downstream software supporting estimating, planning and facilities management.

Background and context

Delivering infrastructure and building projects requires collaboration across multiple disciplines and stakeholders over the duration of the construction project, into handover and through the operation and maintenance of the asset. Current practice, even using modern object-based software does not support smooth collaboration due to the lack of coordination of objects, properties and values through projects. Much of this is due to a lack of motivation to coordinate information sharing, while some of it is concern over protecting intellectual property invested in creating object libraries.

Sustainable Built Environment National Research Centre

How much more efficient would the construction industry be if there were a National Object Library?

The *Collaborative Object Libraries* project has developed such a system. It is currently being tested within Project Services, the Queensland Government's building design and procurement arm. The library is accessible from within software applications and also from standard modern web browsers. An image of the user interface is shown in figure 1.

The main objective for the project is to create a National Object Library (NOL) server to meet the needs of Australian infrastructure and building projects. It is proposed that this will be managed by a single national industry body. The NOL manager would maintain the generic objects and update them to match changes in Australian Standards and legislation. Manufacturers will be able to upload details of their products to the NOL and manage their products over time.
The commercial arrangements underpinning the operation of the NOL are still under discussion, but the key feature will be that access by users is free.

The Collaborative Object Libraries project is being undertaken in stages. The current stage supports a single national library, controlled by a librarian. Users have read-only access to the library, and interfaces have been developed for BIM-based architectural software.

The next stage of the project, to commence in January 2013, will increase the number and range of software that supports interaction with the NOL. It will also add the ability to create a 'project server'. This will enable reading and writing to a library server under user control. This would then update adapted objects from the NOL as necessary.

Figure 1: Object Library User Interface

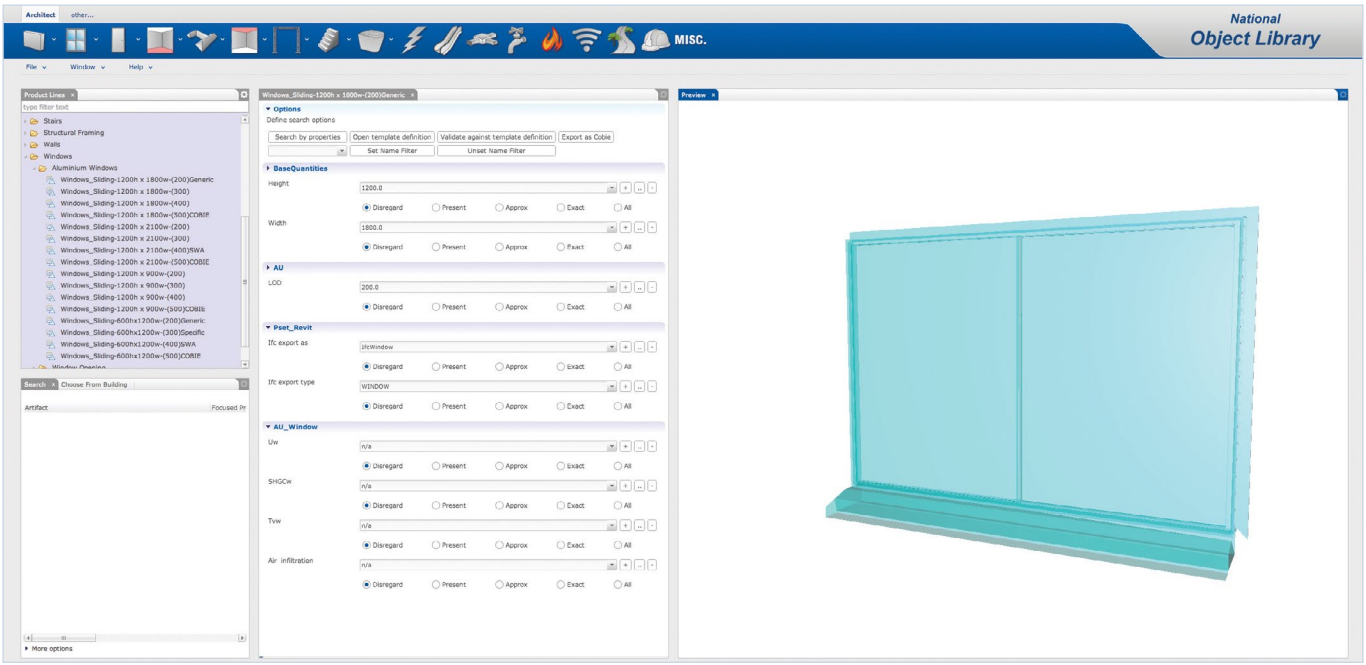
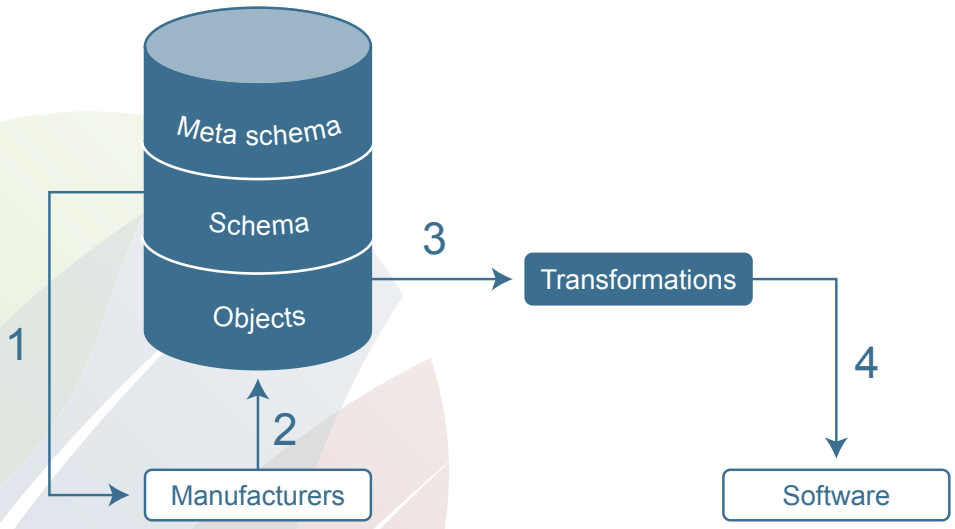
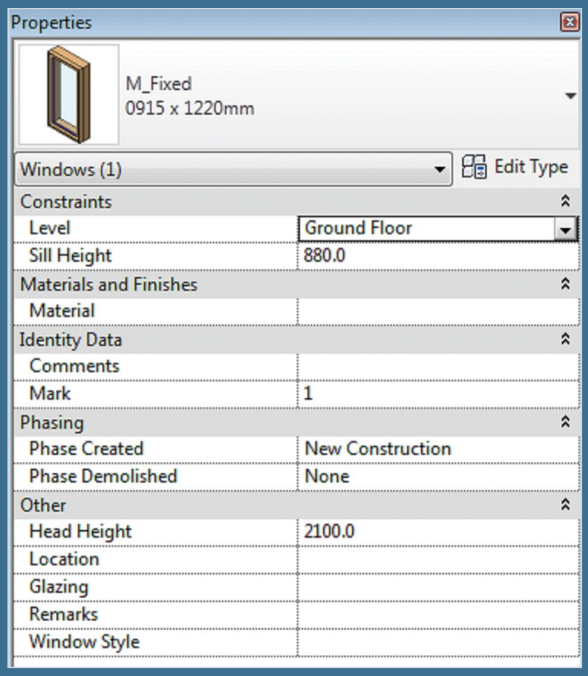


Figure 2: Object Library



Figures 3 and 4 show the properties dialog for a window (a) with standard properties and (b) after bringing in a new window definition. Note the change in geometry as well.

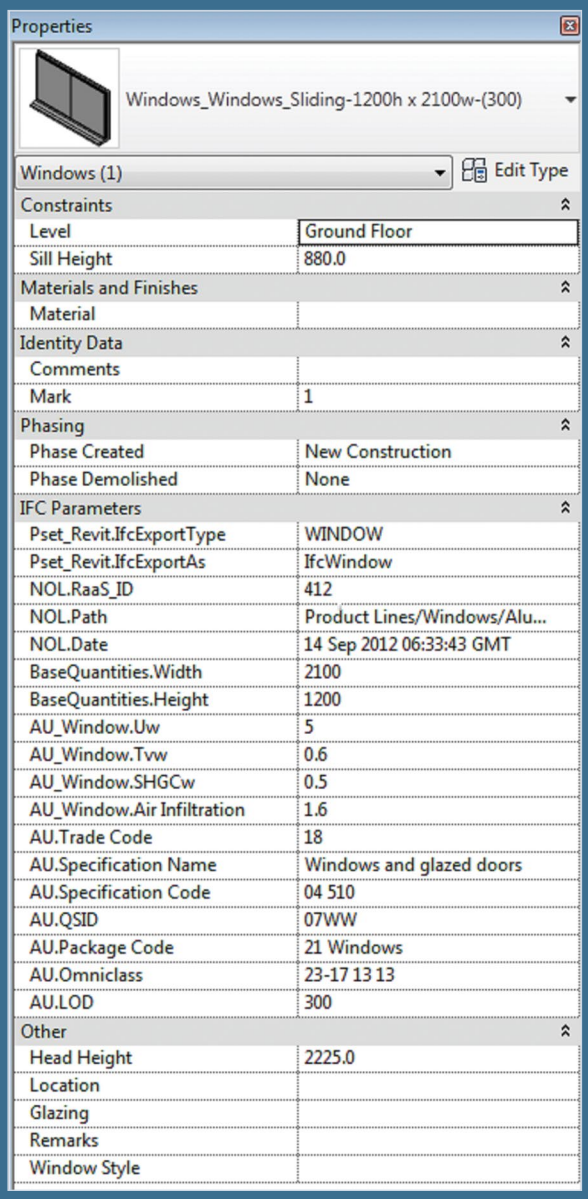


Properties

M_Fixed
0915 x 1220mm

Windows (1) | Edit Type

Constraints	
Level	Ground Floor
Sill Height	880.0
Materials and Finishes	
Material	
Identity Data	
Comments	
Mark	1
Phasing	
Phase Created	New Construction
Phase Demolished	None
Other	
Head Height	2100.0
Location	
Glazing	
Remarks	
Window Style	



Properties

Windows_Windows_Sliding-1200h x 2100w-(300)

Windows (1) | Edit Type

Constraints	
Level	Ground Floor
Sill Height	880.0
Materials and Finishes	
Material	
Identity Data	
Comments	
Mark	1
Phasing	
Phase Created	New Construction
Phase Demolished	None
IFC Parameters	
Pset_Revit.IfcExportType	WINDOW
Pset_Revit.IfcExportAs	IfcWindow
NOL.RaaS_ID	412
NOL.Path	Product Lines/Windows/Alu...
NOL.Date	14 Sep 2012 06:33:43 GMT
BaseQuantities.Width	2100
BaseQuantities.Height	1200
AU_Window.Uw	5
AU_Window.Tvw	0.6
AU_Window.SHGCw	0.5
AU_Window.Air Infiltration	1.6
AU.Trade Code	18
AU.Specification Name	Windows and glazed doors
AU.Specification Code	04 510
AU.QSID	07WW
AU.Package Code	21 Windows
AU.Omniclass	23-17 13 13
AU.LOD	300
Other	
Head Height	2225.0
Location	
Glazing	
Remarks	
Window Style	

Operation of the current Object Library server

The National Object Library (NOL) Server contains three types of information:

1. The 'meta schema' that supports the definition of the transformations between data formats that are the core functionality of the system.
2. The Schema contains the definitions from the industry on what products and components are stored within the system and the properties and values that they should have at particular levels of definition.
3. Then the objects themselves are stored as properties and geometry in the generic format (based on IFCs) that can be mapped onto the target data representations in users' software.

When a manufacturer wants to add a new product to the NOL they will bring up the schema definition for the product (Figure 2: step 1). They will then add required data, possibly add optional data and define the geometry of the product. Manufacturers will be able to request the addition of new properties that they believe are necessary to differentiate their product. The object is then added to the NOL once the object definition is complete (Figure 2: step 2) and becomes available for use by others. When a manufacturer wishes to revise a product description the old description is retained to ensure that links do not become "broken". However, notification that a new version exists will be available for software vendors to support updates.

A user can interact with the NOL in two ways – through a modern web browser; or through software that has been adapted to support the NOL. The current interface is shown on the previous page.

When adding a new object from the NOL from within other software the user selects the command to access the NOL, browses the library and chooses the object. Since the NOL knows which software has generated the request it can feed the object data into the appropriate software transformation (Figure 2: step 3), which then downloads the resulting customised object to the requesting software (Figure 2: step 4) for inclusion in the project.

If an existing object is selected when the NOL is accessed, the type of object is sent to the NOL, which then uses this information to filter the results shown to the user on initial access. If the user selects a more detailed representation of an object than currently exists then the additional data can be added to the existing object. This supports the gradual refinement of design, construction and operation information as a project progresses.

Benefits to industry

Once established as a National Object Library this project will provide benefits across a range of industry participants:

For **Product Manufacturers** – the National Object Library will provide a single point for distribution of 'intelligent content' across multiple software vendors.

Design Disciplines – architects, engineers, and cost planners will benefit through improved sharing of information - for both components (objects) and project data; and improved fit of information with work flows and reduced costs in defining and maintaining internal object libraries. The vendor independent library of objects has the potential to be a national standard. This will contain nationally defined properties and values that correspond to Australian Standards and regulations. These will support consistency across disciplines and through the procurement process.

Constructors - lead contractors, sub-contractors and manufacturers will benefit through improvements in the information flowing into their processes from designers and the ability to link this information (through future work) into their supply chains. This will also improve the quality of as-constructed documentation.

For **Facility managers and Maintenance Personnel** – the NOL will facilitate conformance with standards for the handover of information at completion of construction. It will also offer improved ability to access information about the existing facility and to maintain current information on the facility throughout its life.

Software Vendors - access to localised object libraries that will complement the software they distribute and which will reduce a major cost to their users.

The Sustainable Built Environment National Research Centre (SBEnrc) is the successor to Australia's CRC for Construction Innovation. The SBEnrc is a key research broker between industry, government and research organisations servicing the built environment.

The SBEnrc is continuing to build an enduring value-adding national research and development centre in sustainable infrastructure and building with significant support from public and private partners around Australia and internationally.

Benefits from SBEnrc activities are realised through national, industry and firm-level competitive advantages; market premiums through engagement in the collaborative research and development process; and early adoption of Centre outputs. The Centre integrates research across the economic, social and environmental sustainability areas in programs respectively titled: Driving Productivity through Innovation; People, Processes and Performance; and Greening the Built Environment.

This research wouldn't be possible without the ongoing support of our industry, government and research partners:

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