ICIS PROJECT #2 – CONNECTING SPECIFICATIONS AND BIM – SUB-PROJECT #2

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EXECUTIVE SUMMARY

The aim of ICIS Project #2 – Sub-project #2 was to produce a report which discusses different methods for the connection / integration of specification information and BIM including the potential advantages and disadvantages of each method.

This report has been produced by the project team with input from the ICIS group members in the form of a survey carried out in August 2013. The report was drafted as a discussion report on seven potential methods of connecting / integrating specification information and BIM and initially issued as a draft (V1.0) for comment in mid-October 2013. Various advantages and disadvantages of each method are discussed and some potential pre-requisites for their implementation are listed.

Each method discussed could be seen as an incremental step from the preceding method, however it is not suggested that all methods discussed are practical or suitable for implementation.

The seven methods which are described within the report are:

- Option 1 – Classification.
- Option 2 – Classification / Keynote Generator.
- Option 3 – Object ID Generator.
- Option 4 – Parameter Only ('Lightweight / Shell') Model.
- Option 5 – Central Library.
- Option 6 – Embedded in Model ('One Model') - with ability to export.
- Option 7 – Embedded in Model ('One Model') - without ability to export.

The respondents to the survey indicated that options 4 or 5 would appear to be the favoured method.

Both options allow for automation and integration, with manipulation of the written or graphical elements of the model having an impact on the other. Both options provide authors and end users of specifications with flexibility, without locking them into the use of any one single application.

The concept of having a written / text model and a geometric / graphical model, which together form the project BIM, would appear to be the direction the ICIS group believe industry should adopt.

INTRODUCTION

Aim

This project was initiated at the 2013 ICIS conference in Japan. The aim of the project was to produce a report which discusses different methods for the connection / integration of specification information and BIM including the potential advantages and disadvantages of each method.

It was agreed that recommendations on individual integration options were outside the scope of this project.

Challenges

It was possible to identify and describe the different methods and discuss the potential advantages and disadvantages of each. However, to determine the pre-requisites of each method and provide

guidelines on their implementation was not as simple, primarily because not all of the methods discussed are currently in use, or possible, and therefore the pre-requisites and implementation guidelines are not fully understood at this time.

Approach

A list of potential methods were compiled by the project team and sent out as a survey to the ICIS group members, to collect their thoughts and get their opinion / experience of each method. The project team then drafted this discussion report drawing on their own experience and the comments received from the ICIS members. A draft report (V1.0) was issued for comment in mid-October 2013.

For the purpose of this report the specification is considered to be the construction specification and is defined as follows:

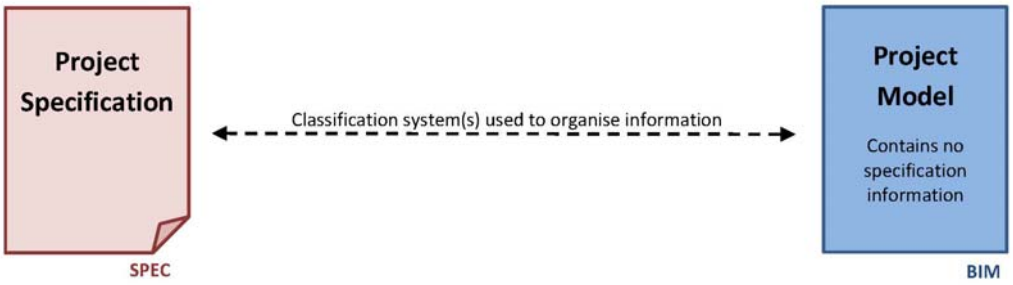
- A document used for administering construction and defining the method and quality of execution, it includes the specification of products and system performances.

POTENTIAL METHODS

OPTION 1 - CLASSIFICATION

Description

This method keeps the model and the project construction specification as two separate entities, but they share a common classification system.



Discussion

This represents a minor incremental step up from the construction specification being completely independent of the model and at best a miniscule movement beyond the historic situation of independent drawings and specifications.

This does not really amount to BIM, it is simply a method of organisation and coordination, not integration.

The primary challenge with this method is to find or develop a single integrating classification system which can link models, which are organised on an elemental basis, with specifications, which are traditionally organised on a work results basis. Recent work on Uniclass 2 may inform this discussion. It would appear however that using a system that links / maps two or more classification systems (possibly building on the work carried out to date on the buildingSMART Data Dictionary - bSDD) would be required.

A difficulty with just using a classification system is that it would not identify many properties of model elements / objects. Classifications, by definition, are groups of like subjects, they do not identify unique instances of objects.

Advantages

- No specific software solution required.
- No new skillsets / training required.
- The construction specification is easily accessible to all.
- An easy to implement first step towards integration.

Disadvantages

- No single classification system covers all elements and work results.
- Manual coordination required. Manipulation of information in either the model or the construction specification will not have an effect on or update the other.
- Construction specification and model are not integrated.
- The benefits of BIM are not realised with this option.

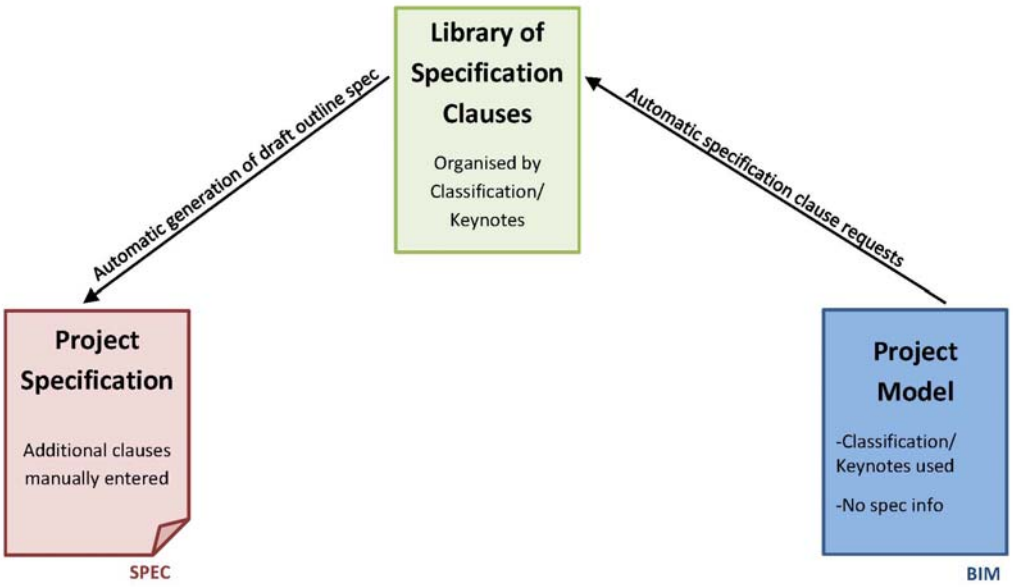
Pre-requisites and guidelines to implementation

- A classification system or combination of existing systems would need to be defined to link elemental based models with traditional work results based specifications.
- All team / project members would need to be made aware of and use the agreed classification to organise and coordinate their information.

OPTION 2 – CLASSIFICATION / KEYNOTE GENERATOR

Description

This method utilises specialist software to compile a draft outline construction specification, as a separate document outside the model, using the classification number / keynote, assigned to the object / element in the model, to generate clauses in a draft project construction specification, from a library of specification clauses. The term keynote refers to a notation assigned to like objects / elements.



Discussion

This method would utilise software capable of linking a model and a specification clause library. It would require coordination between the classification / keynotes used in the model and those used in the library to identify specific clauses.

This method would require manual assignment of the classification / keynote to the object in the model (unless a graphical object library is being used to populate the model).

As with many of the options discussed in this report, how specification information relating to items not generally modelled is dealt with, would need to be considered. The software would generate a draft outline construction specification, outside of the model. Non-modelled information could then be manually added to the specification.

Making changes to the specification would not automatically update the model to reflect those changes. Making changes to the model would only generate new additional clauses in the specification if the classification / keynote was also changed. How the superseded clauses in the specification, from such changes, are dealt with would also require manual coordination.

The same issues regarding the use of a classification system and which classification system to use, as described for Option 1, are relevant for this option.

Advantages
- No new skillsets / training should be required.
- The construction specification is easily accessible to all.
- Some automation involved.

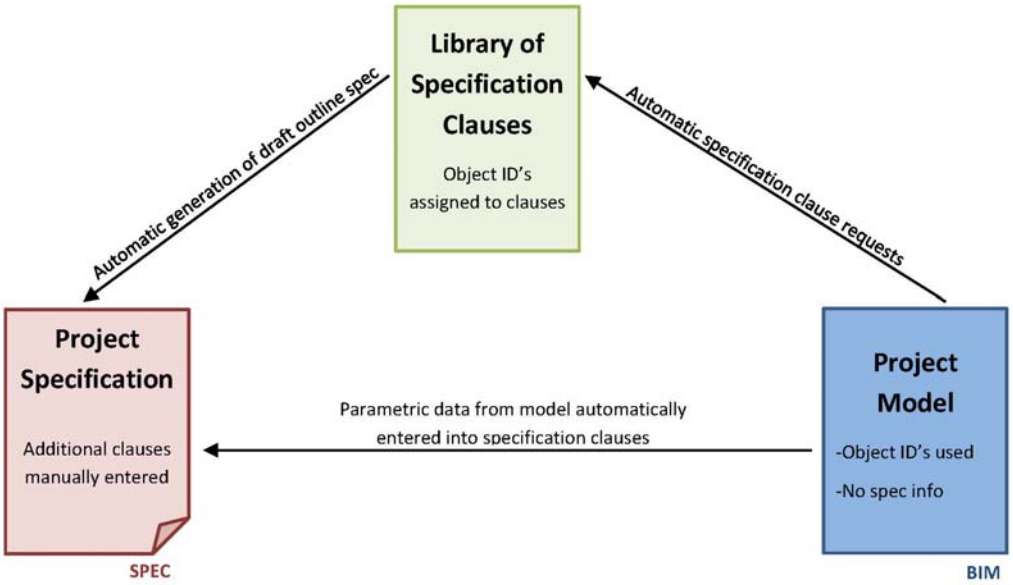
Disadvantages
- Manipulation of the specification information does not update the model, therefore manual coordination still required.
- Non-modelled construction specification information would require manual input.
- Construction specification and model are not integrated.
- Construction specification information cannot be accessed from the model.

Pre-requisites and guidelines to implementation
- Software with ability to generate clauses from a specification clause library.
- All team / project members to be made aware of and use the agreed classification / keynotes when authoring in the model and organising their specification information.

OPTION 3 – OBJECT ID GENERATOR

Description

This method compiles an outline draft construction specification, as a separate document outside the model, by extracting defined object ID's and their related parameters from the model, generating the required clauses from a specification clause library and partly populating specific clauses, such as product parameters.



Discussion

A similar option to that of Option 2, but with further information from the model automatically populating the draft construction specification. Many of the issues discussed for Option 2 are applicable to this option.

This method allows objects and their properties to have their own unique ID's, which may overcome some of the 'non-unique' issues of using a classification system.

The parameters defined in the object and those defined in the specification clauses would require close coordination.

The use of a mechanism such as the bSDD could be considered to assist this process.

Advantages

- No new skillsets / training should be required.
- The construction specification is easily accessible to all.
- Automation involved.

Disadvantages

- Manipulation of the specification information does not update the model, therefore manual coordination still required.
- Non-modelled construction specification information would require manual input.
- Construction specification and model are not integrated.
- Construction specification information cannot be accessed from the model.

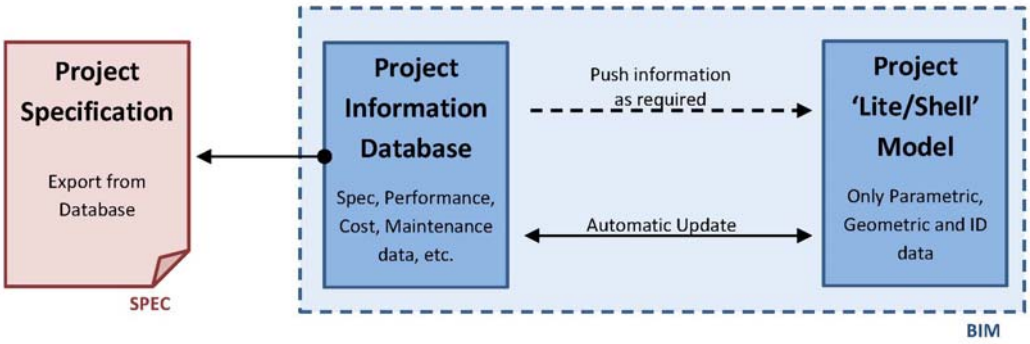
Pre-requisites and guidelines to implementation

- Software with ability to generate and partly populate clauses from a specification clause library.
- Defined list / database detailing objects and their ID's.
- All team / project members to be made aware of and use the agreed object ID's when authoring in the model and organising their specification information.

OPTION 4 – PARAMETER ONLY ('LIGHTWEIGHT / SHELL') MODEL

Description

Objects in a lightweight (lite) / shell model have parameters associated with geometry, parametric behaviour and identification only. Most other properties and specification data are managed in an external database and linked to the object using an identifier code.



Discussion

Information from the external database is pushed into the shell model as and when required by the user. Information could also be accessed directly from the external database using a number of applications. The shell model and the external information database would be considered the BIM.

The requirement for any one modelling software application having to contain / manage all the information is negated with this option. Users would only require knowledge of the application they actually need to use to do their portion of the work.

How data entered from one or more applications is accessed in another application, would need to be addressed. Again, work to date on the bSDD could inform this process.

It could be said that this option would still have the same coordination issues that currently exist between traditional drawings and specifications, however it would be envisaged that changes made to information in the database, would automatically update the shell model if it had an impact on any of the parameters which are stored in the shell model and vice versa.

Users requiring information from the database would either access the database directly to obtain that information, printing / exporting if required, or push the information into the shell model, when they require it, if the information is needed in a model environment (i.e. for rendering, performance analysis, etc.). This would mean that the shell model becomes much more than just a 3D shell, as and when it needs to.

Similar issues to those discussed for the previous options also exist for this option, regarding how information is structured / identified, to allow it to be pushed into the model and also automatically update the shell model parameters.

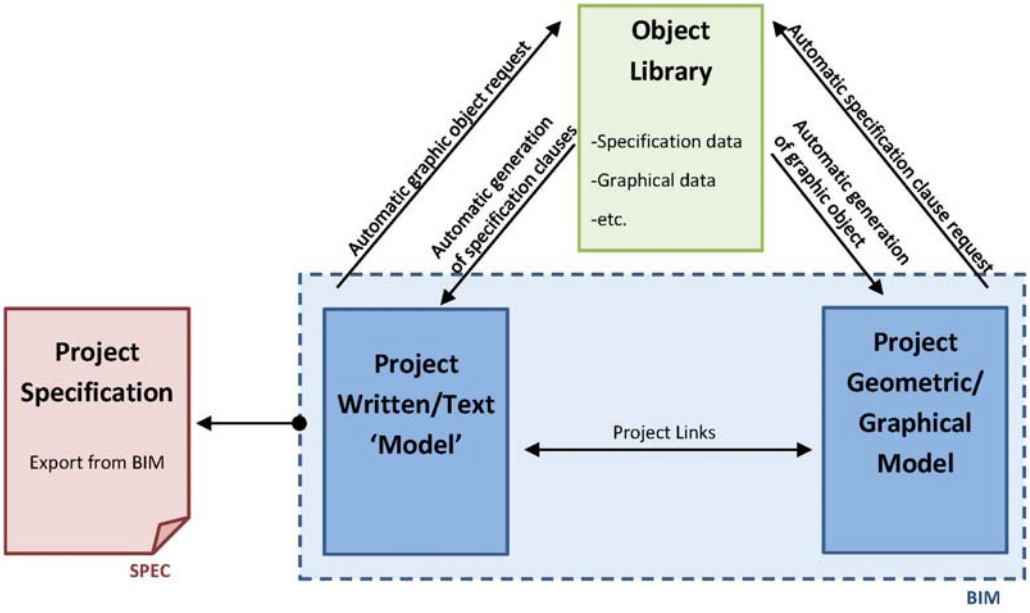
Advantages
- Partially automated, integrated approach.
- Flexibility for users.
- Minimal additional training required (for new software applications).
- Information easily accessible for users.
- Less likelihood of information 'overload' for the user.
- Specification data isn't duplicated for multiple instances.

Disadvantages
- Possibility that user may not be viewing all the relevant information.
- Information not immediately accessible for graphical navigation of model.

Pre-requisites and guidelines to implementation
- Highly structured input of information required to allow transfer between different applications.
- Software applications would need to be able to communicate with each other.

OPTION 5 – CENTRAL LIBRARY

Description
A product / object definition library (possibly with GUIDs and potentially with property sets) provides the central resource through which both construction specification information and BIM objects are linked.



Discussion
It is understood that this is the closest option as to how NBS Create works, which uses the UK National BIM Library (NBL).

Selecting specific specification clauses from a central library would generate specific objects in a graphical model and vice versa. The library would be a resource, but the project links between the construction specification and the geometry would not be made through the library, they would be made in two project specific models, a written / text model and a geometric / graphical model. Together these two models would form the project BIM.

It is assumed that the written model could include information, such as administrative construction specification clauses (e.g. a requirement to submit shop drawings), which is not (and not necessary to be) represented in the geometric model. Information could be printed / exported from either the written model or the geometric model.

The use of parametric, rather than non-parametric, objects could mean that modifications to the project written model would be reflected in the project geometric model, without the need to go through the library to replace the object with an alternative object from the library.

The creation of the object library itself could raise the same queries as raised in some of the other options. For example, would all the information (specification, performance, geometric, etc.) all be stored with that object in the library, or would information be linked to the geometric object? i.e. is all information embedded in the object in the library or is the library also made up of a written model and a geometric model?

Advantages

- Automated, integrated approach.
- Information easily accessible from model.
- Allows for both graphical and written navigation and generation of model information.
- Specification data isn't duplicated for multiple instances.

Disadvantages

- Potentially less flexibility for users than Option 4. Would depend on exactly what and how information from model could be exported to other applications.
- Non-modelled construction specification information would potentially still require manual input.
- Training in new software for specification authors would be required.

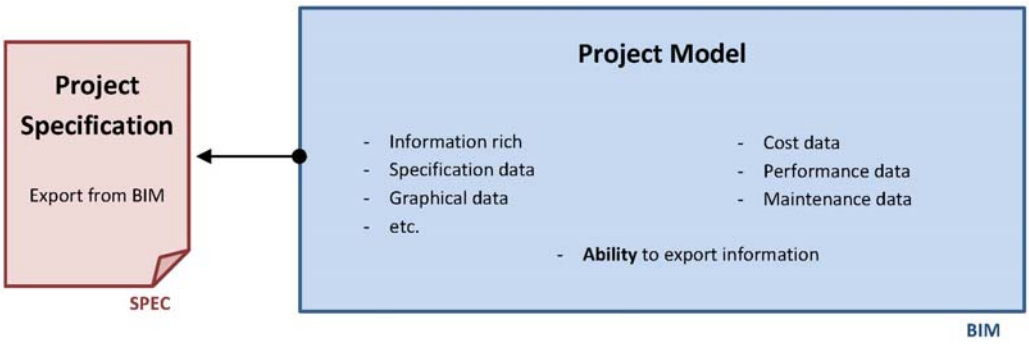
Pre-requisites and guidelines to implementation

- Possibly study how NBS Create has approached this method.
- New software would be required, including training in its use.
- Clear mapping between object / element classification and work results construction specifications would be required.

OPTION 6 – EMBEDDED IN MODEL ('ONE MODEL') WITH ABILITY TO EXPORT

Description

The construction specification information is embedded fully within the graphical model, with the relevant clauses embedded in each modelled object. The ability to export information from the model in the form of a construction specification would exist.



Discussion

Fully embedding construction specification information within the graphical model would result in unnecessarily large file sizes and duplicate information being assigned to like objects. As for some of the previous options, the issue of non-modelled / non-physical specification information is an issue which would need to be resolved, as the information would need to be assigned to an object / space, which may not necessarily be modelled (general requirements, for example).

Current modelling authoring software would need to be significantly revised with new features to accommodate this additional information.

This method would require all project team members to use the same software application and be skilled / trained in doing so. It would also reduce workflow flexibility as all users would work on the one model in the one application.

The construction specification would simply be a report exported from the model, in the same way a materials or quantities report, for example, would be exported.

How the construction specification information is entered into the model (i.e. automated or manually entered) would require some of the same considerations as discussed for the previous options.

Advantages

- Fully integrated approach.
- Information stored in one application.
- Information can be exported from the model as required.

Disadvantages

- Information 'overload'. Could create problems navigating through all the information you don't need, to find the information you do.
- Specification data is duplicated for multiple instances.
- File sizes would be unmanageable / unworkable.
- New skillsets / training would be required for specification authors.

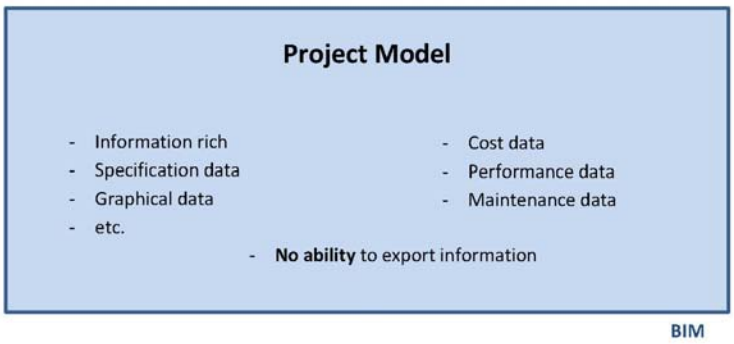
Pre-requisites and guidelines to implementation

- Current modelling software would require significant new features.
- Training would be required for all authors of the model and specification information.

OPTION 7 – EMBEDDED IN MODEL ('ONE MODEL') WITHOUT THE ABILITY TO EXPORT

Description

The construction specification information is embedded fully within the graphical model, with the relevant clauses included as part of each modelled object. The ability to export information from the model does not exist.



Discussion

It is extremely unlikely that this option would ever come into existence. Primarily due to that fact that the ability to export information from the BIM is likely to always be required. The ability to extract

information from the BIM is one of the key benefits of BIM to the design, construction and facilities management industries.

At the very least this option would require a 'viewer' element to be included in the software to allow a construction specification to be viewed as a consolidated document. Not having all information in a consolidated document would increase the risk of multiple interpretations. If the construction specification could be viewed as a consolidated document then there would be no reason why it couldn't be exported as a consolidated document.

The only difference between this option and Option 6 is the lack of ability to export information from the model. In this respect this option becomes even more restrictive than Option 6 and would require all users including all end users of a construction specification to be trained to navigate the model to find the information they need.

Advanatages

- Fully integrated approach.
- Information stored in one application.

Disadvanatges

- No ability to export information from the model.
- Highly restrictive and not flexible for use.
- Specification data is duplicated for multiple instances.
- File sizes would be unmanageable / unworkable.
- Information cannot be exported from the model.
- New skillsets / training would be required for the end users of construction specifications.

Pre-requisites and guidelines to implementation

- Legal requirements for written contract documents would need to be abolished.
- Current modelling software would require even more new features than required for Option 6, to harness the full potential of BIM (performance analysis, etc.), as information could not be exported from the model.
- Training would be required for all authors and end users of the model and the specification information.

CONCLUSIONS

Consensus

The feedback from the ICIS group member survey respondents was that a method of connecting BIM and construction specifications, similar to options 4 or 5, would appear to be the favoured method.

Both options allow for automation and integration, with manipulation of the written or graphical elements of the model having an impact on the other. Both options provide authors and end users of construction specifications with flexibility, without locking them into the use of any one single application.

The concept of having a written / text model and a geometric / graphical model, which together form the project BIM, would appear to be the direction the ICIS group believe industry should adopt.

Further research

It is clear from the group responses that further research of the options discussed would be required in order to fully promote, endorse or recommend any of the suggested methods of connecting construction specifications and BIM or to provide a detailed description of the advantages, disadvantages, pre-requisites and guidelines for implementation, which would be relevant to all members of the ICIS group.

Such research should consider how construction specifications relate to BIM and which solutions can be envisioned concerning:

- The data model – How to store / exchange data.
- Classifications – How to name data.
- The process – What to describe and when.

Final comment

One respondent commented that the linking of specification data and BIM cannot necessarily be handled in the same way as other information included in / linked to BIM. Their comment was as follows:

"Specifications are a special case because the specification data and the CAD data together comprise the construction contract. Costing data does not fit into this category, nor does project management software, analysis software, or any other that I can think of. It is this difference that makes linking CAD and specifications so critical."