Constraints in Authoring BIM Components for Optimal Data Reuse and Interoperability: Results of Some Initial Tests

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ABSTRACT

This research investigates the issues of authoring reusable BIM components that can be delivered across multiple platforms. A key constraint in the uptake of Building Information Modelling (BIM) technology is interoperability, the ability to accurately and automatically share and exchange data. This has been addressed by the creation of a system of standards: Industry Foundation Classes (Ifcs). Recognising the importance of Ifc standards, the promoters of many proprietary BIM software platforms generally claim that their products support them fully. This has been challenged, and the reported work has aimed to test these assertions. A simple test model was constructed to represent the various geometries that are encountered, which were then expressed in Ifc files. Fourteen commonly-used BIM software tools were subjected to tests in which the range of geometries within the test model was imported into each tool in Ifc format. A simple visual analysis of the outcomes showed a dramatic failure to process the geometries as they were intended. The results of the study indicate that the current commercial BIM authoring tools, whilst being technically capable of providing support for the required component geometric representations, are constrained from doing so by their conversion interfaces from Ifc geometries. The practical implications of this are considerable, and could result in the possibility of serious errors within designs for construction projects. This is particularly relevant in the case of the BIM library components that are currently being authored for importing into project design models. The test model has been circulated to experts in the area, and their observations, as well as results of any further tests will be made publicly available.

Keywords: Building Information Model, Component Libraries, Design Collaboration, Geometry Standards, Interoperability, User Requirements

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INTRODUCTION

As Building Information Modelling (BIM) becomes more prevalent in the construction industries of the world some of the practical problems of authoring and sharing models are also becoming more evident. It is generally accepted that BIM-related technologies offer considerable advantages to many, perhaps most participants in the construction sector (Eastman et al., 2008). In the UK, for example, the Government has mandated the use on all its projects of ‘fully collaborative 3D BIM … as a minimum by 2016’ (Cabinet Office, 2011).

A fundamental limiting factor in the uptake of BIM is the issue of interoperability, defined by the International Alliance for Interoperability (IAI, now ‘buildingSMART’) as ‘an environment in which computer programs can share and exchange data automatically, regardless of the type of software or where the data may be residing’ (see Fischer & Kam, 2002: p.14). Currently, there exists a whole range of commercially available BIM software platforms that have developed to suit the functional needs of their current main users (architects, structural engineers, services engineers, constructors, and so on) and consequently differ structurally and semantically. The aspirational ideal of fully collaborative BIM presumes a single model, allowing the full integration of all aspects of the design and further, for the same information to be re-used in the delivery and operation of the constructed facility. To do this effectively, secure and reliable exchange of data is essential. It is this requirement that underlies the concept of ‘interoperability’, or more specifically ‘semantic data interoperability’ (Yang & Zhang, 2006). As Cerovsek points out a key issue has been how to achieve ‘inter-operability between multiple models and multiple tools that are used in the whole product lifecycle’ (Cerovsek, 2011: p. 224) and BIM usage is still largely restricted to discrete models that relate to the contribution of each of the disciplines involved: currently, as evidenced by NBS’s National BIM Report (NBS, 2012) full collaboration is still far from a reality.

For some time the recognised basis of BIM interoperability has been the system of Industry Foundation Classes (Ifcs) designed by the International Alliance for Interoperability and maintained by buildingSMART (Tolman, 1999; Fischer & Kam, 2002). However, the mere presence of Ifc is not sufficient for overcoming the problems of interoperability, and, for some critics, data exchange remains ‘unreliable and unpredictable’ (Sacks et al., 2010, p. 420). Fischer and Kam (2002) identify such problems, particularly when they result in ‘geometric misrepresentations across different software packages reading the same IFC source file’ (Fischer & Kam, 2002, p. 40).

The Problem of Standard Component Libraries

The problem is perhaps most acute when it comes to the effective authoring and use of standard building component libraries for BIM; a development that has, for some time been seen as to have significant potential for improving the productivity of designers and specifiers (Howard & Bjork, 2008). Demand for library components from the industry and construction product manufacturers is high and there are organisations currently attempting to author library components that can be delivered across multiple BIM platforms with the minimum amount of re-authoring.

Buildings contain numerous components – windows, doors, etc. - that are standardly procured from their manufacturers. However, when they exist within a proprietary BIM tool, these components are native to that particular tool and not easily shared between different BIM platforms; for example, a boiler component authored in one tool is unlikely to be
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