Optimizing the Usage of Building Information Model (BIM) Interoperability Focusing on Data Not Tools

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Abstract –

Architectural, Engineering, Construction (AEC) and Facility Management (FM) industry rely on varied expertise to achieve a highly successful project. The industry professionals in these fields require greater level of collaboration in managing the expectation of a project success. When every individual in the team uses different BIM software, it becomes stressful, time consuming and an excessive use of budgeted funds to maintain accurate design model version. It also becomes virtually impossible to controls users, compare versions and analyze different models and data. Consider a large-scale project for example, there are several teams and different professional specializations coming together, all using different BIM software's they have been tasked and making all those interoperate, multiplying the challenges in several folds.

Overall, data is extremely important, and no single firm would want to be held back by the tools they use, nor do they want to maintain various disparate software packages. This paper seeks to find optimal ways in addressing BIM interoperability with emphasis on data exchange not the tools. The study reviews number of top vendors and manufacturers website and solicit their views on BIM interoperability and how those companies deal with the challenges of providing a product that integrate well with competing industry software packages.

Keywords –
Building Information Modelling (BIM); BIM Software; Interoperability; BIM Collaboration; Data exchange

1 Introduction

1.1. Building Information Modeling (BIM)

The National Building Information Model Standard Project Committee defines BIM as "a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition" [1]. A basic premise of BIM is collaboration by different stakeholders at different phases of the lifecycle of a facility to insert, extract, update or modify information in the BIM to support and reflect the roles of that stakeholder. Use of BIM goes beyond the planning and design phase of the project, extending throughout the building lifecycle, supporting processes including cost management, construction management, project management and facility operation.

Participants in the building process are constantly challenged to deliver successful projects despite tight budgets, limited manpower, accelerated schedules, and limited or conflicting information. The significant disciplines such as architectural, structural and MEP designs should be well coordinated, as two things can't take place at the same place and time. Building Information Modeling aids in collision detection at the initial stage, identifying the exact location of discrepancies.

The BIM concept envisages virtual construction of a facility prior to its actual physical construction, in order to reduce uncertainty, improve safety, work out problems, simulate and analyze potential impacts [2]. Sub-contractors from every trade can input critical information into the model before beginning construction, with opportunities to pre-fabricate or pre-assemble some systems off-site. Waste can be minimized on-site, and products delivered on a just-in-time basis rather than being stock-piled on-site [2].

BIM can bridge the information loss associated with handling a project from design team, to construction team and to building owner/operator, by allowing each group to add to and reference back to all information they acquire during their period of contribution to the BIM model. This can yield benefits to the facility owner or operator. For example, a building owner may find evidence of a leak in his building. Rather than exploring the physical building, he may turn to the model and see

that a water valve is located in the suspect location. He could also have in the model the specific valve size, manufacturer, part number, and any other information ever researched in the past, pending adequate computing power [3]. Dynamic information about the building, such as sensor measurements and control signals from the building systems, can also be incorporated within BIM software to support analysis of building operation and maintenance [4].

BIM technology is receiving great attention in the architecture, engineering and construction (AEC) industry, and since it contains a complete set of information of the lifecycle of a structure in the form of a digital model, it is widely projected to be the technology of tomorrow. By being a comprehensive digital database, it is rapidly gaining acceptance as the preferred method of communicating the design professional's intent to the owner and project builders [5]. BIM has been traditionally used for design and its use in the construction phase has also been increasing recently. However, nowadays owners have realized the potential of BIM and insist on inheriting the BIM models for further use. The owner can benefit from the BIM model as an archive of as-built information, for purposes such as Facility Management (FM) decision making tool or repository of materials.

1.2. BIM Interoperability

Architecture, engineering, construction, and facilities management are information intensive industries, and are highly dependent upon effective information technologies. Various software and tools are used to help with the AEC/FM design and management tasks. However, currently the information is passed from one project member to the next by producing paper based or electronic documents which can only be interpreted by people. These members must also re-enter relevant information into their own professional tool. This manual data entry is a non-value adding activity, can often introduce errors into the project, and inhibits the use of better computational tools [6].

With respect to software, the term interoperability is used to describe the capability of different programs to exchange data via a common set of exchange formats, to read and write the same file formats, and to use the same protocols [7]. One common use case for software interoperability is for the customers freedom to switch from one product to another while keeping the data intact after the transfer. This is especially important for use cases where the data will stay in one system for a long time (e.g. in Computer Aided Facility Management - CAFM systems or cloud) to prevent vendor lock-in.

In the AEC industry where, one-off projects teams are assembled across different organizations, disciplines and phases you want the different discipline tools to share information with each other and you want data generated in one phase to be usable without re-entry for the next phase. This is the foundation for openBIM. You cannot have a true openBIM workflow without interoperable software. Interoperability is about freedom to work with the best in any discipline and for them to use the tools they are most comfortable and productive with.

To communicate with each other systems, need to use common data formats and communication protocols. Examples of formats are IFC, XML, JSON, SQL, ASCII and Unicode. Examples of protocols are HTTP, TCP, FTP and IMAP. When systems are able to communicate with each other using these standards they exhibit syntactic interoperability.

For BIM tools to work together we need more than just the ability to transfer information. We need the ability to transfer meaning. What is sent must be the same as what is understood. To achieve this both sides must refer to a common information exchange reference model. We need semantic interoperability. Interoperability between various software applications can be achieved in a number of ways such as: Using software that directly reads the proprietary file format contained in the BIM software application, which will be the case for a suite of software applications developed by one software vendor; using software that incorporates an Application Programming Interface (API), providing a well-developed interface between software from different providers; and using software that supports data exchange standards such as Industry Foundation Classes (IFC) format [8].

2 Industry Foundation Classes (IFC)

BuildingSMART developed Industry Foundation Classes (IFCs) as the open and neutral data format for openBIM with the aim of improving information exchange between software applications [14]. The specification of the IFC standard includes for each major and minor edition:

- the IFC Specification html documentation (including all definitions, schemas, libraries)
- the URL for the IFC EXPRESS long form schema
- the URL for the ifcXML XSD schema

The IFC specification is written using the EXPRESS data definition language, defined as ISO10303-11 by the ISO TC184/SC4 committee. It has the advantage of being compact and well suited to include data validation rules within the data specification.

The ifcXML spec is provided as an XML schema 1.0, as defined by W3C. The ifcXML exchange file structure (the syntax of the IFC data file with suffix ". ifcXML") is the XML document structure. The XML

schema is automatically created from the IFC-EXPRESS source using the "XML representation of EXPRESS schemas and data", defined as ISO10303-28 ed. 2. This ensures that both IFC-EXPRESS and ifcXML handle the same data consistently and that the *.ifc and *. ifcXML data files can be converted bi-directionally.

2.1 IFC Data File Formats and Icons

IFC data exchange has two alternative formats for the exchange of some information content [14]. These formats are:

- IFC format or IFC part 21 Format, which is based on the ISO 10303 -21 standard,
- The ifcXML format, which is based on an XML Schema definition of the IFC product

IFC data files are exchanged between applications using the formats (Table 1) and should be indicated by the published icons:

Table 1 IFC data file exchange format

Icons	Data File Format
.ifc	IFC data file using the STEP physical file structure according to ISO10303-21. The *.ifc file shall validate according to the IFC-EXPRESS specification. This is the default IFC exchange format.
. ifcZIP	IFC data file using the XML document structure. It can be generated directly by the sending application, or from an IFC data file using the conversion following ISO10303-28, the XML representation of EXPRESS schemas and data. IFC data file using the PKzip 2.04g compression algorithm (compatible with e.g. Windows compressed folders, WinZip, zlib, info-zip, etc.). It requires to have a single .ifc or *. ifcXML data file in the main directory of the zip archive.

3 Review of Comparative Building Design and BIM Software

Building design and building information modeling (BIM) software includes computer-aided design (CAD) products used commonly within the architecture and construction industries. Many of these products offer tools and libraries specifically targeted toward architectural design and construction, including mechanical, electrical, and plumbing (MEP) and building information modeling (BIM). Table 2 categorizes BIM software that offers a model-based process for designing and managing buildings and infrastructures, going beyond construction drawings to generate a digital representation of the functional properties of a facility. Other products in this category may be used for a range of CAD purposes beyond architectural design, but their rankings within this grid focus exclusively on their use as a tool in building design. The best products in Table 2 are determined by customer satisfaction (based on user reviews) and market presence (based on products' scale, focus and influence). The list is not meant to be excusive.

Table 2 Comparative Building design and BIM software

Product Name	Features
Revit	Specifically built for Building Information Modelling (BIM), Building design software for consistent model-based approach.
Vectorworks	Tackles complex ideas in 2D and 3D, refine construction details with ease and directly inside files
ARCHICAD	BIM software application for design, document and collaborate on building projects.
SketchUP	Layout, Extension Warehouse and the 3D Warehouse to design everything
Bentley	BIM Application for MicroStation, PowerDraft, and AutoCAD
Navisworks	Reviews integrated models and data with stakeholders to better control project outcomes.
BIM Object	Creates a straight path to the users of any BIM software.
IrisVR	Integrates with Revit, Rhino, SketchUP, and other 3D tools
Trimble Connect	Avenue for designers, builders, owners and operators to collaborate, share and view project information.
AECOsim Building Designer	Single building information modelling (BIM) software application for multi-discipline teams
Tekla BIMsight	Check for clashes, and share information using the same easy-to-use BIM environment.
Virtual Construction	Leverages 2D drawings and 3D BIM models for 4D model-based scheduling and 5D model-based estimating.
Konstru	Cloud-based automation platform that lets you view, edit, clean, synchronize and share model data stemming from a variety of BIM

4 Case Study

Under this section, the paper demonstrated the potentials on interoperability as well as the issues and challenges specific to the selected vendor software's in Table 2. Authors further examined views of how these vendors' deals with challenges of providing product that integrates well with other competing software's. The vendor software products that featured for the case study include;

- Bentley
- Autodesk,
- Graphisoft,
- Vectorworks,
- Konstru, and
- Trimble.

The selection is done in no order of preference. It was solely based on informational purposes and to facilitate the decision-making process for the end-users.

4.1 Bentley

Bentley provide i-models that enable users to access and share information-rich models. This can include competing solutions and varying file formats. i-models act as a container for exchanging information and conveying AECO data to the right people at the right time by breaking down issues with interoperability that have hindered the progress of infrastructure projects. Bentley is fully committed to i-models by recently launching iModel 2.0 Platform which offers a better solution for synchronizing work in infrastructure projects by managing all the change related to a project. Bentley also announced the availability of AECOsim Building Designer CONNECT Edition (Figure 1) which is Bentley's building information modeling (BIM) application designed for building projects of significant size and/or engineering complexity, and which are typically characterized by the challenges of combining vertical construction and horizontal infrastructure (like roads, railways, utilities, etc.). AECOsim Building Designer CONNECT Edition shares a comprehensive modeling environment with all of Bentley's CONNECT Edition applications. Without a comprehensive modeling environment, engineers and architects have had to struggle with complex data exchange, resulting in information loss and repeated translations, or even resort to force-fitting a BIM application beyond its intended use to model geometry, which is lacking in BIM intelligence [15].

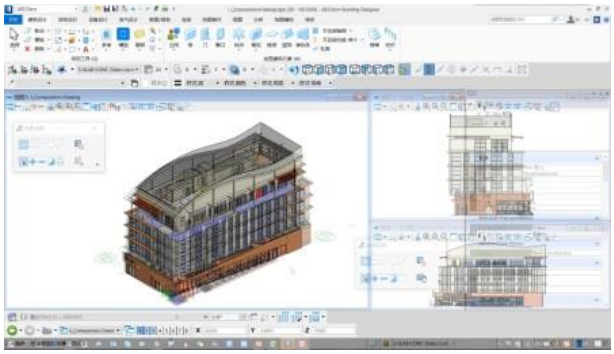

Figure 1: AECOsim Building Designer CONNECT Edition sample

4.2 Autodesk

Autodesk supports interoperability with other BIM vendor software and hardware in a variety of ways. In fact, in 2016, Autodesk and Trimble signed an interoperability agreement to benefit AEC Customers to gain greater flexibility throughout the BIM Project Lifecycle [16]. And, also signed an interoperability agreement with Bentley nearly a decade ago.

- All the BIM products have support for the IFC standard as well as other Industry Standard Formats.
- In addition, Autodesk offer direct reading of Multiple BIM formats with Autodesk Navisworks and cloud-based BIM 360 products. Navisworks is widely regarded as a key BIM interoperability solution on the market today.
- Autodesk provides its IFC software for Revit as a free open source toolkit [17].

Revit software provides certified IFC export and import based on the buildingSMART IFC 2×3 Coordination View data exchange standard. This includes architectural, structural and MEP certifications based on the buildingSMART IFC 2×3 coordination View 2.0 data exchange standard, as of March 2013 and April 2013, respectively. Revit received stage-1 IFC 2×3 Coordination View Certification in June 2006, and full stage-2 certification for Coordination View in May 2007. The IFC for Autodesk Revit 2016 contains up-to-date improvements on the default IFC import and export capabilities of Revit contributed by Autodesk and the Open Source contributors. This application also includes an alternate UI (User Interface) for the export that has extra options from the default.

While this app is not necessary for IFC support, it is recommended that users that depend on the quality of their IFC files download this app and keep it up-to-date, as new enhancements and defect fixes are added, for more information on IFC [18].

Autodesk Software with IFC support: Autodesk Revit LT, Autodesk Navisworks, Autodesk Infraworks, Autodesk BIM 360, Autodesk Robot Structure,

Autodesk Advance Steel, Autodesk Inventor, Autodesk Civil 3D. Examples of initiatives that Autodesk participates in around the world include:

- Support of the U.S General Services Administration (GSA) IFC model view definitions.
- Support of COBie via IFC and xlsx
- Autodesk BIM 360 Docs is designed to help government clients comply with the BIM Level 2 mandate in the UK [19].

Through Application Programming Interfaces (APIs) Autodesk software offerings also provide many ways to work with other BIM vendor's information. For example, when viewing BIM information from other software systems and when using 3D vector file formats for

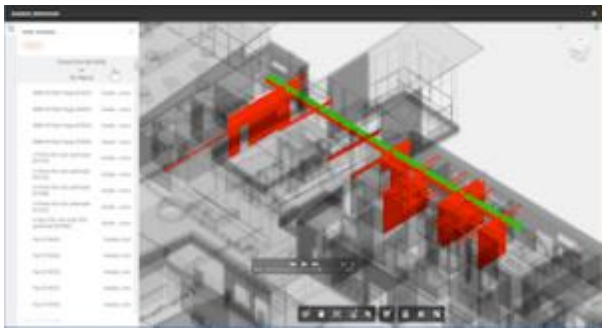

Figure 2. Autodesk BIM 360 Glue on Forge sample

detecting clash/collisions, BIM 360 Glue (Figure 2) supports the many file formats [20]:

4.3 Graphisoft

GRAPHISOFT has been involved in the development of IFC standards since 1996. The latest ARCHICAD version (21) supports the import and export of IFC 4 models including two types of the Model View Definitions, which are developed for multi-disciplinary 3D mode-exchange workflows [21]:

- IFC4 Reference View
- IFC4 Design Transfer View

ARCHICAD continues to support the former 2×3 version of IFC as well. In order to enhance model base communication, ARCHICAD also provides native BIM Collaboration Format (BCF) support in ARCHICAD. There are many other unique solutions in ARCHICAD, such as built-in collision detection, IFC model change detection or custom IFC translators that offers the best in class OPEN BIM workflow for the users (Figure 3).

Figure 3. GRAPHISOFT ARCHICAD Sample

4.4 Vectorworks

Vectorworks provides several different methods for sharing data across a large spectrum of workflows and file formats, giving users the ability to select the best option for their needs. For BIM, where geometry and associated information are important, there is the IFC export/import, as well as ODBC. Vectorworks is also the first product to offer import of RVT and RFA files based on the Open Design Alliance (ODA) Teigha BIM software development kit. In addition, important 2D and hybrid 2D/3D workflows can be supported with PDF/3DPDF, DWF and DWG/DXF export and import. For 3D geometry-centric processes and workflows, especially around early design and building product research, Vectorworks supports import and/or export of another dozen or more file formats including 3DM, SKP/COLLADA, 3DS and a multitude of point clouds formats **[22]**.

4.5 Konstru

Konstru, a new product launched in June 2017 is a central interoperability platform that automates the exchange of BIM data between analysis & modeling software tools. Konstru supports all your favorite and most popular design and analysis tools and allows them to communicate with one another.

The product was created by structural engineers and for structural engineers, in order to make this communication possible between BIM software programs. Konstru is a quick plug-in download that allows you to upload your current projects model to their secure cloud. It's possible to exchange BIM data across multiple platforms, make necessary revisions, and visually understand everything that changed.

Konstru has an open API and modern API to allow for people have the flexibility to build their own use cases and develop apps for BIM without much programming language.

4.6 Trimble

Trimble has a philosophy that project team members

should be able to work together smoothly regardless of the tools they use in demonstrated the integrations and interoperability features across multiple solutions:

- **Trimble Connect** — a collaboration environment where everyone involved in a construction project can access and manage project data from other software packages via a cloud platform. For example, a team member using Revit can upload the .RVT file to Trimble Connect for others to view.
- **Tekla Structures** – Tekla Structures has an open approach to BIM. Through IFC, Tekla links with AEC, MEP and increasingly with plant design software. Tekla Structures effectively integrates with other AEC industry software solutions through Tekla Open API, while maintaining the highest levels of data integrity and accuracy [23]. In addition, for anyone working with AutoCAD, those CAD files can be imported and exported into and from Tekla Structures.

Tekla Structural Designer – Tekla Structural Designer was developed specifically with BIM interoperability and collaboration in mind and helps design engineers maximize collaboration with other project parties, including technicians, fabricators and architects. Its unique functionality allows users to integrate the physical design model seamlessly with Tekla Structures or Autodesk® Revit®, and to round-trip without compromising vital design data.

- Most importantly, industry stakeholders, government agencies, educational institutions and users of BIM application must be educated, to fully understand the capabilities and benefits of BIM based collaboration and building lifecycle management.
- Secondly open, vendor independent, practical BIM standards must be adopted in every country.

4.7 Case Study Evaluation Process

BIM tools that works together, ability to transfer meaning, serves as a common information exchange reference model and able to interoperate between various software application formed the basis for the authors evaluation method. Table 3 defines the vendor software products which reads directly the proprietary file format contained in the BIM software application. The authors used the vendors software product that featured for the case study analysis and ranked them against each other to determine a particular software vendor using software that incorporates using an Application Programming Interface (API), providing a well-developed interface between software from different providers. The authors also considered the software that frequently supports data exchange standards such as Industry Foundation Class (IFC) format for the evaluation. The number of meaningful data exchange transfer model/interfaces that each BIM software product could successfully perform among each other were counted. Based on the number of programming interfaces (API) and open standards file formats associated with each software products was assessed. Based on each assessment, paper ranked the software's according to the scale of "LOW to HIGH". "HIGH" indicates a product that can smoothly communicate and transfer data with less effort or difficulty while "LOW" constitute substantial difficulty in exchanging data. To broaden the support base for this analysis, the paper further took into the following considerations; the customer satisfaction – based on user reviews and market presence – based on product scale, focus and influence.

Table 3 Evaluation of BIM Product to support data interoperability

BIM Products / **Project Data Format**	**Bentley**	**Autodesk Revit**	**Vectorworks**	**Graphisoft ArchiCAD**	**Konstru**	**Trimble.**
File Extension	***dgn**	***.rvt**		*.pln	*.vmx	.dwg
Application Programming Interface (API)	i-models	Revit Open .NET API	API + Vectorscript scripting language	Geometric Description Language (GDL)	Open	FC (2x3, 4), IFCZIP
Open Standards						
• Architectural Model	XFM, ODBC	IFC, RVT, DWG, DGN, PLN, NWD	IFC	IFC, DWG, DGN	SAP2000, ETABS	IFC
• Structural	IFC	IFC,	IFC	IFC	IFC	IFC

Mode		CIS/2				
• Civil Engineering	DWG	LandXML, DWG, DGN	DWG	LandXML, DWG	DWG	IFC
• Cost Estimating	CSV, XLSX	XLSX, ODBC	ODBC	ODBC	DWG,IFC	IFC
• COBie Data	PDT	IFC, XLSX	IFC	IFC	XLSX	IFC
• Scheduling Data	P3, MPP	P3, MPP	P3, MPP	P3, MPP		IFC
• Energy Analysis	IFC, gbXML	IFC, gbXML	IFC, gbXML	IFC, gbXML	IFC,	IFC
RANKING	**Medium**	**High**	**Medium**	**Medium**	**Low**	**Low**

5 Challenges

As BIM technology and interoperability continue to evolve, every indication shows that the challenges are less about the technology but more revolves around:

- Contracted deliverables: Engineers are still producing drawings. Even those who would give up drawings in a heartbeat are likely still contractually bound to produce them for the client (usually the architect in design-bid-build contracts) as part of their deliverable. Because of this, they spend more time than is necessary working on 2D drawings. It would be worthwhile spending time on things such as value engineering and identifying potential constructability issues in a 'constructible model' and then simply sharing that model.
- Contracted responsibilities: Often referred to as Level of Development (LOD) 300, contracts typically require that engineers only produce a full set of 2D construction documents that convey the design intent. This approach is very inefficient for the owner as overall project costs can escalate due to RFIs and change management issues during construction.
- Liability. Many engineers are concerned about providing too much detail because if something goes wrong later in the project, they seem to be concerned that it could make them liable.

6 Discussion

The goal of this paper was to provide different approaches to allow for a flexible response to complicated data transfer challenges. The major issues raised in the case study readily focused on project data standards and its interoperability.

Autodesk encourages owners to use their BIM mandates to ask for the data in the native file format of the authoring tool and in IFC format [24]. Autodesk offers both open source and owned its own plug-ins for interoperability. IFC is the most often used but other methods are also useful. For example, autodesk has series of free utilities to facilitate the quality of BIM data exchanges. These consist of classification manager for Revit, COBie toolkit plugin for Revit and a model checking tool for Revit [24].

There are varieties of options, including openBIM, open sources, and host of others but the preferred standard for Bentley would be to ensure cityGML and IFC are adhere to, to deliver and share better engineering – ready models [25].

Most structural analysis programs were written before the emergence of BIM and work around centerline base wire frame model. This becomes extremely difficult if not impossible to find a perfect solution to fit-in nicely with physical modelling solution like Revit and Tekla Structures regardless of how good the link may be. Trimble has developed a structural analysis solution purposely with this problem in mind (Tekla Structural Designer). Tekla Structural Designer has a physical model and a wire frame model working together so the transfer of information and out of BIM environment is made easy [27].

buildingSMART International provides the global marketplace with the openBIM standard IFC format for BIM interoperability. It is the only open, non-proprietary data exchange standard for the building industry that is comprehensive enough to address the many workflows, processes and stakeholders involved in the design, construction and operations of a building over its entire lifecycle. Because it is an International Standards Organization (ISO) standard, like XML and HTML, anyone can build tools to read and/or write IFC data, including BIM authoring, simulation and analysis, viewing and data server platforms. IFC puts the emphasis on the data, not the tools, so important information can be transmitted regardless of source or receiver of the data. This also encourages a healthy, open marketplace for tools to give end users the best technology and value proposition for their investment. Trying to achieve the same level of BIM interoperability by only utilizing proprietary APIs is economically infeasible at the scale necessary to serve so many end users, for so many projects, in so many markets, using so many different tools [27].

There are over 200 software products by 140 plus vendors/developers across the globe that support IFC data exchange for their customers, irrespective of their country of practice. buildingSMART also has a software certification program to verify the technical capability of applications to read and/or write IFC data. This certification program includes IFC2x3 support and has recently started on the new IFC4 standard. To date, 22 different applications, including major market applications from the Nemetschek Group, Trimble and Autodesk, have been certified to exchange IFC2x3 files. Efforts by five vendors, including Vectorworks, are already underway to certify on IFC4 exchanges [28].

7 Recommendation

The market is changing and so are the requirements for managing data throughout the project lifecycle in AEC industry. Digitization and cloud-based services are the trends resonating with all industry players, who want to make data talk to other data platforms. In this regard, stakeholders must embrace the change through:

- digital platforms, and understand the changing context of BIM information,
- organizations need to ensure this information can be interoperable but resolute in order to better connect distributed teams.

Though technical capability of BIM interoperability and other tool interfaces has improved significantly over the past decade, end-user's knowledge and ability to leverage that capability needs to improve as well. Many times, the biggest obstacle to BIM data exchange is the end users' lack of understanding the best practices in their tools for creating good BIMs, neglecting set up of good, consistent data exchange requirements and processes with collaborators and not knowing how to utilize the data exchange commands in their tools for the best results.

Data exchange standard technology also, needs to improve continuously, improving the IFC data exchange transfer results for project teams.

The authors data interface analysis evaluation gives credence to fact that, Autodesk Revit is more versatile BIM tool capable of accommodating a wide variety of design interfaces for data exchanges among other software products, scoring "HIGH" in the rankings in Table 3.

8 Conclusion

From the search and analysis conducted across the interfaces of almost all the software products, each vendor firm is drifting towards cloud services. Autodesk for example, is pushing heavily for cloud services and cloud central model management, so each project team member could readily access changes and updates from their project data irrespective of their location. Based on this paradigm shift, the authors believe cloud is the future for interoperability and collaboration. The could services does not only offer powerful processing potential but also data distribution and accessibility by enabling a connected data environment.

It will be far-fetched to say technology that is holding back BIM interoperability. It is being held back by contractual issues. One simple solution would be to execute more projects as Design-Build projects rather than Design-Bid-Build. That way, it is in everyone's interest to share information to compress construction schedules. Some structural engineers are adopting what is being termed, 'HD BIM' techniques or offering 'Construction Services' as part of their service – this is another way of eliminating some of these contractual issues. Also, in all situations, it would be ideal on all projects to implement a true BIM execution plan that states who will create a model, to what LOD and how it will be utilized.

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