An in-depth look into the how and why behind the steel construction industry's migration to IFC.

Interoperability for Construction

BY CHRIS MOOR AND LUKE FAULKNER

IN 1998 the American Institute of Steel Construction (AISC) adopted CIS/2 and invested heavily to make it the data exchange standard for structural steel. The effort proved to be a huge success. So why, 14 years later, is now the right time to start focusing efforts on another open standard: IFC?

IFC does *not* stand for Interoperability for Construction, but it could. It's actually an acronym for buildingSMART's Industry Foundation Classes, an industry-wide open standard that is gaining traction across the vertical and horizontal construction industry. While on the surface it purports to offer no more than any other neutral format or standard, in fact it offers a promise unmatched by previous standards—that of interoperability using a single standard across the construction industry and up and down different trades and professions.

For almost 15 years, AISC and the structural steel industry have been leaders in electronic data interchange (EDI). The structural steel industry was among the first to adopt 3D modeling tools throughout its supply chain and by working with software vendors, educating the market and promoting the benefits of EDI, CIS/2 was adopted and embraced. It became a major success, improving productivity and positioning the steel industry at the forefront of interoperability and what was later to be called building information modeling (BIM).

However, as with so many so-called "neutral" formats, CIS/2 is focused exclusively on one discipline, structural steel. Other materials were not even considered in the schema. It has been widely adopted within the "steel silo" and often continues to provide the best option for transferring data up and down the steel supply chain. However, the inability to share data beyond this limitation, coupled with a lack of formal certification and testing, have left CIS/2 on a plateau, with further growth, development and support unlikely.

While the steel industry led the way in the use of 3D models, other industries and trades have quickly been catching up. This has led to a widespread trend toward adoption of not only BIM, but also collaborative delivery methods that BIM enables. Now the construction industry as a whole aspires to have a single global data exchange standard. Such a standard would enable project teams to strive for multi-discipline models and seamlessly exchange model data among architects, engineers, contractors and a multitude of subcontractors.

Chris Moor is AISC's director of industry initiatives. He can be contacted at **moor@aisc.org**. Luke Faulkner is AISC's director of information technology initiatives. He can be contacted at **faulkner@aisc.org**.

Past and Present

For too long the industry has relied on an assortment of data exchange formats, each tailored to a specific discipline, software set, or even country. Software vendors have spent hundreds of thousands of dollars and man-hours programming and maintaining these formats and users have had to spend valuable time trying to learn which one works where and to what degree. Too often, expectation has been overstated and the quality of data exchanges has been unreliable and unpredictable with no one in particular to blame.

Much of the problem lies in the way open standards have been, and still are, viewed. CIS/2, for example, took a top-down approach focused on capturing every single piece of data that might ever be needed, and in every possible way it could be described, within a single industry. Simplistically the idea was that if two software products fully adopted the schema, then the end user could simply press a button to exchange data and it would be 100% correct.

> Industry Foundation Classes offer the promise of interoperability using a single standard across the entire construction industry.

As a result of this approach, the depth of data available within the CIS/2 schema is impressive, but implementing and programming it has become complex. Software programs contain different amounts of data described and referenced in different ways; of course, unless the same programmers write all the industry's software programs using the same language, these differences will always exist. So when it came to writing that data out to an external "neutral" format, programmers had to decide how to define various elements within the CIS/2 schema. Invariably then, two programs may end up with different, but still correct implementations of CIS/2. Because of this, CIS/2 "flavors" developed (i.e., two software vendors agreed on ways to interpret data such that their programs worked together) and results became erratic. Without a formal, independent, testing and certification program to police these kinds of things, the problems continue and faith in the standard erodes, even as vendors continue to work on it.

Interestingly, these issues, along with advancing technology, have led to an ever increasing number of proprietary links between various software programs. Software companies strategically create such links in direct response to market requirements. More often than not the quality of the exchanged data is very high and in addition, well documented and tested. The downside to proprietary links is that one is needed for every link in the chain, which is expensive to develop and maintain. It also gets confusing for the end user as choices expand.

Lessons Learned

Digesting this information leads to one conclusion: In the future, if interoperability is to become a reality, new approaches will be necessary. Over its 15-year experience with the topic, AISC has learned a few things that help determine what those new approaches might be:

1. Successful interoperability requires more than just the technical capability of the chosen format, the software and the end user. First, a legal framework and appropriate contract documentation are necessary to allow the sharing of data between parties without the fear of increased risk or liability. With the increase in collaborative delivery methods the sharing of data becomes an integral component of the project team but documents need to be in place to protect the participants.

Added to this, communication among the project team is crucial: Expectations must be set at the outset of the project with apparently trivial things, such as origin points and file formats, being decided early as possible. It must be clear what is to be modeled to what extent by whom and when, and just as importantly, what will likely not be modeled. A clear narrative on the level of development of models must be in place such that other users know what the model content can be relied upon for. The list goes on, but developing this kind of BIM execution plan is time well spent.

2. Interoperability is market driven. Software vendors want a return on their programming investment and are naturally driven by market requirements, strategic opportunities and client needs. Consensus-style open standards move too slowly to meet changing market requirements so software companies need to look for the quickest, most reliable and efficient way of meeting the need. Often, the answer is a proprietary data exchange link. As noted above, proprietary links are expensive to maintain and support and vendors tell us repeatedly they would prefer to have one standard to write to and maintain, but that standard needs to help them satisfy the market. To be successful then, any open standard in the future needs to have some kind of mechanism where changes and extensions to the schema can be done quickly and without waiting for consensus approval.

3. Open standards can never exchange all the data two programs could exchange directly. There is no escaping the fact that an open standard can never exchange all the data two programs could exchange or that a client wants to exchange. In essence open standards do not support innovation or creativity and cannot always keep up with the market. As a result, even with the best will in the world, there will always be a need to supplement the open format data exchange with additional enhancements. It boils down to this: Open Standard + Proprietary Enhancements = State of the Art.

The open standard allows the essential data to be transferred while a layer of proprietary data enables a company to maintain its competitive edge, meet market requirements and still reduce its overall development effort. As long as the limitations are known, solutions can be found.

4. Interoperability needs to be workflow driven. While the top down approach described for CIS/2 has proved successful, a bottom up approach will provide more flexibility and

agility. A workflow driven approach requires studying and documenting every data exchange point within the supply chain, from concept to installation. At each exchange point a thorough understanding is needed of who is involved, what software is involved, what data needs to be exchanged (or can be exchanged) and what that data will be used for. This becomes a blueprint for the industry and the foundation upon which an open standard can be built. Every software program serves a niche set of users and in this way, only the exchanges that affect them need to be considered. In the same way, this approach deals with the areas where other disciplines are involved or need to be combined, avoiding any issues with "silos."

IFC already has become a broadly supported and accepted standard outside the structural steel world.

5. A successful open standard needs to have formalized procedures and be well defined, policed and offer a certification program for software providers. This is an area where CIS/2 fell short and it was a long way out of the realm of AISC. However, it is an important area that ensures reliability of the exchanges and reduces the likelihood of errors or unexpected results.

With these lessons in mind, and noting that a new direction clearly was needed for the structural steel industry to maintain leadership and competiveness, AISC's Technology Integration Committee (TIC) has spent the past year studying this issue, reflecting on our past experience, and considering the options before us. The reality is that the broader construction industry has started to embrace BIM in a big way and IFC has been gaining a huge amount of traction among various disciplines and industries. In the end AISC has chosen a unique, bold approach that leads us toward an IFC solution for the industry, that is both flexible and realistic along the way.

By understanding the five points made above, the choice to head toward an IFC solution for the future was actually fairly easy; the keys were to be realistic about the capabilities and to keep an eye on improving the present situation. In reviewing the above five points, IFC scored high because:

- While the scope of an open standard such as IFC does not cover legal issues and collaboration/communication, these concepts cannot be ignored. buildingSMART, aside from having IFC at its core for interoperability, also heavily promotes communication and collaborative delivery methods and processes. In addition, the National BIM Standard—United States (NBIMS-US) has active AISC involvement and supports all of these topics within its mission.
- While the market is driving interoperability, there are efforts across the industry to promote IFC at all levels such that the market is beginning to demand IFC as its solution.
- IFC exchanges are derived from workflows. Among these formalized procedures are a well-thought-out, user-defined specification for what information is required and additionally, a technically defined methodology for adapting these requirements into a specific schema—IFC in this case. This is work that is well under way and will help the steel industry in honing a standard that allows all the required information to flow to a fabrication level, while at the same time easily exporting to a level useful for coordination by a general contractor. AISC is working with industry experts at Georgia Institute of Technology, and is in the final stretch of completing an Information Delivery Manual (IDM) for the structural steel industry. The IDM is a plain English explanation of the data exchanges that occur within the structural steel industry from concept to installation. It includes a description of each exchange, including such things as who is exchanging the data, what data are included, what the data can be used for, and what software is being used.
- A formalized and official testing and certification procedure is in place for IFC. Aside from the ability to communicate data effectively beyond the structural steel supply chain, IFC offers an advantage CIS/2 never could; an established methodology for testing and certification. IFC has a well-defined, systematic, rigorous procedure for this. While it's not easy to attain, a certified implementation offers a level of certainty that CIS/2 never did or could.

While this is exciting, we still have to acknowledge that IFC is not quite ready—yet. We know that IFC is capable of moving data supportive of structural steel at the coordination level; we even know that it is capable of supporting some fabrication-level information. The reality is though; you will not wake up tomorrow or next week, or next month to find that IFC is ready to supplant CIS/2 for fabrication-level information. It is a long and arduous process that at times may prove frustrating. The payoff, though, is that the steel industry will end up with a standard that was developed with its own input to support its own needs—both internal and external.

The Missing Link and the Key Component

What gets lost in all the talk of IFC is what happens between now and when a solution is available. This is the key component in AISC's strategy.

- Yes, AISC has changed its single-minded outlook from "only CIS/2."
- Yes, AISC is actively moving toward an IFC solution for the industry.
- No, AISC is not abandoning anything, or putting anything on hold in the meantime—quite the opposite.

The reality is that the broader construction industry has become very BIM-hungry and as its capacity to utilize BIM has grown, so too have the expectations of what data it expects to be able to access. It's not without some serious thought that AISC opted to pursue this course. Although IFC lacks the overall capability of CIS/2 within the structural steel domain, it already has become a broadly supported and accepted standard outside the structural steel world. To remain a leader, it has become incumbent upon AISC to look not just introspectively at our own industry, but to look beyond and examine how we will fit into a wider BIM world.

Our short-term goal is to ensure data can be exchanged as needed utilizing any type of data exchange available. In other

words, we support, recommend and encourage the use of any format to exchange data to the satisfaction of both parties, be it proprietary, CIS/2, SDNF, DSTV, XML or a combination thereof.

To support this, our foundation is the Information Delivery Manual described earlier. AISC is using the IDM as a living, evolving document to understand data exchanges, identify problem areas and gaps, and then find ways to solve them. The IDM is a valuable tool that now sits at the heart of all the interoperability objectives for the steel industry.

Essentially, we will examine each data exchange point and get a thorough understanding of what data is being exchanged and why, and between what roles and which software. From there we will look at all available data transfer options between the software programs on either side of the exchange and document what works and what doesn't, what's missing and, in the end, what the best solution is for exchanging the needed data at that point. If we find that one method works better than another, that is what we will recommend for that particular data exchange. If we find fixable errors within exchanges, we will report them to the software vendors and recommend they be corrected. In the end, our goal is to provide a service to the industry such that users can enter a few pieces of information about their role, software and the data they wish to exchange and in response will obtain a recommendation for how best to achieve the exchange.

At the same time, it's important to note that while AISC is moving toward IFC and preparing the market and the foundation, the most important thing is that interoperability can happen now. CIS/2 is not being disavowed. It fits into the larger, short-term strategy that we want exchange cases to be supported in the most robust, capable way. Where feasible, CIS/2 will be further enhanced to support those data exchanges, and will even help us document the workflows that will establish what information is in IFC. In this way, we hope to improve the exchanges available right now, and at the same time build a knowledge base that can be used for building the IFC exchanges for the future.

Summary

It's not without some serious thought that, after 15 years, AISC decided it was time to move toward IFC. But IFC is for the future and we also needed to improve interoperability and help our members such that they can exchange data as they need to right now. CIS/2 does not go away, just as SDNF and other older formats have not gone away. They have their place and are used where appropriate, and that will continue to be the case. AISC's approach takes into account all currently available options and hopes to be able to learn from each of them, document them and build the foundation for an effective IFC solution for the industry in the future. IFC may not stand for Interoperability For Construction yet, but it will. MSC