

Building Smart – A Strategy for Implementing BIM Solution in Singapore



The Construction and Real Estate Network (CORENET) initiative was launched in 1995 and its aim is 'to reengineer and streamline the fragmented work processes in the construction industry, so as to achieve quantum improvements in turnaround time, quality and productivity'. To drive the seamless exchange, management, comprehension and integration of project information or interoperability across diverse platforms, the adoption of graphical object technology (also called Building Information Modelling or BIM) was identified as a critical cornerstone. This article examines the state of the industry's adoption of BIM, including the critical success factors for its smooth implementation. Action plans are recommended to accelerate the use of BIM for the construction sector.

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1 Introduction

The Construction and Real Estate Network (CORENET) programme is a strategic initiative spearheaded by the Ministry of National Development to drive the transformation of the construction industry through the use of IT to reengineer its business processes to achieve quantum improvements in turnaround time, quality and productivity [1]. The purpose of CORENET is to provide the necessary infrastructure for exchange of information speedily and seamlessly among all parties to building projects, as well as the regulatory authorities; through the use of IT. Its objective is to improve the SITUATION as shown in Figure 1 [2].

SITUATION

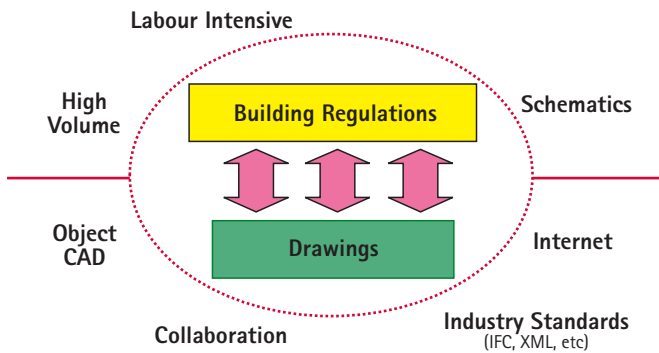


Figure 1: The Situation

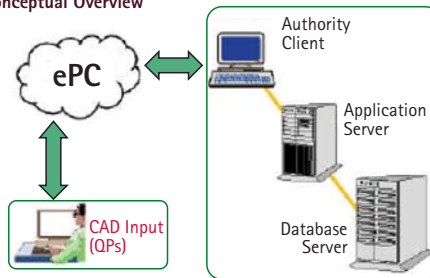
For the vision of CORENET to be fully realised, invariably the construction industry has to be transformed in terms of their practices and the adoption of appropriate technologies. One such technology advocated is the Building Information Model (BIM) solution and the project under CORENET that aims to encourage the construction industry in Singapore to use BIM is the CORENET e-Plan Check system. This project is fully funded by the government and aims to provide a compelling value proposition for the construction industry to migrate from traditional 2D design drafting approach towards a digital graphical modelling approach whereby project information is captured as attributes in a building information model which serves as a portable database that can be progressively enriched throughout the building life cycle right from design through construction to demolition.

2 What can CORENET e-Plan Check System do?

CORENET e-Plan Check system (refer to Figure 2) [2] is an expert application, built on a client-server architecture, that essentially allows building professionals (such as registered architects and professional engineers) to check their design for regulatory compliance through the Internet gateway. Regulatory officers are also able to conduct audit checks on submission made by the building professionals through the same system.

SYSTEM ARCHITECTURE

Conceptual Overview



INFORMATION FLOW

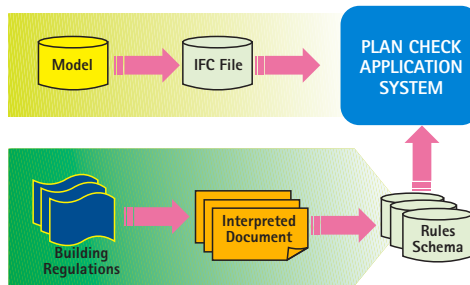


Figure 2: CORENET e-Plan Check System

The building professionals will be given an account to access the e-Plan Check system via the Internet. They will prepare their design using object-oriented BIM tools and then upload the BIM into e-Plan Check system for automatic on-line or batch processing. When the automatic checking process is completed, the system will generate a downloadable report to highlight the areas of non-compliance.

These Qualified Professionals can also view graphically the areas of non-compliance if they choose to do so with aid of the e-Plan Check viewer. The system adopts the Industry Foundation Classes (IFC) 2x2 specification developed by International Alliance for Interoperability (IAI) which defines the means and manner of construction of the desired building data model. A stable and rich model, this allows the e-PlanCheck System to analyse and interpret the design. IFC 2x2 provides a stable core model to build the rich information that the e-Plan Check system needs. Essentially, Singapore has adopted IFC as the standard for BIM implementation in the local construction industry.

3 Benefits of CORENET e-Plan Check System

The checking and approval process using the manual approach is generally very time-consuming and inefficient. The CORENET e-Plan Check system speeds up the checking process and also helps to reduce the ambiguities and subjectivity in building code interpretation and regulatory compliances.

This will result in reduced design errors, minimise the risk of professional liability and improved overall performance in the design process. As a multi-agency project, building professionals are able to automatically check their design against more than one regulatory agency requirements. This would help to ensure potentially conflicting regulatory requirements are avoided by the building professionals and hence ensure that their submission for final approval could be granted in an expedient manner.

In the longer term, the e-Plan Check system will lay the foundation for the impending change of the design world from 2D to 3D object-oriented environment. The interoperability nature of the building model would translate to increase collaboration amongst the industry stakeholders. In addition, the knowledge stored in the IFC-based building model could be used for facility management purposes after the building is completed.

4 Prerequisite for Successful Rollout of e-Plan Check System

Under the CORENET programme, object-oriented or 3D CAD (also known as BIM) has been identified as a critical success factor to enable seamless information interchange and management. CORENET e-Plan Check system is one such application to accelerate its industry adoption by offering the value of greater regulatory predictability and consistency.

The design of CORENET e-Plan Check system is based on IFC to ensure long-term sustainability. However, IFC is a relatively new standard. It will take time for IFC to be widely adopted by CAD developers and vendors unless building owners and CAD users demand such IFC-compliant CAD software in their procurement specifications. Hence, to hasten the implementation of IFC by major CAD developers and vendors, the IAI has embarked on a worldwide programme to encourage its member organisations to specify IFC in their own applications. Singapore, through the CORENET e-Plan Check system, is supporting these international efforts to bolster the early adoption of IFC. After all, the widespread use of IFC-based BIM is a prerequisite for the success of e-Plan Check implementation.

5 Critical Success Factors for Smooth Implementation

Based on the foregoing consideration, the following factors have been identified as critical success factors for the smooth implementation of CORENET e-Plan Check system:

- Conformance of CORENET e-Plan Check specifications with IFC;
- Availability of IFC-based BIM tools that are compatible to CORENET e-Plan Check requirements; and
- Widespread adoption of IFC-based BIM technologies.

5.1 Conformance of e-Plan Check with IFC

One of the means to accelerate the acceptance of any new system is to ensure the system conforms to recognised international standards. In fact in 2001, through the e-Plan Check project, IAI (Singapore) succeeded in getting the international body to incorporate the code checking information model requirements as part of the international (mainstream) IFC specifications. In October 2002, the e-Plan Check information model was certified by IAI as IFC-compliant. Subsequently, the e-Plan Check system itself was certified compliant with IFC Architectural View for Code Checking Stage 1 and Stage 2 in October 2003 and October 2004 respectively.

As one of the leading applications designed to IFC specifications, the e-Plan Check project has generated considerable interests in a number of other countries. Government bodies of these countries have begun to pursue similar pilot implementation projects based on IFC.

5.2 Availability of IFC-based BIM

As e-Plan Check runs on data from BIM based on IFC specifications, steps have to be put in place to ensure that such BIM tools are made available to the industry as early as possible. The Building and Construction Authority (BCA) will work with the Singapore Chapter of IAI to involve and engage key industry stakeholders as partners in the promotion of IFC-based BIM. To this end, BCA has forged a strategic alliance with IAI(S) to jointly steer the industry towards the widespread adoption of IFC-based BIM.

One of the initiatives identified under a Memorandum of Understanding signed between IAI(S) and BCA to promote interoperability (through such means like BIM) aims to encourage CAD vendors to expedite the enhancement and customisation of their BIM software to comply with IFC and e-Plan Check requirements and to bring to market a cost effective offering to the industry. However, the ultimate objective of the e-Plan Check system is not just to put in place an automated plan checking system but to provide the impetus to gear up the industry towards greater interoperability amongst the construction players through effective deployment of IFC-based BIM tools.

As part of Singapore's efforts to accelerate the implementation of IFC by CAD vendors to support e-Plan Check rollout, IAI(S) hosted an IFC Code Checking Certification Workshop in October 2003 in Singapore. The objective of the workshop was to certify those commercial BIM solutions that could comply with CORENET e-Plan Check requirements for Architectural View.

The workshop was completed successfully with the 1st Stage Certification awarded to Autodesk's ADT, Graphisoft's ArchiCAD and BCA's CORENET e-Plan Check application. One year later, on 29 October 2004, ArchiCAD and e-Plan Check successfully completed the 2nd and final stage of this certification. Most recently, on 8 April 2005, Autodesk's REVIT has successfully obtained the 1st Stage code checking view certification. All these software are pushing for BIM as the solution for the construction industry.

As the e-Plan Check requirements have been incorporated into the mainstream IFC specifications, vendors who can comply with Singapore's requirements would potentially be able to market their solutions in other countries that may embark on similar regulatory automation projects. Similar workshop is also planned to certify BIM solutions complying with CORENET e-Plan Check requirements for building services view in the next phase.

5.3 Adoption of IFC-based BIM

Users of CAD tools are generally aware that the trend of CAD technology is towards 3D. For the past several years, at international AEC shows, the pitch of the major CAD vendors had been on 3D design and drafting as a means to improve productivity. The advantages of 3D CAD information being used to facilitate quantity takeoff and downstream facilities management have been well publicised.

However, most users are currently not aware of IAI's push to promote IFC as the international standard for the exchange of 3D building information model across platforms. They are also oblivious to the potential benefits that such an international standard could offer to the various players in the building project team in terms of freely communicating and exchanging project information amongst the parties throughout the project life cycle. Hence, there is an urgent need to educate the industry through a series of publicity activities from now on to increase user awareness of 3D BIM technology that complies with IFC specifications.

The IFC Implementers Work Group (IIWG) of IAI (S) would be playing a leading role to drive the awareness and adoption programme of IFC-based BIM tools. The initial focus would be on the promotion of IFC-based architectural BIM tools to support e-Plan Check rollout for the architectural components. In the following year, promotion efforts would be extended to IFC-based building services BIM tools to support the building services components. From 2005 onwards, IIWG and BCA would jointly embark on a promotion and training programme to migrate the industry from 2D to 3D IFC-based BIM solutions.

6 Strategy and Action Plan for Implementing BIM Solution

Based on the aforesaid critical success factors, BCA and IAI (S) have mapped out the strategy and action plan to promote the use of 3D CAD design and to pave the way for the rollout of e-Plan Check system. The strategy for implementing BIM solution in Singapore (refer to Figure 3) is via a combination of activities of the action plan such as the following:

- Involving the industry in pilot testing of e-Plan Check;
- Conducting public education programme through regular seminars;
- Providing assorted incentives to train professionals in the use of IFC-based BIM tools;
- Working with institutes of higher learning (IHL) to prepare new entrants to the industry on the use of 3D BIM in their design work; and
- Working with government bodies and developers to include 3D design models as a requirement under the building contracts.



Figure 3: Strategy and action plan for implementing BIM solution in Singapore

6.1 Pilot Testing

Pilot trials on e-Plan Check (architectural) system involving seven architectural firms commenced in last quarter of 2004. This pilot testing spanned a period of eight months with each pilot site contributing at least two building models in IFC format (using current or past projects) for checking by the e-Plan Check system. The total effort from each participating firm was estimated at about two man-months. The participating firms were compensated under CORENET funding for their efforts. Results and feedback from the pilot tests are in the process of being incorporated into the system.

The same approach would be used for e-Plan Check (building services) pilot trials, which are expected to commence in end-2006.

6.2 Seminars

IIWG and BCA would be working closely with CAD vendors to organise a series of seminars to share with the industry the benefits of using IFC-based 3D BIM tools. At least two such seminars will be planned every calendar year.

6.3 Training Grants

To hasten the adoption of BIM technology, assorted incentives would be provided to the industry firms to help mitigate the capital cost of migrating to a new technology platform. As 3D IFC BIM technology is being promoted as a productivity tool, greater priority would be given to early adopters of BIM technology.

6.4 Collaboration with IHL

IIWG and BCA will be working with the universities and polytechnics on joint projects to train students in the use of 3D IFC BIM and to formulate a good practice design guides for the creation of 3D building models. The objective of this collaboration is to start training new group of students so that they would be ready for 3D design when they enter the workforce from 2006 onwards.

6.5 Collaboration with Government Bodies and Developers

The most effective way to make building professionals embrace 3D design is through procurement contracts for building projects. Some enlightened building owners are already doing so as they realise the potential benefits of 3D design model for their subsequent facilities management requirement.

IIWG and BCA will approach and encourage developers of public and private buildings to specify IFC-compliant 3D building design models for their projects. If more and more developers and building owners start to specify IFC 3D model in their contracts, in due course, building professionals would be motivated to migrate to 3D IFC CAD design on their own accord.

7 Conclusion

Singapore's e-Plan Check system is probably one of the largest projects ever undertaken by a government agency in support of IFC and BIM technology. As e-Plan Check runs on IFC-based BIM data, its deployment heralds BCA's confidence on the the timeliness of BIM and appropriateness of IFC in the construction industry. Hence, it is important that CAD developers and vendors support Singapore's efforts by accelerating their IFC implementation programme and come up with their IFC-compliant products early. After all, they too depend on major IFC-based applications to ensure quick and early adoption of their products.

With a focus strategy and appropriate support from CAD vendors and solution providers, we believe that the BIM technology would permeate through the construction industry in an accelerated pace.

8 References

- [1] Construction and Real Estate Network (CORENET), <http://www.corenet.gov.sg>.
- [2] Cheng T.F. (2004), CIFE-CDI Award for Exceptional Building Project Value Nominations Form.

For enquiries and further information of the CORENET Programme or the BIM Initiative, please contact Mr Lim Boon Han of the Building and Construction Authority at lim_boon_han@bca.gov.sg.