

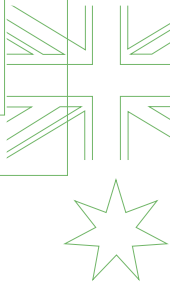
American Institute of Architects

Report on integrated practice

International developments



9



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International developments

Why is an international perspective important?

We live in a global society and we work in an industry that is increasingly global in its scope of operations. Acclaimed designers like Cesar Pelli, Sir Norman Foster, IM Pei, Santiago Calatrava, Daniel Libeskind, and Renzo Piano win competitions and are commissioned to design signature buildings worldwide. Construction companies like Skanska (Sweden), Kajima (Japan), Turner (U.S.A.), and Multiplex (Australia) build projects internationally. Large architectural and engineering firms like Arup, HOK, Gensler, and Skidmore, Owings & Merrill support many offices in many different countries. Beyond the traditional sourcing of sought after raw materials globally (ceramics, marble, hardwoods, etc.), many local markets are now being served by international distribution networks, as building product manufacturers move production facilities offshore.

As a result of globalization, our industry now faces a new challenge: the need for a common language and shared work practices. Metric measurement (with the exception of the U.S.) and a select number of pervasive technologies that have created “defacto standards,” such as PDF documents and DWG files, are two frontiers of a still very limited common vocabulary. Unfortunately, our industry is littered with a legacy of many competing classification systems—Barbour Index, CI/sfb, Uniclass, Master Format, OmniClass, and BARBI, etc.—and dozens of different forms of contract, hundreds of project delivery “best practices,” and thousands of different federal, state, and local building codes.

Today, the need for integrated practices extends well beyond the boundaries of a single firm or even the boundaries of a large project team involving many companies. The need has grown to global dimensions. Some of the most exciting innovations to address this need are happening outside of the U.S., where key industry stakeholders in many different countries are committed to evaluating the advantages of integrated practices and to being among the first to implement them. Several international initiatives have progressed from problem identification through research to initial implementation, achieving early success.

Early identification of the need for new practices

Dating back to as early as 1998, a Construction Task Force led by Sir John Egan took a first critical look at the diminishing competitiveness of the U.K. construction industry. The resulting report, entitled “Rethinking Construction,” proposed many astute recommendations for innovation and change that today we would readily label as the pursuit of integrated practices.¹ The task force’s ambition was to make recommendations that would deliver improvements in quality and efficiency across the U.K. construction industry. They identified five key drivers of change designed to set the agenda for a more efficient and competitive U.K. construction industry: committed leadership; a focus on the customer; integrated processes and teams; a quality-driven agenda; and commitment to people.

¹ Rethinking Construction: Report of the Construction Task Force to the Deputy Prime Minister, John Prescott, on the scope for improving the quality and efficiency of UK construction www.dti.gov.uk/construction/rethink/report

Researching the problem

The “Pro IT” project in Finland was started in 2002 after the Finnish government recognized that its construction industry’s processes were highly fragmented. Design data were frequently inadequate; there was no common language among the various participants; it was difficult to check plans; errors piled up at the worksite, causing unexpected costs and timetable problems; and investment decisions were being made purely on the basis of the costs in construction.

The International Construction Research Alliance (ICALL) was established in March 2003 to bring together leading research organizations with the collective aim of creating world best practices in international construction and property management.² The foundation members of ICALL include the Center for Integrated Facility Engineering (CIFE), Stanford University, U.S.; Centre Scientifique et Technique du Bâtiment (CSTB), France; Cooperative Research Centre for Construction Innovation, Australia; Research Institute for the Built and Human Environment, The University of Salford, U.K.; and VTT Building and Transport, Finland.

Pilot projects for evaluating integrated practices

Wind the clock forward to today and there is a determined effort underway to conduct pilot projects on both public and commercial buildings as the basis for proving the value of adopting integrated practices.

Finland

Four Pro IT pilot projects were completed in 2005 and the experience gained was published in a report that documents the chief advantages of product (building) modeling.³ These include the integration of plans and reduction of errors; clash detection analysis; faster and more accurate quantity surveying (bill of materials) and resulting cost estimates; the clarity of three-dimensional plans; and extracting visual marketing materials such as perspectives, renderings, and drawings directly from the model.

United Kingdom

The U.K.’s leadership in pursuing integrated practice in the construction industry continues today under two separate but related initiatives. Firstly, the “Construct IT for Business” initiative has been set up to coordinate and promote innovation and research in IT (information technology) in Construction in the U.K. to improve competitive performance of the U.K. construction industry.⁴ Secondly, the “Constructing Excellence” initiative aims to deliver improved industry performance, which results in a demonstrably better built environment.⁵ Both initiatives are actively engaged in promoting and sponsoring pilot projects.

² International Construction Research Alliance:
<http://icall.crccli.info/>

³ ProIT News:
January 2006 Edition
http://virtualvtt.fi/proit_eng/indexe.htm

⁴ Construct IT for Business:
<http://www.construct-it.org.uk/>

⁵ Constructing Excellence in the Built Environment:
<http://www.constructingexcellence.org.uk/aboutus/default.jsp>

Australia

The “CRC for Construction Innovation” initiative has a broad mission to deliver tools, technologies, and management systems that will improve the long term effectiveness, competitiveness, and dynamics of a viable construction industry in the Australian and international contexts.⁶ CRC is currently working closely with leading schools, industry, and government to sponsor pilot projects. An important focus for CRC is education and industry awareness. In 2006, for example, they hosted the “Clients Driving Innovation” International Conference, during which speakers from 11 countries addressed themes such as integrated practice, sustainable design, facilities management, safety, procurement, risk management, and various other current issues facing our industry.⁷

⁷ Clients Driving Innovation Conference:
<http://www.construction-innovation.info/index.php>

⁶ CRC for Construction Innovation:
<http://www.construction-innovation.info/index.php?id=3>

Norway

The Norwegian government and leaders in Norway’s construction industry are working together to initiate a set of new and ground breaking changes in their construction industry. Areas of study include building control (automatic code checking), planning (e-submission of building plans), and integration in the design + procurement+ construction+ facility management of a project lifecycle. The objective of these “buildingSMART” pilot initiatives is to produce a significant impact on the efficiency, productivity and quality of the construction industry in Norway.⁸

⁸ Building SMART Projects:
Nordic Chapter,
International Alliance of Interoperability,
http://www.ia2.no/nor_ia2_projects.htm

Early implementations

Singapore

The Singapore Building and Construction Authority is leading the CORONET (Construction and Real Estate Network) project in collaboration with the Singapore Ministry of National Development to re-engineer the business processes of the construction industry to achieve a quantum leap in turnaround time, productivity, and quality.⁹ Two examples of the early successes of this ambitious information technology initiative that are already having a positive impact on the efficiency of the construction industry in Singapore are:

CORONET e-Submission

An internet based system that enables AEC professionals to submit project-related plans and documents to regulatory authorities for approvals. The system has been designed to enable faster processing and turnaround time and improve public service controlled approvals through greater efficiency in managing and processing electronic (versus paper-based) submissions. It also has the added benefit of harmonizing rules and streamlining forms among the different regulatory authorities involved.¹⁰

CORONET e-PlanCheck

Anyone who has been involved with the manual process of code-checking can attest to how labor intensive and time consuming it can be, and to the often long delays waiting for review and approval. Worse still is the problem of inconsistencies that arise when same code is interpreted differently by different individuals. Accuracy can also be a problem, since checking is rarely fully comprehensive, due to time constraints. The e-PlanCheck system has been designed

¹⁰ CORONET e-Submission:
Regulatory authorities who are participating in the CORONET e-Submission system, including the Building and Construction Authority, Urban Redevelopment Authority, Land Transport Authority, Public Utility Board, Singapore Power, Housing & Development Board, etc., along with various industry associations including the Singapore Institute of Architects, the Institution of Engineers, Association of Consulting Engineers, Real Estate Developer’s Association, and the Singapore Contractor Association.

to automatically check digital building plans using Artificial Intelligence and BIM (Building Information Modeling) technologies to support the analysis and evaluation (rules based checking) for compliance with regulatory requirements.¹¹

These “successes” are now being exported overseas to international markets via a technology-sharing agreement with Norway and initial trials in the U.S.¹²

A vision for integrated practice in the future

Perhaps the most forward looking international effort is the “Construction 2020: A Vision for Australia’s Property and Construction Industry” initiative.¹³ This report was compiled by consulting industry members and leaders across the country. It documents a framework that will allow Australia to set a research agenda for innovation to position itself to perform more competitively at an international level. The findings reflect both major concerns that need to be addressed, as well as the improved future environment in which industry stakeholders would like to work. Eight interdependent visions emerged from the study as follows:

- 1 environmentally sustainable construction;
- 2 meeting client needs;
- 3 improved business environment;
- 4 welfare and improvement of the labor force;
- 5 information and communication technologies for construction;
- 6 virtual prototyping for design, manufacture and operation;
- 7 off-site manufacture; and
- 8 improved process of manufacture of constructed products.

Can architects afford to continue to rely upon current approaches for project execution and delivery?

The fragmented nature of our industry is well documented. The need to change adversarial contractual relationships is universally agreed. It seems abundantly clear from comparing all of the initiatives described above that all of the same symptoms and many of the same underlying problems are being experienced globally across the entire construction industry.

The August 2004 study completed by the U.S. National Institute of Science and Technology (NIST) documented the extraordinary cost burden of continuing with the status quo. The final report entitled “A Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry” described that inadequate project coordination, poor team communication, and the lack of interoperable software applications is costing the U.S. building industry \$15.8 billion annually.¹⁴ By extrapolation, it is not hard to imagine that this number is many multiples higher internationally.

¹¹ CORENET e-PlanCheck:

The AECbytes article entitled “Building the Future” provides an excellent overview of Singapore’s automated code checking system which is available at <http://www.aecbytes.com/buildingthefuture/2005/CORENETePlanCheck.html>

¹² State Visit:

The King and Queen of Norway signed a technology agreement with Singapore http://www.novactynets.com/fornews_2004oct.htm

¹³ Construction 2020:

A Vision for Australia’s Property and Construction Industry
<http://www.construction-innovation.info/index.php?id=366>

¹⁴ National Institute of Standards and Technology (NIST) Report:

“Cost Analysis of Inadequate Interoperability in the US Capital Facilities Industry”

<http://www.bfif.nist.gov/oaef/publications/gcrs/04867.pdf>

Building owners are not waiting!

In its report, entitled “Collaboration, Integrated Information and the Project Lifecycle in Building Design, Construction and Operation,” the Architectural/Engineering Productivity Committee of the Construction Users Roundtable (CURT) points out that the construction process is fraught by lack of cooperation and poor information sharing that most often results in project delays and cost overruns.¹⁵ The report concludes that: “The goal of everyone in the industry should be better, faster, more capable project delivery created by fully integrated, collaborative teams. Owners must be the ones to drive this change, by leading the creation of collaborative, cross-functional teams comprised of design, construction, and facility management professionals.”

Government owners in particular are well positioned as influential building owners given their “public” accountability to drive bottom line savings to their federal and state building programs. Two such examples follow.

U.S. General Services Administration (GSA):

The GSA’s Building Information Modeling (BIM) initiative resulted from a Public Building Service policy directive, which calls for the use of standardized BIM models to support concept reviews for projects receiving design funding in FY2007, including checking designs against program requirements and cost estimates.¹⁶ The GSA has previously demonstrated its capacity to drive innovation in the construction industry as a leading proponent of sustainable design, and by being one of the first building owners to require LEED certification for its public buildings. In fact, this bold initiative has been in large part responsible for starting the subsequent National Building Information Modeling Standard (NBIMS) initiative described below.

Norwegian Directorate of Public Construction and Property (Statsbygg):

Statsbygg is the State building and planning authority in Norway. As a forward thinking owner, Statsbygg publishes standard Planning Guides to try to ensure that the public buildings they commission and operate conform to required minimum design and construction parameters. In the Central Government Budget for 2005, Statsbygg was funded to “initiate and participate in R&D projects, including making accessible [their] own building projects as pilots, thus contributing to the gradual proliferation of digital BIM models in the AEC industry through the lifespan of buildings.”¹⁷ Accordingly, Statsbygg is now involving its consultants and suppliers in testing the use of alternative methods for specifying Planning Guide and Construction Program requirements as “constraints” and “planning rules.” This will mean design quality can be validated automatically via computer-based comparative modeling to determine that proposed solutions meet the desired building requirements.

¹⁵ Curt Whitepaper WP1202:

“Collaboration, Integrated Information and the Project Lifecycle in Building Design, Construction and Operation”
http://www.curt.org/14_0_curt_publications.html

¹⁶ GSA Building Information Modeling Initiative:

https://hsc.wes.army.mil/symposium/2004/Tuesday/DesignDel_Graves_files/frame.htm

¹⁷ Statsbygg:

Using IFC for Early Design on the Bodø College project:
<http://www.iai.no/ESP/index.htm>



Four ways not to be left behind

The good news is that many of the current integrated practice initiatives have started to align. As we enter this new era of cooperation, sponsoring organizations are more willing to coordinate their efforts and to share resources. Importantly, the learning from these initiatives is typically being documented, published, and disseminated to the industry as a whole. The result of this alignment will most likely be acceleration in the adoption of integrated practices.

The following such initiatives, in the opinion of this author, are poised to effect permanent change in our industry. All four are international in scope; all have government sponsorship and include the support of trade and professional associations. However, a critical success factor for all of these innovations will be the participation of forward-thinking practitioners who are willing to invest their time and effort to help advance the state of the art of our industry.

1. National Building Information Model Standard (NBIMS) (U.S.)

The mission of the National BIM Standard Project Committee is to improve the performance of facilities over their full life cycle by fostering a common, standard and integrated life cycle information model for the A/E/C & FM industry.¹⁸ This information model will allow for the free flow of graphic and non-graphic information among all parties to the process of creating and sustaining the built environment and will work to coordinate U.S. efforts with related activities taking place internationally. The NBIMS Project Committee is managed by the Facility Information Council, which “provides an industry-wide forum for the standardization and integration of electronic systems for the full automation of the entire life cycle of buildings.” This is the same group that was responsible for the predecessor National CADD Standard.¹⁹

2. Information Delivery Manual (IDM) (Norway)

The IDM project was formed to identify and describe the information needs of project processes from the perspective of the AEC/FM stakeholders rather than through the lens of software developers or information modeling experts.²⁰ The methodology involves 1) process maps being documented by domain experts which describe all the business processes and tasks throughout a building's lifecycle; 2) exchange requirements being identified which outline all of the information necessary to enable a specific business process (inputs) as well as the expected result (outputs) from that same process; and 3) functional parts being determined which capture all of the technical information required to support communication between each of the different “roles” on a project. The premise of this work is that the benefits of applying BIM as a source of intelligent information about a project can only be realized by integrating that information with work processes.

¹⁸ National BIM Standard Project Committee:
<http://www.nibs.org/BIMcommittee.html>

¹⁹ See Alan Edgar, Assoc. AIA, “Right Thinking about BIM and the National BIM Standards Committee,” AEC Bytes:
http://www.aecbytes.com/buildingthefuture/2006/BIMstandards_pr.html

²⁰ IDM Project:
<http://idm.buildingsmart.no/confluence/display/IDM/Home>

3. The Avanti Program (U.K.)

Avanti is an approach to collaborative working that focuses on people, process, and mobilizing existing enabling technologies. The goal is to help construction project partners to work together more effectively. Avanti's principles for working collaboratively include early access to all project information by all partners; early involvement of the supply chain; and sharing of information, drawings, and schedules in an agreed and consistent manner. Team communication and access to a common information model are at the heart of the Avanti approach to managing the project life cycle. As with other integrated practice initiatives, Avanti has been designed to reduce risk, minimize waste, and improve business performance by increasing the quality of information and the predictability of outcomes. Importantly, the learning being captured from Avanti managed projects is being well documented (e.g., the "Design Management Principles" document) and is being shared with the entire industry.²¹

²¹ Avanti:
Design Management Principles
<http://www.avanti-construction.org/products.html>

4. "buildingSMART" (International)

The "buildingSMART" initiative, originated by the International Alliance for Interoperability (IAI), promotes the dynamic and seamless exchange of accurate, useful information on the built environment among all members of the building community throughout the lifecycle of facilities through the use of open data standards.²² What is unique about this initiative is that it tries to "unify" efforts to improve interoperability in the construction industry in several dimensions. First, buildingSMART has been adopted by all eleven IAI Chapters representing industry leading companies in 24 different countries. Second, buildingSMART endorses a range of existing open data solutions which improve interoperability (such as CIS/2 and gbXML) as well as promotes the use of the Industry Foundation Classes (IFCs) in conjunction with the NBIMS project.^{23,24,25} Third, buildingSMART is being co-sponsored by related industry bodies and associations (some examples include NIBS and the AIA in the U.S.A., CRC Construction Innovation in Australia, Construct IT in the U.K., and more). Speaker presentations from both the 2005 and 2006 International buildingSMART Conferences, held in Oslo and Munich respectively, are available online and provide a rich source of material on integrated practice initiatives and players globally.²⁶

²² International Alliance for interoperability:
<http://www.iai-international.org/>

²³ CIMsteel
Integration Standard:
<http://www.cis2.org/>

²⁵ Industry Foundation Classes (IFC):
"The IFC Building Model: A Look Under the Hood";
Khemilani, L., Editor of AECbytes
<http://www.aecbytes.com/feature/IFCmodel.htm>

²⁴ Green Building XML:
(gbXML)
<http://www.gbxml.org/>

²⁶ International buildingSMART Conferences:
Speaker Presentations are available at -
└ First International buildingSMART Conference,
Oslo, Norway May 31st - June 1st, 2005
http://www.iai.no/2005_buildingSMART_oslo/buildingSMART_Oslo.htm

└ Second International buildingSMART
Conference, Munich, Germany April 5, 2006
<http://www.buildingsmart.de>



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