Development of a Research Framework for Building Information Modeling

(Draft prepared by Virginia Tech, I²SL, IFMA and bSa/NIBS*)

Goal:

To develop a research framework that supports a strategic plan for the full implementation of open standards based Building Information Modeling (BIM) for the design, construction, operation and management, and deconstruction of laboratories and related high technology facilities, including healthcare, cleanrooms, data centers, etc.. The proposed framework shall serve as a "roadmap" for the purpose of identifying and prioritizing research needs that are both reactive and proactive with both short and long-term objectives. The roadmap will be reactive through identification of current issues, barriers and constraints to BIM reaching its full potential, and proactive by seeking to identify applications and strategies for enhancing the current BIM platforms toward a desirable future state of functionality and implementation. The roadmap shall provide the guidance for competency and consistency in applying BIM in new and retrofit projects nationally and establish the appropriate level of information necessary to ensure the operational integrity and sustainability performance of the facility throughout its expected life-cycle. Finally, the framework shall identify mechanisms to support and fund the research activities that emerge from this effort.

Overview:

Building Information Modeling (BIM) is transforming how buildings are designed and constructed, and currently to a much lesser extent how they are operated. While a growing number of architecture and construction management firms are implementing BIM with varying degrees of success, few believe that BIM has reached full implementation nor full development. To reach full potential there is a need for a comprehensive and organized approach for research and development of BIM. Unfortunately, the current research activities for BIM are unorganized between BIM vendors, design and construction firms, and academic institutions. As a result activities are likely duplicated, disconnected and potentially misdirected. To overcome these obstacles to full implementation of BIM the buildingSMART alliance, International Facility Management Association and International Institute for Sustainable Laboratories have organized an effort to develop a research framework for Building Information Modeling. The plan outlined below will be an outcome of this effort.

Approach:

The proposed approach for the development of a research framework for BIM would be both reactive and proactive with short and long term vision, and include at least the following:

1) **Identify a Champion.** The Champion would be a collaborative of organizations sharing in the following characteristics:
   a. Significant connectivity and/or representation with the industry groups that will both inform and benefit from the effort
   b. Positioned to advance and engage the industries involved.
   c. Experience with research related to building design and construction
   d. Understanding of BIM as both a tool and as a process
   e. Working relationships with public and private sector organizations
   f. A commitment to the proposed effort

   The International Facility Management Association (IFMA) will be the champion for this effort.

2) **Establish an advisory stakeholders group**. This group will be tasked with development of the research framework, implementation strategy and approaches to funding. The advisory group should include but not necessarily be limited to:
   a. Innovative BIM users from design, construction, and facility management
   b. Interested BIM vendors
   c. Academic institutions working with BIM
   d. Public and private sector organizations

3) **Establish Task Committees.** Led by representatives from the advisory group, task committees will be established to address particular issues with the research framework and to provide input to the advisory committee. It is anticipated that these task committees would include five to ten representatives from the same sectors as from the advisory committee. It is anticipated that the Task Committees with include but not be limited to:
   a. BIM as a tool – issues of file exchange, interoperability, etc. would be of concern to this committee. Barriers and constraints to full implementation would be identified and prioritized.
   b. BIM as a process – issues of information flow and organizational structure would be of concern to this committee. Barriers and constraints to implementation would be identified and prioritized.
   c. Educational needs: What should be taught and how should it be taught and how should it be taught? Addressing issues of differences in professional needs A-E-C as well as differences in professional and academic agendas.
   d. Might also consider task committees related to professional domains and needs assessment. For example the needs of architectural design and documentation, construction management, and facility management are likely to be related but different. These differences should be captured.

e. BIM as a vision – longterm opportunities and development of BIM. Might include identifying strategies such as evolution of BIM from Information management to knowledge management and explicit decision-support.

Operational Approach:

As an operational approach to initiate this effort it is suggested to hold a one-day meeting of the Advisory Group. This working session would be intended to establish the specific objectives and expected outcomes of the proposed effort. In addition, this working session should include discussion of strategies to support the effort. This should include both in-kind contributions as well as how to financially support the implementation of the framework. This might include identifying potential public sector sources, private sector sources such as philanthropic foundations as well as a strategy for pooling resources.

This advisory group working session would also include establishing operating procedures as well to identify potential leaders of the Task committees as well as suggested membership on these committees. Task committees will operate to address two interrelated agendas, 1) to identify and understand current needs within the BIM stakeholders community, and 2) assess the opportunities for future enhancement and expansion of the functionality and implementation of BIM.

The task committees may be structured and organized around the following:

1. Education / Research / Certification

Current: There is currently no coordination throughout the education and research community regarding BIM.

Vision: While organization will be free to conduct research and develop curricula, there should be an authority to encourage research and educational guidance that addresses a basic level of facility management information necessary for laboratories and related high technology facilities., This would likely be incorporated into certification efforts already existing.

Tasks:

1) As a starting-point, capture and assess the academic and corporate research underway and ascertain the direction and relevance of it with respect to supporting laboratory and related high technology facility management.

2) Identify where gaps exist in the research efforts and prepare a roadmap of research needs to fill the gaps. Together, publish these needs and coordinate awareness to encourage public and private partnerships to fund the needed research.

3) Educational review

>   a. Obtain and review academic, corporate and association curricula being taught,

>   b. Assess the relevance to facility management,

>   c. Develop the components that promote the incorporation of FM into the curriculum, and

>   d. Create specific modules that support FM for laboratories and related high technology facilities.

4) Develop common curricula by convening a panel from recognized leading universities both nationally and internationally.

5) Develop an overarching certification program for industry wide consideration and then develop the sub sections that would apply to each of the "to be determined" sectors of the industry, inclusive of Design, Procure, Assemble, and Operate.

2. Information Clearinghouse / Bridging the silos

Current: There is no central place to go for information about building information modeling encompassing all the stakeholders.

Vision: There will be a hierarchal approach where the National Institute of Building Sciences' (NIBS) Whole Building Design Guide will be the central clearinghouse where the key interoperability documents are stored with pointers to the supporting organizations. The supporting organizations community sites will contain additional and more detailed information and point to the central site for interoperability related documents.

Tasks:

1) Convene a group to develop the most appropriate means for dissemination of information to respective audiences of each organization as well as the industry at large.

3. Best practices / Metrics / Awards

Current: There is no central location to find case studies or best practices. There are no metrics in place to compare projects. There is one known awards program administered by the American Institute of Architects.

Vision: Using the process to be developed under #2, provide a forum to disseminate best practice projects/case studies. This would help the industry see where the bar has been set for building information modeling with respect to laboratories and high technology facilities rather than the larger community which would be relevant to NIBS. The projects would each report on

specific metrics so the user could understand the maturity of the project. This may be based on the Capability Maturity Model presented in the National BIM Standard - United States. An awards project will be developed using this criteria for formerly recognizing projects that are best in class. I2SL does have an awards program that could utilize the NIBS criteria.

Tasks:

1) Develop metrics by which laboratory and related high technology facility projects will be measured and compared

2) Utilize the I2SL awards program to recognize these projects

4. Business Process Re-engineering / Change Management / Best Business Practices

Current: In order for building information to function effectively, business processes will need to change. Currently, the business processes in place for many organizations were developed in former times prior to a desire to collaborate. Change management is not often implemented and best business practices are not well known.

Vision: Use cases will be identified by the laboratory and high technology sector of the industry focused on the optimizing the flow of information and collaboration. The business practices once developed will be controlled by change management practices so if a business process does not perform as anticipated a root cause analysis will be conducted and a modification suggested and implemented. Best business practices will be disseminated. This will not preclude an organization adopting their own practices; however, the inputs and outputs to that practice must mesh with the surrounding business practices so that collaboration can occur.

Tasks:

1. Convene a group of committees to identify the use cases focusing first on those related to the laboratory and high technology industry sector, but considering ultimately the broader impact on facilities management in general.

2. Develop information delivery manuals (IDM) that can be used in model view definitions (MVD)

3. Develop model view definitions in conjunction with users, and software vendors

4. Implement best business practices throughout the industry sector

5. Disseminating Consensus Standards

Current: While there are standards used in each market segment there are none that are designated as standards for building information modeling. There are no specific standards for building information modeling.

Vision: Laboratory and high technology standards will be developed collaboratively and existing standards where they exist will be evaluated for use in building information and then so referenced in the National BIM Standard – United States.

Tasks:

1. Create one or many laboratory and related high technology facility projects to accomplish the above efforts

2. Identify items that need to be balloted within those projects

3. Submit ballots for comment and consensus voting

6. Tool Development

Current: Vendors lead the facility management industry based on users groups oriented toward a specific product.

Vision: The facility management industry defines its needs and software, hardware and other technology. Vendors develop tools to support those needs.

Tasks:

1) Convene a working group to oversee and coordinate the work being accomplished under other tasks of this research agenda as well as coordinating with information being developed earlier in the facilities life cycle, which might be available to the facility management sector

2) The working group would coordinate with the vendors developing tools to support the facilities management phase of the facilities life cycle, and mapping existing structures into the BIM environment

7. Data Lifecycle issues

Current: Currently data is stored in many ways and access to data is in question due to proprietary software and versioning format issues, and basic media format and longevity issues

Vision: Both graphic and data is available throughout the life of the building and beyond in a format that is usable to the facility manager, the designer and constructor over a 50 to 100 year building life.

Tasks:

1) A committee develops a manual for use by facility managers describing the approach to archiving and access to information for the life of a facility. (Note: having three pieces, first use an ISO standard way to capture graphics such as PDF/E incorporating 3D PDF (not yet an ISO standard), using IFC's (ISO 16739) as it emerges and storing information in a data center as they will maintain the physical media.)

8. Data Maintenance

Current: Data maintenance is looked at as a separate task and is often not done in a timely manner or not done at all. It is typically updating 2D floor plans and does not have enough information to be a source of record for follow-on work.

Vision: The model is used as the authoritative source of information prior to work being accomplished to include preparing for the work prior to visiting the site thus eliminating one trip to the site. Work orders are not closed until the work accomplished including new data is updated in the model and the CMMS and CAFM tools.

Tasks

1) Develop the business processes required to accomplish this approach

2) A verification/quality control process that will insure the quality of the information for design use shall be developed

3) Develop a training program, which will help organizations move from their current approach to this new way of doing business.

9. Model Holder of Record

Current: There are neither defined tasks nor best practices established to identify the functions or responsibilities of the model holder of record.

Vision: There are clear-cut roles and responsibilities defined for the model holder of record.

Tasks:

1) Starting the discussion of what should be the "model holder of record" function and responsibilities when we begin to look at creating a program focus for the maintenance of project documents.

2) Convene a group of laboratory and related high technology facility managers, and related technology partners and building designers, to document best practice guidelines

It is anticipated that some of the activities of the Advisor Group and Task Committees will extend beyond the currently recognized boundaries of BIM. This might include establishing and executing social networks for exchanges of ideas, questionnaires and surveys of stakeholders as well as collection and organization of information and data related to BIM. Also assessment of needs within and between stakeholder groups that may serve as indicators for future BIM development. For this academic institutions such as the College of Architecture and Urban Studies at Virginia Tech that have experience with these types of activities could serve as resources to the committees. How best to support these activities should be a point of discussion for the initial Advisory Group meeting.

The initial meeting of the Advisory Group should also seek to establish a timeframe and benchmarks for meeting the goals and objectives of the framework development.

Ideal would be to have available a small source of funding to support attendance to the Advisory Group meeting as well as incentive for active invloment.

*Authors:

Dr. Jim Jones, Virginia Tech University, School of Architecture and Urban Studies
Phil Wirdzek, Founding President and Executive Director, International Institute for Sustainable Laboratories (I^{2}SL)
Robert Blakey, President IFMA R&D Council, Principle, Strategic Equity Associates, LLC
Dana "Deke" Smith, Executive Director, buildingSMART alliance (bSa), National Institute of Building Sciences (NIBS)