Does the Building Industry Really Need to Start Over?

A Response from Bentley
to Autodesk's BIM/Revit Proposal
for the Future

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1. Overview

This is an exciting yet defining time for software in the Building industry. After many years of using computers mainly for creating drawings, professionals and companies are beginning to see real benefits of modeling both graphical and non-graphical aspects of the Building life cycle.

This advance is variously called building information modeling/BIM, Single Building Model/SBM and Virtual Building Model/VBM. To save the industry the confusion of another TLA (three-letter acronym) for this vision, we'll agree to the term "BIM" that has now been accepted by several industry analysts.

With a goal of improving user productivity and with considerable user success, we at Bentley have already spent much time and effort over the past five years encouraging this direction and enabling this advance.

Bentley users as well as industry editors and analysts, especially in light of Autodesk's recent announcements, have asked for our perspective on BIM. This paper reports our progress, user successes and continuing vision for the Building industry.

To summarize with three points:

1. We have no argument with the goal of moving beyond drawings—quite the opposite; we agree 100%. We have long pioneered technologies in this area that are today making building projects and operations better, cheaper and faster for users. Our MicroStation TriForma product has become a mainstay in many major projects around the world.

2. We believe that "starting over" with a new, incompatible platform (as Autodesk suggests with Revit) in order to achieve these goals is dangerous, wrong and wholly unnecessary. This path has never been an option for our users — there is simply too much investment and value in today's tools, data and workflows to throw it all away. Users with large investments and lots to lose from technology discontinuities demand and deserve a predictable and evolutionary path. Bentley has been and remains committed to providing an evolutionary path to our users.

3. The technical aspect most critical to the success of BIM implementations remains the overall data architecture or structuring. There are fundamentally two approaches to data structuring: first, a distributed or "federated" database; and, second, a centralized database. After years of experience and testing with both, we are championing and expanding a federated database approach, which meets BIM needs and is inherently highly scalable.

We found the scalability risks for applying a centralized database to the Building life cycle unacceptably high. While a centralized database can be tempting for smaller, simpler Building projects, its fundamental conflict with the widely distributed and complex nature of typical Building projects eliminates it as a viable approach.

In examining these three points, we hope to show that Bentley's vision, implementation strategy and products remain the most compelling in the Building industry.

2. A Common, Compelling Vision of BIM

For well over ten years, leading software providers and users in the Building industry have been increasing the productivity gains of CAD tools by moving toward BIM. It is useful to specify the fundamental user needs that must be met in this move.

We view user needs for BIM as a hierarchy of needs[*], starting with the most basic:

1. Enter/access/analyze information: users in all disciplines across the life cycle must be able to effectively enter/refine their ideas and get decision-making information using appropriate productivity tools, using an appropriate interface.
2. Share information: Users must be able to share their information with the extended project or operations team. This sharing extends to data from other systems and previous projects.
3. Synchronize shared information: Users must be confident that the data they share and receive is appropriately updated and reviewed by all team members, and that a historical record of who did what and when is maintained.
4. The best context for work: Users must be presented with information in the context that is most productive for their task or decision at hand—for example, HVAC designers should be able to do their work using HVAC-specific tools while viewing a structural representation of the building.
5. A secure environment for full collaboration: All users must be confident that their ideas and intellectual property (IP) remains well-maintained and secure, and that neither is compromised in the process of digital collaboration.

[*] We are borrowing the construct from psychologist Abraham Maslow whose "Hierarchy of Needs" was introduced in the late 1960's. Maslow's hierarchy for individuals was Body Needs, Safety Needs, Social Needs, Ego Needs and Self Actualization.

The benefits of BIM are compelling. Architectural and engineering firms, design/build firms, contractors and building owners/operators embracing BIM are finding that:

* A higher level of abstraction (information over rudimentary graphics) leads to higher productivity and better designs
* Automated creation and coordination of documentation result in fewer errors/omissions
* Designing-in-context across disciplines and automatically enforced standards lead to more correct-by-design
* Never-before-possible analysis leads to fewer design iterations
* Design history reports result in fewer disputes and litigation
* Having the right info at the right time leads to better informed decisions and less time wasted on waiting/back-tracking for everyone
* Increased IP security encourages a free exchange of information
* Operations models and interactive facility maps, naturally derived from the building model, lead to more efficient operations.

With the vision stated, let's examine the transition path from CAD to BIM for users.

3. Starting Over Is Not an Option

Bentley users typically use our software for mission-critical applications in Building projects and operations. Their present and future success relies on steady and improving performance of our products. Drastic or high-risk changes that could disrupt highly complex and collaborative projects or operations are not acceptable to their business.

So we have long taken the view that the revolutionary path of "starting over" with a new, incompatible platform to realize BIM is not an option. There is simply too much user investment in functioning tools, data, customizations, applications, training and business methods to throw it all away. It's next to impossible for large project communities to abandon these investments and successful practices en masse. BIM must be a superset of CAD.

In support of an evolutionary path to BIM for users, our platform development strategy has long been to:

- Stay focused on a single, comprehensive platform
- Extend and improve it continuously and compatibly
- Augment it as appropriate with server-based collaboration products.

With this strategy, there is no reason for users to start over. Our focus and anticipation of BIM needs has already brought all the required enabling technologies for BIM into MicroStation* and its collaboration servers.

* The twenty enabling BIM technologies are listed in the Appendix.

And It Does Take a Platform

One could argue that starting a new platform would detract us all from our BIM goals. CAD required a platform of robust underlying technical subsystems including APIs, a data structure, customizations, applications and much more. BIM takes a platform too—in fact, a more extensive one. It would consume years of user calendar time before we or anyone else could reproduce those same capabilities with the scalability and quality of the MicroStation platform.

At Bentley, we've engineered our single platform to handle evolving project data. MicroStation's hybrid data model concurrently and natively reads/writes multiple file formats – including DGN and DWG – and model types. By allowing projects to support a mix of old and new methodologies, this core feature provides the critical feature of a "data ramp" from drawings to BIM. MicroStation projects can be an interoperable mix of new and old.

Starting over for BIM is a non-starter at Bentley . Our users demand an evolutionary path that allows them to introduce and grow new technology in a non-disruptive manner—on the right projects with the right people and the right timing. They will not tolerate any risk of platform cancellation or phase-out—they simply have too much investment and increasing returns in MicroStation, its environment and its applications.

4. The Right Implementation for BIM: Ensuring Scalability

As BIM places immense demands on data management, the technical aspect that is most critical to the success of BIM implementation is the data structuring. In order for any BIM system to perform and scale, it must comfortably handle a large, shared, mixed volume of data, support a life cycle that transitions from creation-intensive to review-intensive, and serve hundreds of varied, far-flung participants.

The challenge—among the toughest in all of data processing and in many ways much more complex than that faced by banks and airlines—is not to be treated lightly. The two options are a federated database implementation and a central database implementation.

The Federated Database BIM Implementation

The first option for BIM data structuring—and our choice—is a federated database structure. A federated database, by definition, is one logical database but distributed in parts to many places and synchronized. It is characterized by a system that allows users/teams to continue to transact locally using methods, tools, data and formats they find most productive and also provides central controls to manage global connectivity and broader transactions.

The strengths of a federated BIM implementation are that it allows for gradual gains, it offers the tightly/loosely coupled transaction mix (the frequency of updates from local to global databases can be fine-tuned) so vital to Building projects, and its local/global load balance makes it highly scalable.

The challenge of a federated implementation is the compatibility that must be maintained between the local (desktop) and global (server) levels.

We believe that our single platform and support of DGN/DWG allows us to meet this challenge. Because MicroStation supports both standard formats and remains our development platform on which all applications and collaborative servers are based, we are able to achieve the consistent and compatible advances so critical to a successful federated BIM implementation.

Some examples of the compatible local and global technological advances that we have made are:

* Enter/access/analyze information: feature-based solids modeling, interactive visualization and analysis
* Share information: document management, project-wide component querying
* Synchronization: design history, coordinated documentation
* Work in context: context-sensitive representation, multidisciplinary model
* Security: IP management including digital rights/IDs

Not only are we confident that the federated implementation is the superior choice for today, we also believe that it the best choice for the future. This approach maintains critical degrees of freedom for us and users towards a future that's increasingly difficult to predict.

The Central Database BIM Implementation

The second option[*] (taken by Revit) is a central database implementation. Basically, users enter all design information and relationships—graphics and beyond—in a special-purpose, central database. The database manages all the information and extracts information for various representations of the design, such as the 2D plans from the 3D model.

There is much to be said for this centralized approach. In fact, over the past ten years, we at Bentley have spent many developer-years researching and prototyping such a system.

[*] The founders of Revit came from PTC, where this approach worked well for mechanical engineering.

The attraction of a central database implementation is that its tightly coupled transactions (all changes to the database are immediately synchronized with the central copy) make it easier for the application to coordinate changes.

However, we found that this same tightly coupled nature soon emerges as a severe limitation. The building life cycle is a demanding beast and requires a careful mix of tightly coupled and loosely coupled data structures. For example, during design, architects often want to detail parts of their work while keeping other aspects "fuzzy." Also, once the detailed design is complete, the engineering teams will then need more time before they can confidently detail their work. Forcing all details too early is frustrating and counter-productive.

As the project progresses, the gap between the tightly coupled, centralized approach and the widely distributed realities of the building life cycle becomes wider. Soon, the central database becomes too unwieldy to be shared as a whole. Then the issue transforms into the large problem of widely distributing a large, tightly woven, fast-changing, heterogeneous central database. Proper resolution would require that the centralized database be subdivided and distributed in ways that no central database ever has been.

To make matters worse, the most compelling feature of this approach—a central change or synchronization engine—would have to survive and scale in a distributed environment hostile to such centralization. New research and techniques would be needed to handle the unimaginable performance loads on this engine—loads that increase exponentially with project activity and size. Also, new thinking and work would have to be done to resolve the thousands of shared parameters unknowingly changed or deleted during checkouts among hundreds of projects members.

Of course, there are various plans of attack for these large problems. However, each problem implies a major software project with significant risks and each requiring restructuring the software core and consuming man-years of work. And, in each case, success is not guaranteed—any of the problems could prove insurmountable.[*] And, with several problems to solve and implement at once, the total risk stacks too high.

In the end, after several prototypes, user testing and a thorough assessment of these challenges, we rejected this approach. We concluded that a central database implementation, while tempting on small and partial projects, would collapse under its own weight when applied to the vast majority of Building projects.

[*] PTC's Reflex was a well-funded but failed effort to create a single-database solution for Building.

5. A Predictable, Clear Future with Bentley as Your Provider

As we stated earlier, the BIM philosophies in this paper are born out of the users and the organizations that we serve. Their unanimous advice to us on the move to BIM, has been: *don't fix what isn't broken, help us reuse our existing data and methods, innovate within our working system rather than abandon it*, *don't make us start from scratch, and keep us competitive.*

Users find that our commitment to their philosophies goes even deeper than BIM and its implementation. Overall, we are committed to their long-term success—a commitment that is manifested in our way of doing business.

Most notably, our long-standing Bentley SELECT program offers not only a portfolio of world-class software solutions, but also a relationship that includes direct training, deployment and support. It also offers flexible procurement options that include software subscriptions and enterprise licensing that holds us responsible for regular advances and provides users with compelling economics for sensibly evolving their use of enabling technology.

We take our role as a long-term provider of mission-critical technology to ENR 500[*] accounts and other Building organizations worldwide very seriously. And we are proud to report that Bentley remains a stable, predictably performing[†] and growing vendor—the largest dedicated to AEC worldwide.

[*] ENR's Top 500 Design Firms list ranks the largest U.S.-based architectural and engineering firms in eight major industry sectors: general building, transportation, manufacturing, industrial process, petroleum, power, environmental and telecommunications.

[†] Since 1998, Bentley revenues have grown 40% while Autodesk revenues have declined.

Appendix: 20 Enabling BIM Technologies

Security of Information Need
20. IP Management
19. Scalable, Open System
18. Enterprise System Integration

Context of Information Need
17. Project Standards Management
16. Multidisciplinary Model
15. Context-sensitive Representation

Synchronization Information Need
14. Change Management
13. Coordinated Documentation
12. Construction/Schedule Simulation

Share Information Need
11. Rapid Prototyping
10. Anywhere Publishing
9. Project Querying
8. Document Management
7. Distributed Data Architecture
6. Native DWG/DGN

Enter/Access/Analyze Information Need
5. Facility/Asset Mapping
4. Interactive Visualization/Analysis
3. Feature-based Solids Modeling
2. Parametric Design
1. Discipline-specific Applications