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Going digital to advance infrastructure delivery: The *open information* project

Owners and contractors can share “integrated project delivery” benefits on any project—including digital workflows and increased visibility—through a connected data environment.



Greg Bentley

CEO, Bentley Systems

To improve upon the unfortunate backdrop of infrastructure capital projects typically being delivered late and over budget, infrastructure owners can reasonably expect the efficiencies and rigors of “going digital” to both make project performance more predictable at the outset and provide greater visibility during their course. To date, though, the benefits of building information modeling (BIM) have tended to be limited in scope to the work within individual disciplines or phases. New advances in computing and software now make project-scale improvements possible—from conception through construction and commissioning. Realizing this potential, however, depends not just upon this new level of information technology integration but also, as importantly, upon a change in mind-set across the project. Not only the owner but also each participant can benefit to the extent that their own digital work is appropriately accessible to and securely shared with the others, to purposefully enable automated workflows and digital visibility spanning the overall project.

Consider a project delivery firm whose business model heretofore has been within separate design, bid, or build phases—but which becomes party to a contract for integrated project delivery (IPD), assuming or sharing responsibility throughout all phases. Suddenly this firm’s imperative would be to take full advantage of potential “digital workflows” in which their software tools would start from the searchable (not paper) results of software tools used in previous project phases, and then in turn provide outputs to be applied by software tools in subsequent phases, all to maximize synergies and minimize errors. The risk and reward outcome of the IPD contract would depend upon the extent and quality of this information integration and its robust automation.

Now, imagine the upside if the same project-level digital workflow strategies were to be availed across all participants on any project, regardless of the contracting model. In this scenario, a connected data environment (CDE), provisioned by or for the owner as a cloud service, captures and intelligently shares all digital work packages, enabling participants to automate their collaboration protocols as if they were one project enterprise. In addition to benefiting from unprecedented visibility into project performance, the owner’s supply-chain choices need not be limited to the few (if any) organizations capable of shouldering IPD risks. The result is that the IPD advantages are achieved and even exceeded (synthetically, rather than contractually). This scenario—an *open information* project—is now possible.

The open information project premise

Despite increasing momentum within infrastructure project delivery to embrace digital technology, to date most benefits have been constrained to individual BIM deliverables, rather than to their integration for improved overall project performance. Each discipline and trade creates its own idiosyncratic 3-D digital models, usually in a format that at best would be inscrutable to other participants—and thus highly vulnerable to mutual inconsistencies. Project coordination must then rely upon, and be limited to, periodic design reviews entailing the time-consuming and manually orchestrated export, import, and translation of incompatible native files, jeopardizing intellectual property (IP) in their exchange. Furthermore, the after-the-fact corrections necessary to resolve interferences between disciplines or trades may already have been outdated by constant project changes, unless progress is stopped for the duration of each design review.

Significantly, however, advances in cloud computing and software platforms now enable an *open information* project's CDE to facilitate continuous digital workflows across the project's supply chain and throughout its lifecycle phases. Consultants and contractors can apply their preferred digital tool sets, while the CDE collates the contents of these disparate but known file formats into self-describing "digital components" for semantic alignment across disciplines and trades. Accordingly, 3-D visualization of the project data can be supplemented with visibility into its meaning, including for instance the "4-D" and "5-D" attributes supporting digital workflows for off-site fabrication.

Key enabling factors of an *open information* project, of course, are its security provisions. On the one hand, the CDE leverages industrial-strength cloud services that can be more robust and secure than an end-user organization's comparatively vulnerable internal environment. On the other hand, while it is vital that each participant undertakes to deliver and to conscientiously update their digital work packages to be accessed as usefully needed across the project, secure workflow protocols assure that the participant's transitory work in progress is only "locally" accessible.

A representative *open information* project charter

Achieving the potential of going digital at project scale requires both CDE technology and the commitment by the project supply chain to endorse digital workflows. Owners must convince and catalyze all participants to empower, enrich, and take full advantage of their *open information* project.

Based on experience, I believe that virtually every infrastructure project delivery participant, given the opportunity, would be willing and able to contribute toward—and gain from—the digital workflows enabled within an *open information* project. Nonetheless, to overcome pre-digital mind-sets, explicit owner leadership is essential in engendering the requisite behavior changes. To set expectations and avert misconceptions among contractors, the following collaboration precepts, as an example, should be accepted by all, as qualifying conditions for working on the project:

- All design and construction engineering work, and work packages at every contractual level, are to be maintained in the project CDE. Work in progress need not be sharable, but activity journals (including what shared information has been queried or updated) are to be generally accessible.
- Each participant is to regularly update a progressively more complete version of their own scope that is to be accessible to (but cannot be changed by) other participants, for queries and continuous integrated reviews of design and construction status.
- Digital models are to be intrinsically geo-coordinated for 3-D positioning within the project's "digital context"—that is, the digital visualization of the work site in the CDE.
- Each participant is to proactively subscribe to the automated notifications of changes by other participants, where and at such levels of detail as can appropriately inform their own work.

- So long as each participating organization complies with requirements applicable to their project phase (for example, BIM execution plan), each can independently choose between professionally accepted software tools.
- Digital access does not confer to any participant, nor the project owner, the right to any IP nor the reuse, beyond the project, of any work product of any other participant.
- No CDE access is granted or enabled beyond authorized project participants who have accepted this *open information* project charter.

How project delivery supply chain participants benefit

The mere availability of project-wide information is made much more valuable by the CDE's capability to present it in the means most fit for the purposes of project delivery participants, supplementing immersive visibility with digital alignment and change synchronization.

Indeed, the work of all infrastructure project participants shares a dependency upon the evolving conditions at the physical work site. By way of the CDE, this digital context can be most usefully represented as an engineering-ready, 3-D "reality mesh" processed from photographs, scanned imagery, or both, and then updated continuously through regular drone surveys. This real-time digital context enables immersive visualization, including through ever-advancing virtual reality and augmented reality devices, to intuitively locate and query any information within the CDE by spatial reference. In so doing, the digital context positionally aligns the respective models of each discipline and trade. Accordingly, throughout the project each participant's work planning and packaging can fully consider the status, sequence, and safety factors of other participants' work.

The advantages of such proactive information sharing would be ephemeral without also making it practical to react in a timely manner to inevitable, unanticipated changes as the project progresses. For this purpose, the CDE journalizes changes in work packages and can provide automated notifications to appropriately subscribing participants, for their visual review and (to the extent they deem the indicated changes to be significant for their own work) potential synchronization.

In effect, for an *open information* project, design and construction status reviews thus become continuous and comprehensive. Each discipline and trade can increase their ability to avoid errors and interferences, and gain visibility to improve schedule and safety, with benefits compounded for the performance of the project as a whole.

How project owners benefit

Among an *open information* project's myriad benefits to owners, it naturally pre-provisions the completions and commissioning phases, accelerating investment returns from asset performance. Moreover, the digital context and digital component data, cumulatively populating the CDE from design through construction, can then help serve as the asset's "digital DNA" for operations and maintenance. And of course, project owners are the

ultimate beneficiaries of the capacity for continuous and comprehensive design reviews during project delivery—improving the owner’s project performance visibility (beyond what is afforded in an actual IPD project) into emerging problems in time for intervention to avert schedule or cost overruns.

By comparison, owners’ primary project insight to date has been limited to external experts’ post-mortem benchmarking, based on belated survey questions. And while it is challenging for owners to sustain in-house engineering experience, their organizations’ capability to apply business analytics to improve enterprise performance is growing apace. Unfortunately, despite the magnitude of infrastructure capital projects risk, the associated engineering information has heretofore been inaccessible—as “dark data”, beyond analytics’ comprehension and in any event not reliably up to date.

In an *open information* project, the illuminating digital alignment and change synchronization functions within the CDE will now empower owners to fruitfully deploy analytics for visibility into project performance. Importantly, analytics will not purport to qualify the owner to second-guess the contractors’ substantive engineering decisions. But it will be possible for owners’ analytics, through automated monitoring of the CDE, to assay and dashboard the quality and consistency of project information. For example, analytics could continuously compare scheduled work package requirements against the on-the-ground reality of craft resource availability.

Increasingly, project owners will then also benefit from applying analytics’ machine learning across a portfolio of *open information* projects, for instance to establish correlations between completed projects’ realized performance and their respective information “footprints.” The voluminous CDE activity journals of current projects would be surveilled for patterns (perceptible only with such analytics) to indicate the extent to which a project is on or off track, based on actual experience.



In an *open information* project, the BIM advancements that individual infrastructure project delivery participants have adopted to improve their own scope are extended, through a CDE, to digital workflows across the project supply chain to advance overall project performance. The supporting technologies are now available, requiring only the initiative of project owners to lead their supply chain to the benefits, for each and to all, of embracing an *open information* project charter. Accordingly, going digital—provided also in mind-set—can finally make infrastructure projects more bankable! 

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