

Owners **Perspective**

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Beyond Construction

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BIM as a Methodology for
Facility Maintenance and Operations**

**Material Developments:
New Technologies and Their Implications
for Building Construction**



Beyond Construction

The University of Texas Utilizes BIM as a Methodology for Facility Maintenance and Operations

By Renee Crittenden-Garcia



In February of this year, The University of Texas (UT) at Austin celebrated the groundbreaking on what was to be a \$100 million, 200,000-square-foot new College of Liberal Arts (COLA) Phase II building situated on the campus's East Mall. The result of years of planning, the building will be the largest of the college's 15 buildings. Moreover, the Liberal Arts Phase II building will cost more than \$10 million less than originally budgeted and will be 7,000 square feet larger. It will also be among the campus's first major capital projects to utilize building information modeling (BIM) to synergize construction asset management with campus building operations and maintenance.

"Projects like these at an institution like UT Austin have a long life," says COLA Assistant Dean Joe TenBarge, who handles the college's opera-

tional support for IT and facilities, including approximately 25 buildings with about 200 classrooms, 4,000 computers, and 50 staff.

TenBarge says planning started about a decade ago when college leadership realized they were running out of space. TenBarge says to get a project built in the UT System, it's got to make its way to the capital improvement projects (CIP) list. First, the college takes the building proposal to the UT Austin Vice President and then to the Campus Facilities and Space Council, which includes the President, the Provost, the CFO, and others. The President then makes the presentation to the UT System Board of Regents. If the regents approve, then the UT System, with the college's assistance, makes a presentation to the Texas Higher Education Coordinating Board. Once a project has the coordinating board's approval, the

project is on the CIP list and assigned a budget. If it's slated for the construction manager-at-risk delivery method, like the Liberal Arts Phase II project, then money is allocated for an architect and construction manager.

For every construction project over \$4 million that is built on a UT System campus, the Office of Facilities Planning & Construction (OFPC), the system-wide group that oversees all capital projects, is the Owner and project manager.

In 2009, after the Student Activity Center (SAC)—the first phase of the planned Liberal Arts complex—secured the parking lot TenBarge was eyeing for the Liberal Arts Phase II building, the State of Texas faced a massive \$27 billion budget crunch. TenBarge recalled, "It looked like the Liberal Arts building would be pulled off. But, on a state university campus in

tight economic times, you have to get creative and piece deals together.”

After strategic study and deliberation, the Liberal Arts Phase II building secured funding and a spot that was home to an aging ROTC building adjacent to the SAC. What’s more, the COLA administration re-worked their internal budget and now plans to use a combination of saved balances, one-time college balances and state bonds, repaid by COLA recurring funds, to pay between \$50 million and \$57 million toward building construction. Additionally, the construction budget includes \$17 million from central campus and approximately \$20 million in gifts, including a \$15 million donation from a graduate of the UT Austin ROTC program, ConocoPhillips CEO James Mulva, and his wife Miriam.

So, unlike most colleges with a building project on the UT Austin campus, COLA is both a pseudo-Owner and a tenant. “We are very fortunate that OFPC has given us a seat at the table at more meetings and

more say over details—especially those that cost extra money—because we are funding a large portion of construction,” explains TenBarge.

Recognizing that higher education is under financial pressure, TenBarge says the biggest effect of paying for the building by reallocating college funds through a budget reduction is that he and his team are truly engaged in the budget “because every dime we don’t spend on the building, we can use for some other critical need.”

With TenBarge focused on the budget, he says it also centers attention on efficiency of the design and construction process. “Anything we can do to save money is good,” he says. Working with Overland Partners as architect and SpawGlass as construction manager-at-risk, TenBarge says the team is doing everything more efficiently.

In fact, in the early stages of the project, TenBarge says that due to efficiencies found in design, he was able to send a request to the UT System to reduce the budget to \$95.7 million.

Those same efficiencies are yielding a building that will now be 207,000 square feet with 65 percent space efficiency, versus the original 60 percent efficiency. The Liberal Arts Phase II building will include about 35 classrooms, multiple conference centers, and a student center, as well as sociology, geography, linguistics, liberal arts honors, plan II honors (campus-wide program), the population research center, and the Army, Navy, and Air Force ROTC units. Additionally, the structure will feature a sky bridge linking the Liberal Arts Phase II building to the recently completed 40,000-square-foot Liberal Arts Department of Anthropology on the top two floors of the SAC building, bringing the liberal arts complex to about 250,000 square feet in total.

BIM for Construction

The Liberal Arts Phase II construction team is the same team used for the SAC. “This has helped to keep everything running smoothly. A&E, subs, everyone

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has worked things out on SAC, and we're all on a first-name basis," says TenBarge. "SpawGlass has put some processes in place that help us to look out for UT-specific things."

TenBarge cites SpawGlass for bringing to the Liberal Arts Phase II building project the collaborative utilization of BIM for construction. To date, BIM implementation includes full utilization of Revit® by Overland Partners and SpawGlass; ongoing reviews of the BIM model in Navisworks® by the owner, campus planners, facilities personnel, subcontractors, and foremen in the field; and utilization of tablet PCs in the field.

The tablet PC is a field tool that provides SpawGlass with a wireless, internet-enabled mobile computer on which changes can be made and updated immediately, allowing SpawGlass can push real-time information to the field. A superintendent can walk a jobsite, access a drawing file, BIM model, or text file and provide direction and/or clarification on the spot instead of going back to the job trailer to track down answers. But on this job, SpawGlass wondered what else the tablet PC could do, and for the Liberal Arts Phase II building, the tablet PCs are gathering information that is pertinent to the life of the building.

TenBarge says the whole process of virtual construction forces discipline and focus that saves time and money.

By selecting an object's barcode, the facility manager will be able to view detailed information about each component. Each barcode will include all requested information, such as commissioning data, installation data, maintenance schedule, start-up procedures, and more.

He says the technology raises the bar on communication and the constructability process. "BIM helps us lay things out well ahead of time and identify conflicts that would otherwise eat up contingency budgets. BIM corrects variances before actual construction, and when you're on a critical path and are able to correct something virtually, you assume you are saving time and money to repair construction."

A job that was originally scheduled for completion in late 2012, the Liberal Arts Phase II building already is two

months ahead of schedule and now estimated to come in under \$90 million. TenBarge says, "Contingencies are largely intact, and I'm confident we can keep those."

BIM for Facility Maintenance and Operations

In the UT Austin campus environment, colleges are not assessed for maintenance and upkeep. Once a new building is at substantial completion, Campus Facilities Maintenance assumes the responsibility of operating and maintaining that building, its components, and its equipment. Currently, Campus Facilities Maintenance operates and maintains more than 150 education and general buildings on the main campus.

Because COLA has a virtual building, TenBarge says using BIM has allowed COLA and Campus Facilities Maintenance to have in-depth conversations about maintenance well before substantial completion. Through the course of virtual construction, TenBarge began to question how not only COLA but also the university campus could use the data derived from the BIM process to generate additional value.

TenBarge, who views his project much as an Owner because COLA is subsidizing construction costs, suggests that may not be the case with all campus tenants. "Perhaps if we had to run our own facilities maintenance, we would pay a lot more attention to



efficiency at the time of design and construction,” he says.

TenBarge believes the complete benefit will be realized by Campus Facilities Maintenance when SpawGlass is able to deliver a method for building maintenance via a tablet PC that is loaded with data compatible with the campus’s asset management database.

Campus Facilities Maintenance staff members have already been in discussions with SpawGlass to begin to hash out future barcoding methodology for inventorying and archiving equipment, but they are also using the BIM model to conduct clash detections for frequently accessed equipment. UT Austin Commissioning & Warranty Project Manager Jim Crump, CPMP, QCP, says, “BIM is a tool that is in the early stages of adoption. Details haven’t been worked out. Standards haven’t been set. Expectations on both sides of the table haven’t been defined.” But Crump says that through BIM model reviews during construction, “campus



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maintenance should be able to limit the amount of future disruption to building users if they can prevent putting equipment where it's difficult to get to and get it out of classrooms."

With consideration for maintenance routes, accessibility issues, and critical equipment clearances, SpawGlass has implemented a "virtual inspection" process using the BIM model. This process inherently takes into consideration clear access to equipment, in all three directions, and quickly shows any conflicts that may occur prior to installation.

"These are methods we are going to use and COLA will pay for because SpawGlass will deliver a system that will be successful. We are willing to be a guinea pig in the hope that we can try it here, and perhaps it will be implemented on the next building on campus," says TenBarge.

TenBarge asserts that "not unlike academic research, the adoption of BIM as a methodology for building maintenance will require additional inquiry, analysis, and evaluation between the construction manager-at-risk and Campus Facilities Maintenance." He admits that the theoretical process may be difficult and imperfect when it comes to actual implementation and adoption, until it is more widely used. But when it works, TenBarge says it will be worth the effort and cost to improve coordination between college facilities departments and Campus Facilities Maintenance, as well as develop a more perfect process for future UT campus projects.

"The construction manager-at-risk and the facilities people have to make it work. The process has to be integrated. There has to be training to support it. We have to bring a lot of people on board with the process, but we will get there," TenBarge affirms.

Database Compatibility

During construction, all relevant information used to design, construct, and coordinate the building process is readily accessible to anyone on the project team through the BIM model, electronic documents, and tablet PCs. However, to prepare the Liberal Arts Phase II building model for use by the Owner at substantial completion, SpawGlass BIM experts will tag

building components and equipment with a barcode number within the BIM model during construction. Initially, SpawGlass will barcode major and minor MEP equipment.

"At this point, we have not barcoded anything. We are setting up the system for barcoding," says UT Austin Facilities Maintenance Specialist Mike Arn. The goal is electronic delivery of critical equipment and parts data that can be integrated into the campus's existing asset management software, FAMIS, and archival software, Meridian.

For this to work, "We knew this had to fit into the way we do things," says Arn. "I was skeptical when SpawGlass suggested this, but their willingness to understand the way we do business demonstrated to me that they were willing to adapt the way they do things to accommodate us and our current and future processes." Arn says because of the pragmatic approach, SpawGlass is helping his group to streamline what they do, not change it.

Facilities and maintenance groups at the campus level recognize the value add of this concept and have used the phrase "paradigm shift" in project meetings. "It would be nice if manufacturers did this, but SpawGlass is doing it for asset management," says Crump. "A lot of contractors say they provide barcoding, but the only way to do it right is to customize it by weeding out the things we won't use. The difference with SpawGlass and the Liberal Arts Phase II project is the collaborative approach they are taking with our existing system."

At UT Austin, the equipment numbers (EQs) are driven by FAMIS, not by a manufacturer. Campus personnel create an equipment record, assign it a unique EQ, print a label, and affix it to a piece of equipment. The barcode for an item is not created until the label is printed.

The real trick is how information is input, as that determines how it can be found. "Our plan is to develop a spreadsheet with information fields for each item of equipment that has an EQ already assigned, and then provide that spreadsheet to SpawGlass," says Crump.

At this time, Arn and Crump are working with SpawGlass to go through



trial and error in format until it is compatible. "Then, SpawGlass will use their scanner in the field. The barcodes that will be assigned are the barcodes that SpawGlass generates, and the barcodes will then be associated with the EQ that campus has assigned. This is a complete collaborative effort, but it has to occur before everything gets barcoded," says Arn. Arn suggests that the commissioning process is the optimal point to obtain accurate make and model numbers.

By selecting an object's barcode, the facility manager will be able to view detailed information about each component. Each barcode will include all requested information, such as commissioning data, installation data, maintenance schedule, start-up procedures, and more.

"What will make this project successful is the compatible nomenclature. The system and work orders will reflect the parent/child relationship of system items," says Arn. He explains that the campus's preventive maintenance program—prior to 2002 and the arrival of FAMIS—would identify each piece of equipment and its set of instructions. Each piece of equipment and its corresponding instructions would be tagged together in the database, and multiple equipment items could be married to show they were part of a system. But when it was time to print a



work order for a system with multiple pieces of equipment, then multiple work orders would be generated.

Additionally, FAMIS is also a work order system. When a label is made and attached to a piece of equipment that has multiple components, such as an air handler, which has a fan, filter, belts, pulleys, etc., facilities and maintenance personnel need a way to identify individual components and schedule maintenance frequency. Ideally, Arn and Crump would like to see EQs and barcodes assigned to the piece of equipment and each of its components. While the air handler itself would be cataloged in FAMIS, its parts may not. However, Arn and Crump want to be able to find parts, and thus want those EQs and barcodes associated with the air handler's data.

"We are moving into maintenance routes," says Arn. "What I'm doing now is looking at systems. For example, for a water heating system, I now create a route for PM [preventative maintenance] instruction set that encompasses all the equipment that makes up that system. Or, if there is a mechanical room with four air handlers, then there is one route for the mechanical room."

Arn says the equipment installed in the Liberal Arts building will require repetitive ongoing maintenance, and subsets of equipment that

need to be actively maintained will be input into FAMIS.

"We want to be able to input a set of PM instructions, or rack a series of them together, and put them on a route. Then, we can initiate a work order for a subset of equipment, instead of individual items. This allows us to perform maintenance that gives the equipment the optimal chance to operate properly, maintain warranty, and get the most value out of the equipment. Plus, from a budget standpoint, it's a resource issue with our people," says Arn.

Owner Deliverables

When construction is complete, SpawGlass will download the BIM model and database to tablet PCs for use in commissioning. At handover, the Owner will have a mobile deliverable that provides the level of coordination in the own and operate lifecycle stage that SpawGlass employed while constructing the project.

As Owner, UT requires proper access and accurate as-built drawings upon substantial completion. To achieve this, it is critical that SpawGlass' as-built model correctly represents the actual field conditions. Thus, based on the actual structure and sleeves locations, SpawGlass' foreman and superintendents create a baseline from which their BIM model detailers can provide coordinated shop drawings. Superintendents then verify and physically measure the installation of the materials and equipment to ensure they match the model. Every trade must install their scope per the latest coordinated model. If changes are made by any party after the coordination drawings are completed, the superintendent then updates the model with the actual conditions in the field.

Once the database/model connection is "plugged in" to the Owner's existing infrastructure, it then becomes the repository for all future information pertaining to that particular building. "Ideally, the data won't just be in a database sitting in a storeroom somewhere. Rather, Owners will have multiple tablet PCs that have information available in just clicks. Then, the owner will be able to obtain the information they need for maintenance much more quickly," explains SpawGlass BIM Technologist Chris Tisdell.

"At substantial completion, the team

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members are tasked with providing the information that details the building project in a nutshell—submittals, specifications, as-built drawings, warranties, operation and maintenance manuals, and commissioning and close out documents,” describes Crump.

“Over the last three years, we have been evolving to get all of our deliverables electronically on a DVD,” says Arn.

Currently, Crump says he may receive 10 DVDs that have to be disseminated to various campus facilities maintenance

build and integrate BIM models with the database or series of databases, depending on what the ultimate solution demands. Then, as tablet PCs are loaded with electronic closeout documents, they will already be compatible with FAMIS and Meridian.

Crump says this technology is brand new on campus, “SpawGlass has been at the forefront of developing deliverables using our tech formats. This has saved the project by reducing outsourcing costs.” Crump recalls

that is created for the Liberal Arts Phase II building because he won’t have to enter barcodes manually into FAMIS, print labels, or go into the building to affix labels.

Crump estimates time saved based on how quickly his group can find what they are looking for when it’s time to fix something. “For projects that do not have electronic documents, I have file cabinets full of closeout documents. It can take up to three or four hours per trip to file storage every time I have to find something.”

How well the Owner learns to use the tablet PCs and open up their possibilities depends on how well they are trained. SpawGlass will have to provide not only the equipment that maintenance can use, but also the training that answers their questions.

“Whatever comes out of this, it will have UT’s handprints all over it,” says Arn. “Maintenance people will be empowered with barcode scanners on their tablet PCs, and we’ll develop and follow standard operating processes.”

Describing the implications of such an undertaking, Arn says, “UT is huge. There are a lot of people who will be using this new method, and it won’t be easy to shift a lot of people to do things differently. We can’t get compliance by legislating it. We are prepared to inspect what we expect to make sure the process is being used consistently and correctly,” Arn says.

Crump considers the possibilities of what barcoding and tablet PCs could do for his group. “Our field folks have problems putting work orders into the system. If they can input in the field, then orders go into the system faster, and it could be an extremely efficient way to get to FAMIS out in the field.”

Crump says, “UT Austin doesn’t have set standards on how BIM models should be developed. Until we get to that point, it’s helpful that some general contractors, like SpawGlass, are willing to work with us in partnership and respect of our practices.”

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divisions such as zone maintenance and custodial services, as well as to other departments such as utilities. But Crump says it’s still an improvement over when he used to get two sets of hardcopies and would have to separate it out and send out paper to each department.

Now that closeout documents are received electronically, they can be digitally archived. “We are using Meridian for archival. When using BIM, we will incorporate closeout documents into Meridian. And when we receive the equipment database associated with those documents, it will be loaded into FAMIS,” says Crump.

Crump explains that in Meridian, all final information is stored in vaults, and each campus department and professional service provider has a vault. While information may be passed back and forth on paper or digitally, it isn’t being updated in all vaults, but it is date stamped. “We have to get it to a point where there is one universally accessible point,” says Crump. “It’s an extreme learning curve to bring us into the twenty-first century, but I am technologically ready,” adds Crump.

To meet the challenge, SpawGlass has internal specialists who will

when facilities first migrated to electronic documentation, and SpawGlass was working on a small expansion on a garage. “I gave them their format; they did it in-house and did it right. It was a great project for them to learn. They have hard drives and thumb drives to go back and get project files. They know how we want the information and how it will work,” Crump adds.

Residual Benefits, Training, and Adoption

Owners sometimes feel like they are walking through their buildings blind. They don’t have blueprints, drawings, and manuals at their fingertips, and information doesn’t always filter down because managing such documents is a labor-intensive process. So the benefit of undertaking such a complex exercise of cataloging equipment electronically, storing documents, and sharing files digitally should be spending less time looking for data that isn’t stale, right? Well, that is still being understood, as is the actual time that is gained from managing building documents the new way.

Arn thinks he could get back three weeks to a month per spreadsheet