What Does it Take to Implement 6 Million Square Feet of BIM?

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FM2524  Class Description

This session will present how a top academic Medical Center collaborated with a BIM-driven architectural firm to deliver a BIM Implementation Plan that has transformed 53 buildings totaling more than 6 million square feet of existing facility space from a traditional 2D AutoCAD format to an intelligent BIM environment using Revit Architecture. This implementation focused not only on the technical aspects and best practices of leveraging Revit Architecture, but included developing a much deeper BIM expertise to ensure the long term success and continued utilization of the models for future growth across the campus. The project team leaders will present how they have developed these models to utilize multiple Autodesk platforms for the sharing of facility information with the diverse staff throughout campus. This has improved the quality and speed of decision-making regarding facility planning, renovation, maintenance, wayfinding, and energy consumption.

Learning Objectives
At the end of this class, you will be able to:

- Describe how The Ohio State University Wexner Medical Center and DesignGroup partnered to deliver this project.
- Explore the multi-phased approach to the defined BIM Implementation Plan
- Define the evolution of the standards and content creation process.
- Illustrate how BIM is improving the owner’s decision-management process.
About the Speakers

**Brian Skripac**

As the Director of Digital Practice at Astorino, Brian has embraced the changing paradigms of architectural practice and throughout the past seven years has integrated building information modeling (BIM) technologies well beyond the traditional design and documentation processes. More recently, he has focused on the integration of BIM to optimize sustainable design outcomes throughout all stages of a project, as well as demonstrating and implementing the value BIM brings to facility owners from a lifecycle management strategy.

Brian holds a Bachelor of Science in Architecture from The Ohio State University, is a LEED® accredited professional, and an Autodesk® Revit® Architecture certified professional. He also currently serves as a Leadership Team member for the AIA Technology in Architectural Practice Knowledge Community (TAP KC) at the National level.

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**Joe Porostosky**

Joe Porostosky is the Senior Manager of the Facilities Information and Technology Services (FITS) at The Ohio State University, charged with maintaining 36 million square feet of space drawings and data, along with providing leadership to facilities related data systems. With a background in technology management, Joe has managed the FITS team for the past 4 years. Providing an active and strategic leadership role within the university Joe has redefined the way his group works by leveraging technology in new and innovative ways. As the team leader for the recent BIM Implementation Project, Joe has led the Wexner Medical Center at The Ohio State University in the adoption of BIM to improve their overall decision making processes. Joe’s BIM initiatives have been the source of many recent publications, and presentations as well as being the recipient of the “Best in Innovative Digital Design Award” from [acronym] online in 2011.

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Idea Development – Moving from Lines on a Piece of Paper

In July 2008, Joe Porostosky and Dave Pifher (Lead Facilities Space Analyst) from The Ohio State University (OSU) began considering a transition away from their traditional AutoCAD documentation for representing building floor plans. They recognized the limitations it had in representing space and the associated data. In short, AutoCAD amounted to lines on a piece of paper for OSU, and OSU’s internal customers desired more value out of their space data. The initial investigation looked at staying with AutoCAD or moving to AutoCAD Architecture or Revit Architecture. Over the next six months, they continued to informally investigate and discuss these options.

In January 2009, Dave and Joe were introduced to Brian Skripac, Director of BIM at DesignGroup, a local architecture firm with a reputation for BIM leadership in Columbus, Ohio (Brian is now with Astorino in Pittsburg, PA). Over the next 18 months, Dave and Joe continued to discuss their options while watching how the technology and the industry were progressing.

In June of 2010, OSU concluded that they needed to formally determine what it would take to make a wholesale switch to BIM for the building considered to be a part of the Wexner Medical Center. The dramatic improvement to the visual presentation of facility plans, along with the ability to do energy modeling, and the general move to BIM by the architecture industry were the driving forces behind this decision. In addition, a 1.1 million square foot Medical Center expansion project was being designed in Revit and coordinated in Autodesk Navisworks, and OSU wanted to be ready for the BIM deliverables at the end of that project. One of OSU’s outstanding students, Michael Lindawan, was tasked with using the summer to investigate several conversion methods. At the end of the summer, he presented his research along with some metrics of how much time, per square foot, the conversion from 2D to 3D would take.

Implementation Plan Development – Planning the Conversion to BIM

Using the work that Michael had done, OSU developed, during the autumn of 2010, a detailed BIM Proposal and Implementation Plan to fully understand the timeline and resource requirements for a complete conversion to BIM. This document was to serve as their way to formally scope the project and to promote this forward thinking initiative to senior leadership gaining the necessary labor and financial resources.
At that time, OSU identified the following as the immediate benefits of the implementation:

- High quality 3D visualizations
- Energy analysis and modeling
- Improved planning in the areas of space, operations, security, and others
- Improved drawing accuracy via field verification and further use of as-built documentation
- Time savings in updating to the BIM following construction or renovation projects versus AutoCAD
- Utilizing industry standard drawing standards
- Improved communication with leadership and customers as it relates to space usage and layout

The following were identified as benefits we would see at some point in the future:

- Detailed location and information of various types of equipment
- 3D campus maps
- Improved way finding services
- Other expanded services: For example, better support for safety, security, and disaster planning, in addition to developing 4D models that will show the impacts of construction and renovation over time

**Partnership & Collaboration**

Now that OSU had made the decision to move to BIM, they needed to better understand how to implement it. Having decided on Revit Architecture as an important foundation to their overall BIM initiatives, the team still needed to have a much deeper understanding of the technology and more importantly how it would integrate/redefine their existing team and processes.

The conversations that Joe and Brian began to have were driven from Brian’s leadership with BIM at DesignGroup and their early adoption of this technology in late 2005. As they’ve evolved into a 100% BIM environment, since the beginning of 2009, Joe had the assurance that this expertise could successfully lead his team through their BIM implementation. Ultimately, the idea of partnership and collaboration became the cornerstone of the project’s success and provided a mutually beneficial outcome for both of the organizations.

**Project Definition**

The first step to the implementation was defining the outcomes for Ohio State, and making sure a solid plan was in place for Joe to present to senior leadership assuring that he would have the commitment of resources to accomplish this project. Understanding how they were going to use the model geometry was important, but equally important was knowing what additional data was needed in the models to optimize their use and met the wide range of uses and expectations for the team at OSU.

In addition, OSU and DesignGroup had lengthy conversations about how the internal team at OSU would be structured. Who was going to take on the task of modeling the more than six million square feet of
buildings in the Medical Center? Would it be OSU, DesignGroup, or both? Who would provide the needed internal technical leadership for this project and the larger ongoing BIM initiatives, and how could that person quickly get up to speed with the technology so they could provide the needed owner’s perspective to the on-going project development?

A key driver behind this discussion was to make sure OSU and DesignGroup were reinforcing the larger educational mission of OSU, and taking a “teach a man to fish” approach to the project. With this in mind OSU and DesignGroup concluded that the best way to accomplish this project was to further educate the OSU team on the applications of BIM rather than doing the work and passing off a completed model for their use.

The final outcome was a decision to bring on a team of architectural and engineering students from The Ohio State University to learn how to develop these models, while providing a valuable real world, educational experience.

Multi-phased approach

These combined approaches proved invaluable as it allowed for a continuous dialog where shared experiences and desired outcomes allowed for a defined scope of work, schedule, and a well planned multi-phased approach to the overall BIM Implementation project. Part of determining the overall schedule was leveraging Michael Lindawan’s initial modeling experience with metrics that DesignGroup provided to identify how long it would actually take to complete the modeling effort of Phase 1 which became known as the “Big Bang Approach”. Joe and his team concluded that a modeling effort covering .029 minutes/sf would be a realistic expectation. Balancing this against a desire to have Phase 1 completed during the summer of 2011 meant that OSU would need to hire 5 full time students to meet the schedule.

- Phase 0
  - Standards & Template Development
  - Process Map and Workflow Integration
  - Best Practices & Consulting
- Phase 1
  - Implementation – “Big Bang Approach”
  - 53 Buildings – 6,012,540 square feet (Medical Center buildings only)
  - Includes basic building information: exterior, walls, windows, doors, columns, etc.
  - Student and User Training
- Phases 2 and 3
  - Planned future detail to models.

The final result of the planning effort was a successfully presented implementation plan that senior leadership signed off on. This provided Joe the resources to build a team of 5 BIM Assistants, define an internal BIM leader within the FITS team, and begin to execute the multi-phase implementation seen above.
Phase 0: Standards and Process Development

Ohio State’s Wexner Medical Center senior leadership signed off on the “Big Bang” approach to converting all 6 million square feet of Medical Center space in November of 2010. Starting in February of 2011, Phase 0 of the implementation plan began, which included four primary objectives:

- Creation of the BIM Implementation Team
- Development of BIM Standards and Revit Templates
- Development of a process and workflow for model development
- Preparing for Phase 1 (Big Bang Conversion) kick off

The first step was to determine who would be responsible for what during this project – this included everything from a project champion, technical staff, BIM experts, and more. The team eventually included:

- Brian Skripac: Project Consultant *(originally with DesignGroup, now with Astorino)*
- Joe Porostosky: Project Champion
- Dave Pifher: Technical and Process Lead
- Tracy Palmer: BIM Coordinator
- Okey Tolley and Peter Pollock: Project Support

As the BIM Coordinator, it was determined that Tracy would be responsible for the day to day supervision of the students, along with maintaining the on-going collaboration with Brian to provide management and development of the BIM standards.

Over the next couple of months, creating standards and templates was not just about rebuilding our AutoCAD content in Revit, but reinventing those systems and process to create a new and better way of doing things. This enabled Brian to guide the conversation and bring his past experiences and unique perspective to this part of OSU’s BIM evolution and development of their BIM Standards.
There were also extensive conversations about what the appropriate Level of Development (LOD) for the models would be (for both now and in the future) to accomplish the outcomes defined for this project. Many of the discussion occurred around the idea of “what does the owner’s model look like?” While the project team explored and understood the differences between an LOD 200 and LOD 300 model, they needed to define how this would impact the project. While some decisions made early on would be modified later in the project, it proved to be a worthwhile endeavor to have these conversations. In addition, the idea of a representational owner’s model became much more important than a buildable model that a design firm would supply.

Joe and his team would define that and “as-maintained” model would be the most appropriate outcome to support the university’s planning and operational efforts. This dialogue not only provided a structure for the content/standard development in this phase of the project, but also set a foundation for the process map and workflow integration that would be defined as well.

Knowing there is no easy way to move from AutoCAD to Revit, OSU’s collaboration with Brian allowed the team to clearly understand how the conversion process would occur. This would include using the AutoCAD floor plans as an underlay in Revit for the team to model on top of. While this provided the floor plan information there was a significant amount of data needed to build a full 3D model that did not exist in the AutoCAD files, such as floors, ceilings, roofs, exteriors, and window, door and wall heights.

With this in mind, the last step in Phase 0 was to collect as much existing building information as possible to ensure the students could hit the ground running when they started in June of 2011. For each of the 53 buildings OSU planned to construct models for, they would need to:
• Conduct a field verification to determine accuracy of the existing AutoCAD floor plans
• Collect supporting drawings such as: as-built plans, wall sections, building sections, elevations, etc.
• Photo document the building exterior and any of its unique features

As part of this implementation project it was OSU’s intent to have each of the building information models accurate within a 1% deviation from the actual conditions. Following the initial field verifications, only 7 buildings did not meet this standard as AutoCAD drawings, and would get additional attention during the next project phase.

Estimates indicate that Phase 0 took approximately 1080 hours over about a 4 month period of time spread across five staff, with Tracy Palmer, as the BIM Coordinator, incurring the bulk of those hours. Based on this, preparation time for the project was about 0.011 minutes per square foot.

The initial project preparation of Phase 0 proved to be critical to the success of the project, as significant and long lasting decisions were made that would have been difficult and painful to change once implementation began. In addition, the Phase 0 work that was conducted significantly accelerated the students’ work in creating the building information models.

Phase 1: Big Bang Implementation

Following the all important completion of Phase 0, OSU was ready to kick off the actual work of developing Revit-based building information models from their AutoCAD floor plans. In June of 2011, the implementation process started with two undergraduate architecture students and two graduate architecture students from the Knowlton School of Architecture, along with one undergraduate civil engineering student, all from The Ohio State University. While their first week included on-site orientation, team building and a project overview, the students quickly became acclimated with the technology they would become expert at during a focused three day training session on Revit Architecture.
This highly customized training, led by Brian Skripac, was a product of the Standards and Process Development effort and focused on the execution of the newly defined process map and workflow integrations to translate information from 2D to 3D. The students were not only taught how to use Revit Architecture but it was presented in a way that would mimic their everyday use of the software as they began to model the existing facilities. Another benefit to this effort was that the project team was exposed to the wealth of newly created content and “kicked the tires” on how well our processes worked. This allowed us to improve and refine our process to the benefit of the project as a whole. As the training concluded, the students were immediately assigned a building and began the process of developing their first model.

Phase 1 included the development of a basic BIM intended to capture the following elements:

- Basic Exterior Wall Construction
- Interior Walls & Cubicles
- Doors & Windows
- Basic Roofs
- Basic Plumbing Fixtures
- Columns & Column Grids
- Basic Floors & Ceilings
- Basic Stairs
- Rooms & Areas
Following the completion of the first set of models, Brian Skripac conducted a careful audit of each building models and documented their adherence to the BIM standard which was presented back to the team as a whole. This allowed the students and full time staff to learn how to create the most accurate and useable models as they continued their work. In addition, this effort provided Tracy, as the BIM Coordinator, a roadmap to audit the rest of the models moving forward. As issues arose during this process, they were identified and the students were provided an opportunity to make the recommended modifications and resubmit their models to be shared as a final version.

By the end of the summer, the students logged 2,750 hours, primarily engaged in the model development process. The calculated metrics indicated that the bulk of modeling effort should have been completed by this point, but only about 77% of the buildings had been completed, by space.

One of the several factors that increased the amount of time to accomplish Phase 1 was the students’ desire to add more detail than we initially planned during Phase 1 (which goes back to the earlier LOD discussion). The result of this increased detail was more valuable models. This affected several aspects of Phase 1:

- Instead of using basic windows, most of the BIMs included detailed window families.
- The exterior wall construction was accurately reflected, and almost all exterior facing wall details were visualized.
- A higher level of focus on accuracy than expected, meaning more time tracking down documentation and performing field verifications.

In addition, during the summer, several high impact projects were brought to the team’s attention. These projects required the team to move students off of BIM development to focus on detailed modeling and renderings of both interior and exterior spaces. While these special projects slowed down progress, they provided excellent opportunities for the team to show the value and power of BIM to senior leadership, which will be described below.

Lastly, the Revit files were developed further to make information more readily available to the masses who would not be using Revit every day. Additional prototypical and printable views, schedules and sheets were built in requiring more time to update all of the models with these changes. Students were also required to produce several renderings of their buildings to maintain on an online gallery of images, which can be found here: [http://bit.ly/OSU_FITS_Gallery](http://bit.ly/OSU_FITS_Gallery).
Following the completion of the project, the following metrics were developed (numbers are in minutes/sf):

- Phase 0 Prep = .011
- Actual (conversion only – work completed by students) = .037
- Actual (with full time support staff) = .055
- Actual Total = .066

End User Training

Transitioning to BIM is not primarily a technical challenge, it is cultural change. To aid in the adoption of BIM across the Medical Center, Brian was also tasked with developing and conducting a series of training sessions customized to the specific needs of the Medical Center’s varying end user groups. These training sessions were held at the end of the summer of 2011, when a number of models were available to use. The hands-on training was broken down as follows:

- Engineering and Operations: A three day session covering how to navigate/interact with a Revit model and how to extract information from the model.
- Interior Designers and Space Planners: A four day session covering everything from scheduling to views to moving walls and placing families, along with how to create renderings and walkthroughs.
- Construction Managers: A half-day session on navigating DWF versions of the Revit model in Autodesk Design Review.
- Energy Engineering: A two day session on how to translate the existing Revit models as gbXML files for their use in tools like Autodesk Green Building Studio and eQUEST.

The Mutually Beneficial Outcomes of Implementing BIM at Ohio State

As OSU’s BIM Implementation Project progressed, both Joe and Brian found this process to be mutually beneficial in many different ways. While there were both extremely positive and some unexpected outcomes, this effort allowed both to capture knowledge and insight that wasn’t initially expected.

Architectural Firm Benefits

From a technology perspective, working with Joe on this project allowed Brian to share the more than six years of experience he had with Revit Architecture and BIM related processes in general. Sharing these experiences did not always match up with the way the Medical Center needed to work which provided a challenge in taking these past experiences and defining the best practices that would most benefit this project and the desired outcomes. Being able to take a step back from how a firm typically works and accomplishes daily tasks proved to be a unique opportunity for Brian to think critically and strategically about how to optimize new design and documentation processes. While this effort was focused on the needs of Joe and his team it has enabled Brian to take those new perspectives and effectively apply them to unique challenges that come up regularly on projects.

Another extremely beneficial outcome of this project was being able to gain a unique insight to how a client is actually using the design documentation that architects provide the building owner once
construction is complete. The ability to see what information is most critical for an owner’s daily activities and how they apply those items during operations and maintenance and lifecycle planning of their facilities proved to be extremely informative. This not only enabled Brian’s firm to think about how they could expand the usefulness of their project deliverables to a long standing client like The Ohio State University, but how they could work to educate all of our clients on the opportunities they have to leverage these building information models to their advantage.

**University Benefits**

The Medical Center has found a number of beneficial outcomes from our transition to BIM, which all revolve around the idea of helping OSU’s staff, faculty, students, patients, and visitors, make better decisions more quickly. We call it BIM Powered Decision Making.

**Renovation Decision Making**

One of the first benefits OSU has seen is the ability to visualize several different renovation options for a given space. Previous to BIM, customers would be provided several 2-D floor plans of a space and asked to decide which one they liked best. While those who work with 2-D plans every day might be able to visualize a space from a 2-D floor plan, many of the user’s of new space cannot do this easily. They might make their best guess, but would frequently not be completely satisfied once they saw the completed space. During the BIM Implementation, in the summer of 2011, a new senior leader joined the Medical Center. Before arriving, she was sent several 3-D renderings of potential office layouts. With these images available she was able to easily understand the space and formulate a decision on which option best met her needs.

**Funding Decision Making**

Closely related to the above example, BIM is allowing the Medical Center to mock up spaces in great detail to inform the decision making process for future project funding. During the summer of 2011, the Medical Center was working to determine if they should invest in renovating the Emergency Department with all new finishes. Using a BIM, the actual finishes were quickly added to the space producing a visualization that was as close to accurate as possible. Instead of using a traditional finish board and asking the decision makers to interpret what the space might look like, they were able to see renderings and a video walkthrough of how the space would appear, complete with accurate finishes and furniture.
**Donor Recognition Decisions**

Visualizations of space is providing the ability to enhance OSU’s development process by providing prospective donors the ability to see how a space might look and how they will be recognized for their contribution. During the summer of 2011, the Medical Center wanted to improve the exterior recognition for a major donor. Utilizing one of the new developed models, it took little time to develop several signage options that the University Architect and the Department of Development could consider. This allowed them to quickly make a decision about which signage looked best and provided the best visibility to visitors. The installed product matches almost identically to the rendering, further reinforcing the value of BIM in decision making.

**Extending the Educational Mission**

As a university, education is one of our primary pillars for existing. The ability to hire a group of students and to partner with their education was a benefit to OSU and to the students. They received real world experience that their formal education cannot provide. In addition, the skills and contacts they have received working on this project will differentiate them from others once they graduate from Ohio State. Further, the OSU team is gaining valuable knowledge and experience that will aid them as they accept BIM deliverables from firms for all new construction in the future.
**Future University Benefits**

*Enhanced Planning Support*

Utilizing the newly created models allows OSU’s Facility Planners a more robust and communicative method of planning for the future of OSU from a space perspective. The ability to more easily demonstrate vertical and horizontal adjacencies, along with comparing how space is currently being used to how it will be utilized in the future not only aids in understanding the implications of future plans, but helps communicate those plans to decision makers and customers throughout the University.

*Improved Patient and Visitor Way Finding*

The building information models will also allow for a more realistic representation of OSU’s space. With such a large campus, way finding can be confusing to a new patient or visitor, but the ability for OSU to now create wall mounted maps with a three dimensional look and feel will certainly improve this effort. One possibility is to create video walkthroughs using the BIMs that take a patient or visitor from a parking garage to their location, thus familiarizing them with space within the Medical Center or other OSU space and helping them visualize their personalized path to their destination prior to their arrival, improving their overall experience. In addition, the OSU team is partnering with a graduate student to conduct a study on the use of 3-D aided way finding to determine if it truly does provides a benefit, and if so, what kind of benefit.

*Energy Analysis*

With Sustainability being a clear goal of all new project at Ohio State (Green Build Policy stipulates that all new projects (building or renovation) over $4 million must be LEED - Silver certified and recycle 50% of the construction materials), BIM is yet another way to contribute to this effort. In addition, the University has developed their Climate Action Plan which outlines their goal to become carbon neutral by 2050.

Working with the Energy Services and Sustainability Group, led by Aparna Dial, the University has become very aware of the potential BIM can bring to their search for ways to reduce energy consumption in existing buildings by seeing how quickly they extract and access the needed data for energy analysis within a BIM environment. Leveraging technologies such as Autodesk Green Building Studio and eQUEST will allow OSU to analyze different sustainability projects to determine which will provide the greatest return on investment and a direct path to achieving the goals outlined in the Climate Action Plan.
Recruitment and Fundraising Tool

Building off the success of OSU’s initial project, using BIM to enhance the recognition of a donor, OSU has found that providing renderings of proposed lab or office spaces can also support the recruitment of new faculty, researchers, and staff. These renderings can also be used during the process of fundraising to help a potential donor visualize how their recognition might actually appear in the space they are donating to.

Improved Asset Management

Following new construction or major renovations, there is typically significant work to get all the systems of the building into the preventative maintenance system. If a BIM was provided at the close out of a project, this could potentially speed up that process and increase the accuracy, while also providing the basis for improved asset tracking by connecting to asset management systems.

Capacity Planning and Detour Effects

OSU is also currently looking into additional technologies that would allow them to analyze our BIMs for people and vehicle capacity analysis, to better understand the effects of a hallway being closed or a street being limited to one lane during a construction process. This would allow OSU to better understand, ahead of time, how severe the effects of a closure are going to be, and better prepare for the negative effects of those detours.

Adding Additional Data to Models

As more and more of OSU’s internal customers see the value BIM can provide, they are asking for additional data to be added to our models beyond the already robust information defined in Phase 1. Major building components such as fume hoods, accurate casework, major building systems, signage, and site information are all slated to be added to the models in the coming phases of the project. These additions will provide a better foundation for the renovation visualizations and space planning decisions discussed earlier.

In addition, OSU purchased a Faro 3-D Laser Scanner in the summer of 2011 to aid in the collection of data. Thus far, they have utilized it to improve the quality of our new model documentation as compared to our traditional AutoCAD drawings (in buildings where the AutoCAD drawings were especially inaccurate, or didn’t exist at all) and have scanned a space that had significant historical value to the University, but was undergoing a complete renovation. In the future, OSU plans to use the scanner to rapidly model mechanical spaces in Revit and support the collection of highly accurate “behind-the-wall” conditions during the construction process improving OSU’s knowledge of the building once construction is complete.

Expanding the BIM Implementation to the Rest of the University

Now that Phase 1 has been completed for all Medical Center buildings, a number of our buildings have already moved on to Phase 2, which is the addition of fume hoods, some building equipment, catwalks, casework, furniture and basic plumbing fixtures.
OSU is now planning on making the transition to BIM for existing buildings for the rest of the campus. Our transition efforts at the Medical Center included 53 buildings and 6 million square feet. The rest of the University includes about 900 buildings and over 30 million additional square feet. Obviously, OSU’s first goal will be to prioritize what buildings will see the most value in developing models for them.

With this strong understanding of how BIM can aid the University as owners of our buildings, OSU is also moving towards BIM supported workflows in our construction process.

This project was successful through the excellent teamwork of the Facilities Information and Technology Services team consisting of Joe Porostosky, Dave Pither, Tracy Palmer, Keri Ours, Okey Tolley, and Peter Pollock. In addition, our core group of outstanding students who did the bulk of the phase 1 work, included Sarah Bonser, Liz Schneider, Kyle Wright, Tony Nguyen, and Tyler Kvochick.

As OSU expands their use of BIM at the University and they show the value of the models to their various customers, new uses are always being suggested. OSU expects that the next couple of years will show the investment they’ve made in the transition to BIM for existing buildings was a wise investment that will pay back many times over.

**Resources & Links:**

- Building Design + Construction - [http://editiondigital.net/publication/?i=94417&p=54](http://editiondigital.net/publication/?i=94417&p=54)
- The Ohio State University Facilities Information and Technology Services - [@OSU_FITS](https://twitter.com/OSU_FITS)