Autodesk University 2012

Design Build Workflow With Building Design Suite

Tomislav Žigo – Clayco Inc.

CR1534:

Design Build Workflow With Building Design Suite

In a fast paced DB environment the ability to streamline and accelerate the processes necessary for optimized project delivery is directly proportionate to one's ability to minimize information loss. In these real life examples we will demonstrate how complex projects and their demanding schedules can benefit from the use of Building Design Suite applications. From the very beginning of the design and construction process when the team makes decisions with lasting impact on the building's performance and lifecycle cost, through the process of program development and client engagement via advanced visualization techniques, and lastly through the process of document production and coordination, a BIM enabled workflow determines a team's ability to collaborate and deliver a finished product that will exceed client's expectations.

Learning Objectives

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

- Implementing BDS workflow on D/B projects
- Leverage the capability of Autodesk BIM applications throughout building design process
- Understand the do's and don'ts of multi discipline information exchange as seen from the client's perspective.
- Overcoming pre-construction myths about BIM enabled project delivery.

About the Speakers

Over the past 16 years, Tomislav Zigo has been an advocate of digital technology implementation as a researcher, designer, and most recently as a designer/builder. His experience includes work in the vanguard of BIM methodology implementation on large health care projects, research work in the field of virtual reality and building performance analysis, and mentorship positions in a number of local and national architectural firms while transitioning toward BIM adoption. As the director of virtual design and construction for Clayco Inc. of St. Louis, he is responsible for implementation of building information modeling methodology in integrated project delivery practice. Tomislav holds a Master of Science degree in mechanical engineering from the University of Rijeka in Croatia, and a Master of Architecture degree from Washington University in St. Louis, where he currently teaches two courses on the subjects of BIM methodology integration into sustainable design practice.

zigot@claycorp.com

Implementing BDS workflow on D/B projects

Defining Design Build in the context of digital project delivery

For quite some time one of the most challenging aspects of comprehensive BIM methodology implementation has been related to the alignment of software solutions with industry adopted practices. Adopting this challenge as a self imposed prerequisite was the primary motivator for Clayco Inc. and our VDC team to define what “Raising the bar” should mean regarding the use of digital media in our everyday work.

In order to properly address this aspiration, a critical examination was directed toward the effectiveness of R&D among comparable industry sectors as well as toward the potential role that technology transfer has in the construction industry.

Design–build (or design/build, and abbreviated D–B or D/B accordingly) as a project delivery system is defined as a method in which the design and construction services are contracted by a single entity known as the design–builder or design–build contractor.

In contrast to "design–bid–build" (or "design–tender"), design–build relies on a single point of contractual responsibility and is used to minimize risks for the project owner and to reduce the delivery schedule by overlapping the design phase and construction phase of a project.

This single point of responsibility also emphasizes the uniqueness associated with this project delivery type as it relates to the software environment, since the design-build workflow is somewhat sheltered from the transactional business model so prevalent in the AEC industry.

Such approach has quite a positive impact in realigning the somewhat wishful marketing approach as coined by software houses with the "master builder" approach, one of the oldest forms of construction procedure.

From a historical perspective the so-called DBB project delivery is actually a very recent concept, having only been in use approximately 150 years. In contrast, the design–build concept–also known as the "master builder" concept, has been in use for over four millennia, and can finally claim a competitive advantage through BIM as a methodology that in its essence is most conducive to DB core advantages.

Streamlining project delivery through a single contract between the owner and the design-build team that saves money and time by transforming the relationship between designers and builders into an alliance which fosters collaboration and teamwork. United from the outset of every project, an integrated team readily incorporates BIM and LEED certification goals.

When comparing DB to the Design Bid Build (DBB) delivery process through the prism of BIM deliverables, one cannot help but notice the drastic difference in the amount of time and information lost during the hand-off phases of the delivery.

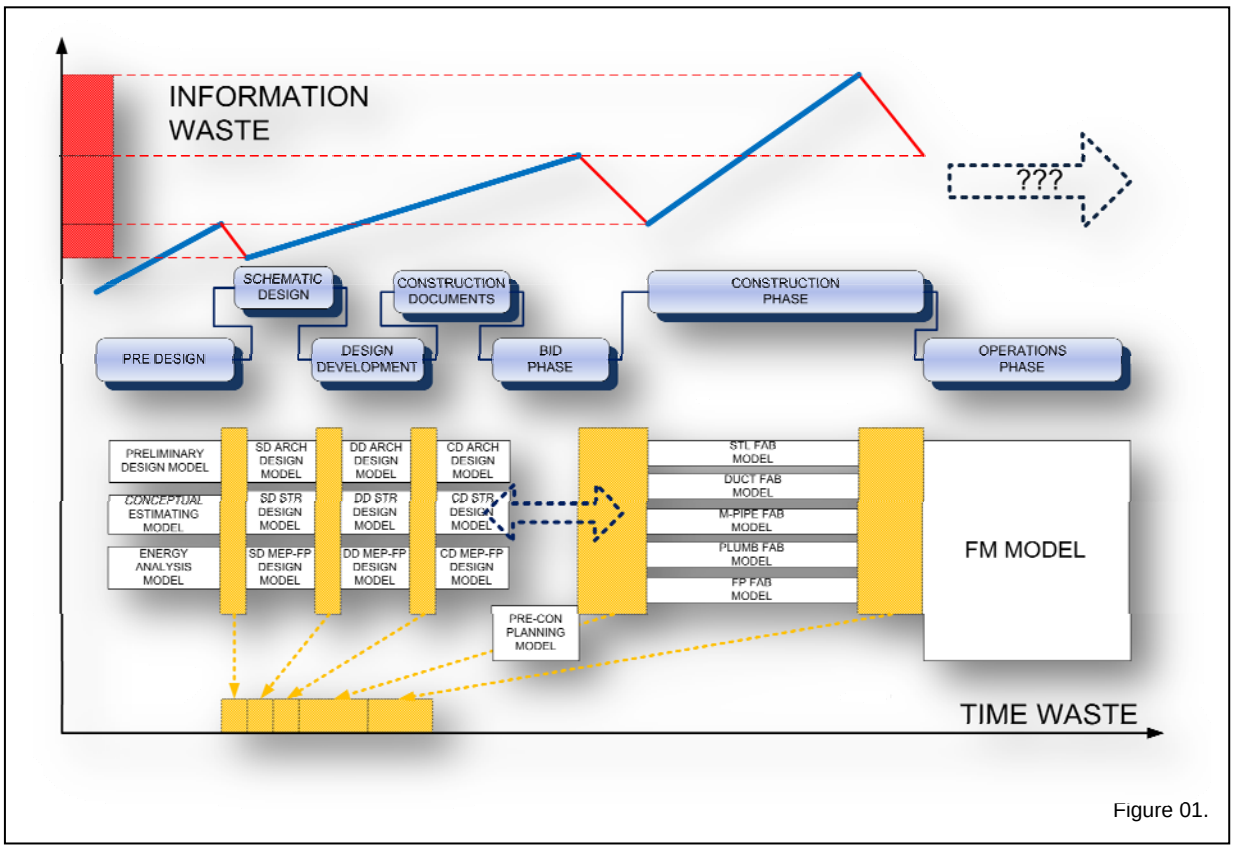


Figure 01.

One of the dominant problems in the industry still revolves around data redundancy and handover loss that happens along each project phase, as illustrated in *Figure 01*. The typical BIM enabled project that exists within the framework of DBB delivery, is riddled with time loses due to repetitive and redundant tasks, complications which are related to infrastructure constraints, communication that often is hampered with silo – like internal knowledge, and process distribution and necessary time gaps required for discipline realignment.

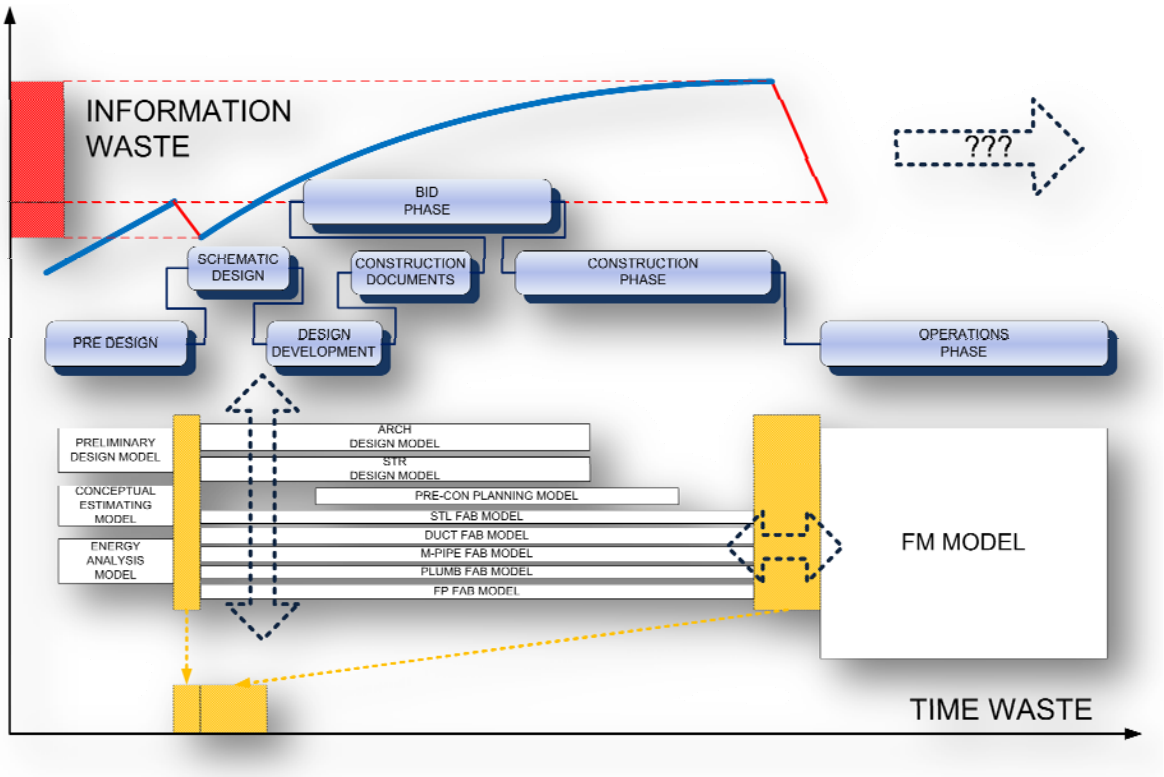
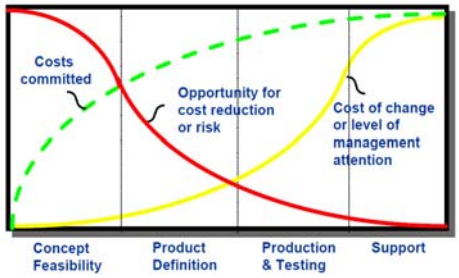


Figure 02.

While realizing that the *Figure 02* might be an idealized picture of BIM enabled DB project delivery, or for that matter any integrated delivery cycle, it is important to reflect upon some simple information management strategies as they have developed over the past several decades in the manufacturing industry.

The concept of concurrent engineering is defined by some rather common sense objectives that due to their simplicity in definition and applicability to AEC process timing, is quite definable within a controlled application environment.

- Work in parallel, controlled manner
- Early involvement – 'righter' first time
- Early use of corporate knowledge to influence design
- Invest time and resource in early design phase
- Sharing information – common source of data



SOURCES:
ULJANIK SHIPYARD
WONDERMAR II – PUBLIC WORKSHOP 2004

To simply draw parallels might be a bit of a stretch, however if one observes a true DB process and tries to find the points of coincidence between the process and the software applied, our recommendation would be to focus on these four, and communicate them clearly.

- **Organized**, early handoffs do save duplication.
- Hand offs can be a **rolling event**.
- When participants can work in **parallel**, a better level of **optimization is possible**.
- BIM provides the opportunity for **many participants** to work in the same "model."

Prerequisites

In the case of a Design Build firm that commits itself to a comprehensive BIM implementation across all of the processes that yield themselves to potential benefits of such, certain prerequisites need to be met to make this implementation successful. Those can simply divided into those of application and infrastructure type, where each organization needs to opt for the level of implementation that fits within their budget and the assessment of the available resources.

Applications environment

Unlike in the typical AE & C setup, the level of required interaction between the application of BDS suites calls for more comprehensive deployment options as well as a more centralized content distribution structure. In the case of Clayco Inc. this distribution structure was based on the underlying idea of the lowest common denominator and on industry nomenclature standards to assure the longevity of information when content is exchanged between multiple project phases as well as application environments. For that reason two major steps have been taken to accomplish this task: (*Figure 04 & 05*)

- Normalizing Uniformat nomenclature for family naming, assembly information, estimating recipes, view naming, catalogs and scheduling.
- Reengineering of project billing codes, space types, mass elements and details in accordance to OmniClass classification

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Category Name	Code	Description	Level	Category Id	Error?
A	Substructure						A	Substructure	1		No
	A10	Foundations					A10	Foundations	2		No
		A1010	Standard Foundations				A1010	Standard Foundations	3		No
			A1010.10	Wall Foundations		Structural Foundations	A1010.10	Wall Foundations	4	-2001300	No
				A1010.10.10	Countinuous Footings	Structural Foundations	A1010.10.10	Countinuous Footings	5	-2001300	No
					A1010.10.11 Cast-in-Place Co	Structural Foundations	A1010.10.11	Cast-in-Place Concrete	6	-2001300	No
				A1010.10.20	Foundation Walls	Walls	A1010.10.20	Foundation Walls	5	-2000011	No
					A1010.10.21 Cast-in-Place Co	Walls	A1010.10.21	Cast-in-Place Concrete	6	-2000011	No
					A1010.10.22 Precast Concrete	Walls	A1010.10.22	Precast Concrete	6	-2000011	No
					A1010.10.23 Unit Masonry	Walls	A1010.10.23	Unit Masonry	6	-2000011	No
					A1010.10.24 Treated Wood Fo	Walls	A1010.10.24	Treated Wood Foundations	6	-2000011	No
			A1010.30	Column Foundations		Structural Foundations	A1010.30	Column Foundations	4	-2001300	No
				A1010.30.10	Spread Footings	Structural Foundations	A1010.30.10	Spread Footings	5	-2001300	No
					A1010.30.11 Cast-in-Place Co	Structural Foundations	A1010.30.11	Cast-in-Place Concrete	6	-2001300	No
					A1010.30.12 Precast Concrete	Structural Foundations	A1010.30.12	Precast Concrete	6	-2001300	No
				A1010.30.20	Column Piers	Structural Foundations	A1010.30.20	Column Piers	5	-2001300	No
					A1010.30.21 Cast-in-Place Co	Structural Foundations	A1010.30.21	Cast-in-Place Concrete	6	-2001300	No
			A1010.90	Standard Foundation Supplementary Components		Structural Foundations	A1010.90	Standard Foundation Supp	4	-2001300	No
				A1010.90.10	Void Forms	Structural Foundations	A1010.90.10	Void Forms	5	-2001300	No
				A1010.90.20	Dampproffing	Structural Foundations	A1010.90.20	Dampproffing	5	-2001300	No
				A1010.90.30	Insulation	Structural Foundations	A1010.90.30	Insulation	5	-2001300	No
		A1020	Special Foundations				A1020	Special Foundations	3		No
			A1020.10	Driven Piles		Structural Foundations	A1020.10	Driven Piles	4	-2001300	No
			A1020.15	Bored Piles		Structural Foundations	A1020.15	Bored Piles	4	-2001300	No
			A1020.20	Caissons		Structural Foundations	A1020.20	Caissons	4	-2001300	No
			A1020.30	Special Foundation Walls		Walls	A1020.30	Special Foundation Walls	4	-2000011	No
			A1020.40	Foundation Anchors		Structural Foundations	A1020.40	Foundation Anchors	4	-2001300	No
			A1020.50	Underpinning		Structural Foundations	A1020.50	Underpinning	4	-2001300	No
			A1020.60	Raft Foundations		Structural Foundations	A1020.60	Raft Foundations	4	-2001300	No
				A1020.60.10	Cast-In-Place Concrete	Structural Foundations	A1020.60.10	Cast-In-Place Concrete	5	-2001300	No
			A1020.70	Pile Caps		Structural Foundations	A1020.70	Pile Caps	4	-2001300	No
				A1020.70.10	Cast-In-Place Concrete	Structural Foundations	A1020.70.10	Cast-In-Place Concrete	5	-2001300	No
			A1020.80	Grade Beams		Structural Foundations	A1020.80	Grade Beams	4	-2001300	No
				A1020.80.10	Cast-In-Place Concrete	Structural Foundations	A1020.80.10	Cast-In-Place Concrete	5	-2001300	No
	A20	Subgrade Enclosures					A20	Subgrade Enclosures	2		No
		A2010	Walls for Subgrade Enclosures				A2010	Walls for Subgrade Enclos	3		No
			A2010.10	Subgrade Enclosure Wall Construction		Walls	A2010.10	Subgrade Enclosure Wall	4	-2000011	No
				A2010.10.10	Cast-In-Place Concrete	Walls	A2010.10.10	Cast-In-Place Concrete	5	-2000011	No
				A2010.10.20	Precast Concrete	Walls	A2010.10.20	Precast Concrete	5	-2000011	No

Figure 04

Another important task that needs to be accomplished when implementation of BDS is part of a long view approach is the consolidation of content and templates, across the LAN as well as between multiple offices.

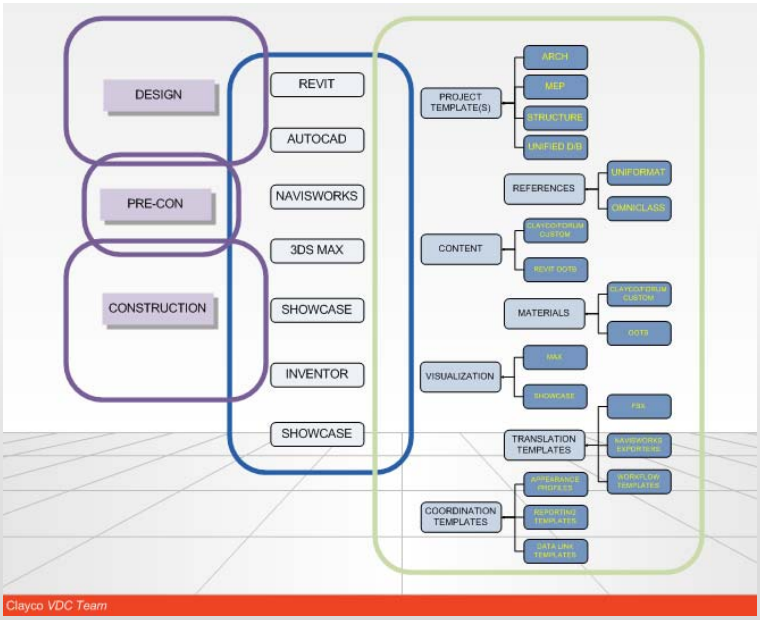


Figure 05

Infrastructure Environment

Clayco Inc. is headquartered in Chicago IL, and the core operational power is in St. Louis MO. The requirements of a seamless BIM centric workflow are met with in-house support for a dual OS environment, selective DFS deployment (due to Autodesk not supporting it), deployment of Citrix environment and full support for mobile app deployment. When it comes to facilitating Revit workflow, Revit Server technology is implemented both across the Clayco domain, as well as across our DB partner domains through the establishment of outside domains and selective trusts between Revit Central Servers and partner's local servers.

As for the deployment of BDSu with full capability locally the hardware specifications are as follows:

Mobile Workstations:

- Dell Precision M4600, 32 GB RAM, 512 SSD, 2GB Graphic Controller
- MacBook Pro 16 GB RAM, 768 SSD

Workstations:

- Dell Precision T7400, 32 GB RAM, 2 GB Graphic Controller
- Dell Precision T3600, 32 GB RAM, 2 GB Graphic Controller

Tablet:

- iPad 2nd and 3rd generation

Leveraging the capability of Autodesk BIM applications throughout the building design process

The ideal approach to software implementation throughout the DBB process yields itself tothe resolution of the information loss due to greater continuity of data as it is being captured by multiple content creation or content management applications.

At Clayco, from day one of BIM process implementation, the decision was made to create prerequisites for seamless data transfer between the multiple stages of the project delivery cycle. This approach had led to a significant investment in reconfiguration of our cost codes and their linkage to resources as being used with applications that constitute BDSu and with a few third party applications used during our pre con process.

The deliberate use of updated Uniformat Classification in combination with OmniClass enumerators created the prerequisite for early data entry, read use of embedded data as provided by the design templates, all the way to the reuse of the same data during the commissioning phase of any project.

Defining objectives

So what does it mean to successfully apply one product or suite to a process that is defined by one simple yet powerful characteristic? The “Integration” is the word that comes to mind if one is to explain what DB represents within the context of both project delivery means and methods, but also from the point of view of human interaction and those critical relationships that make any project go smoothly.

When our VDC team, in collaboration with our design subsidiary, as well as our operations, procurement, technical assistance and our real-estate groups, decided to consolidate and standardize our internal process and the software supporting it, the following questions needed to be answered:

- What is the cost of consolidation?
- What and are there any savings?
- Which project will immediately benefit from this implementation?
- Who and when needs to be trained?
- How will this make our Design and Pre-Con integration “smoother”?
- How will this impact our sometimes a bit hectic workflow with the consultants?
- How will this impact our 4 year old initiative to bring BIM to field?

Answering those questions proved to be a bit challenging, and the answers to a few are still being collected, compiled and compared to our ability to deliver a project without this desired level of integration.

Consolidation

Making the decision to either purchase or cross grade to BDS, or as in our case BDSu (Building Design Suite Ultimate), was a relatively easy decision. Leveraging the number of users that were proficient multi-platform users and number of projects that were dependent on more than one Autodesk application, had proven to be sufficient for justifying to pursue the ratio of 25% of total seat count to be BDS based.

Meaning that on 15 seats with the average application utilization of 4 software titles , we as an organization have saved roughly $150,000 in software purchases.

Savings & Training

However one cannot regard the avoidance a future purchase as a savings, as the actual need on a project and the ability to leverage utilization of network based software licenses would most likely yield toward a more optimized licenses distribution.

Another indicator of potential savings or expenses in that regard is a need for the additional training and post training implementation. The ability to absorb, process and implement any new software know how varies greatly between individuals, and is somewhat dependent on the their generational association.

This is particularly evident in a adoption rate of software titles beyond those that are required for the immediate production needs, and bridging this gap or eliminating inefficient use of BDS suite is most challenging part of this implementation.

Addressing this issue is one of the primary roles of Clayco's VDC department and is done through the following steps:

- Formal 5 day 4 hour application training with the project based curriculum.
- Periodic Lunch and Learn events covering topics applicable to real-life projects.
- Ad-hoc training that happens on dally basis, and is performed mainly as a part of an ongoing support effort by any of VDC team members.
- Software reseller based training with Clayco project material.

Immediate beneficiaries

The two groups that became the outspoken early adopters of suites implementation were the design team and project engineers. The design teams have effectively integrated these applications in their day to day workflow and also pushed the implementation team to develop the respective templates:

- Autodesk Revit
- Navisworks Manage

- Showcase

On the operations side, the project engineers have directly benefited from field deployment of the following software titles:

- Navisworks Manage
- Navisworks Freedom
- Inventor and Inventor Publisher

Designs, Estimators and Project Control

This is the one area where implementing BDSu resulted in mixed enthusiasm, to say at least. The complexity and the required speed of interaction on fast paced DB projects requires a more nimble set of tools that are capable in meeting the real time requirements of the information exchange. The construction quality models, quantities and the need for embedding means and methods within the design model, are combined, quite a challenge. This is an activity where Forum Studio has performed admirably in adapting their design process toward embedment of construction requirement within their modeling techniques, and with the help of VDC team and Revit's construction tool set the design intent model is ready from the day one for Pre-Con transition.

In the ideal world, this scenario would mean that all of the work toward total BIM integration is done, but in reality this is where the real problems get in the "suites" way:

- Questionable estimating quantities
- Take Off tool that is not quite up to snuff
- Lack of dynamic reporting
- Need to bring 3rd party applications (VICO Office, Primavera, SQL Server / Reporting Engine) on board in order to fulfill this most critical information exchange on a construction process.

Consultants

The need for integration extends beyond contractual agreements and fiscal relationships. It is reflected in one of the most sought after prerequisite for a consistent BIM workflow, which is collocation. In that regard, the managing of available applications and making them available to consultants, either during the content creation process or during spatial coordination, is greatly simplified with BDSu.

The consolidation of the Revit platform and the availability of AutoCAD MEP made is possible to have the following discipline integration readily present on Clayco projects at LOD 300 content development:

- Mechanical (Revit & AutCAD MEP / Inventor)
- Plumbing (Revit & AutCAD MEP)
- Electrical (Revit & AutCAD MEP)
- Fire Protection (Revit & AutCAD MEP)

The Field

Over the past 18 months Clayco has successfully deployed several solutions as our default BIM platforms that are not necessarily bound to BDSu, but are capable of enabling and ensuring real time access to project content. Applications like Buzzsaw, Design Review, BIM 360 and Inventor Publisher Viewer have become the standard of our DB practice.

Defining metrics

Our belief in the process made us ask questions that are more in tune with the reality of our team's interaction and individual proficiency and that are less dependent on the overall capability of the each application.

This metric can be dissected into the following categories:

- Objectives in the context of POP (Product, Organization, Process) model and
- Objectives in the context of project phase (Plan, Design, Construct, Operate)
- Objectives in the context of available human resources
- Objectives in the context of interoperability

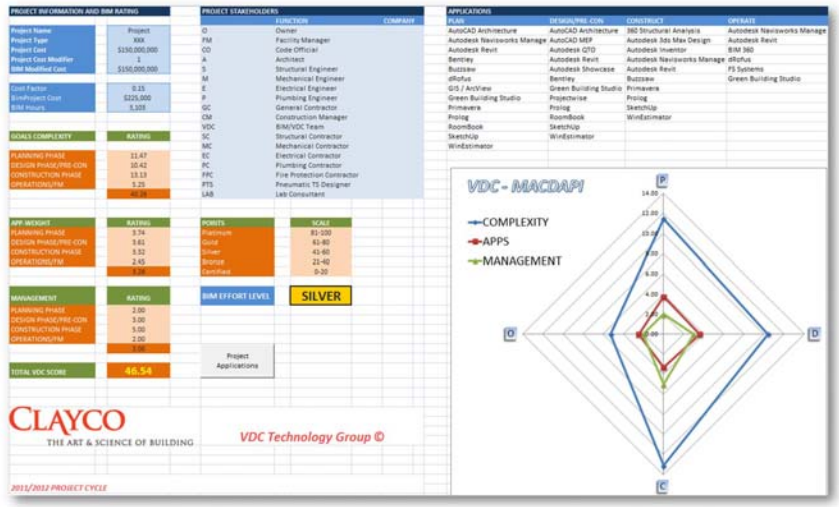


Figure 06.

POP objectives

The Product, Organization and Process (POP) CIFE© model has been loosely applied on all phases of BIM enabled project delivery at Clayco Inc. This has been done by purposely neglecting the specific need to define the level of detail, since it is implicitly assumed to be associated with the proposed phasing structure, and explicitly defined through the BxP as derived from this matrix.

The scoring is based on definable objectives that have been identified for the Planning, Design/Pre-Con, Construction and Operations phase of our projects, and are furthermore categorized by their role in product, organizational and process improvements.

For each category in this matrix, there are four separate software choices as they determine the complexity of information exchange during the content creation, followed by the content management and distribution.

The first software choice category which carries the most weight is based on the BDSu applications suite, and it serves as a benchmark for the default content production cycle, assuming that every consecutive application associated with a particular project objective is in one way or another forced to exchange some information with the application from BDSu. (*Figure 07 & Figure 08*)

Figure 07.

Figure 08.

Resources

Successful leveraging of the combined capability of the BDS software suite is by all means related to two factors. The first is focused on an organization's determination to disperse a discipline centric BIM and the second is related to actual project requirements.

From a Design Build point of view, the distribution of the software titles with BDS and all of the accompanying subscription titles calls for a thorough evaluation of indicators that are related to acquired or "homegrown" knowhow as well as those that are related to plain math.

If one is to judge the status of knowhow which is required to deliver a DB project through all of the previously mentioned four phases, attention needs to be directed to identification of all those tasks that are directly or indirectly dependant on software proficiency.

The somewhat subjective approach guiding this evaluation is being contained through the collaborative approach and peer to peer evolution at the level of Clayco's VDC steering committee, and tracks the accumulation of knowledge as our capacity to meet a certain project task with a desired level of proficiency. (*Figure 09*)

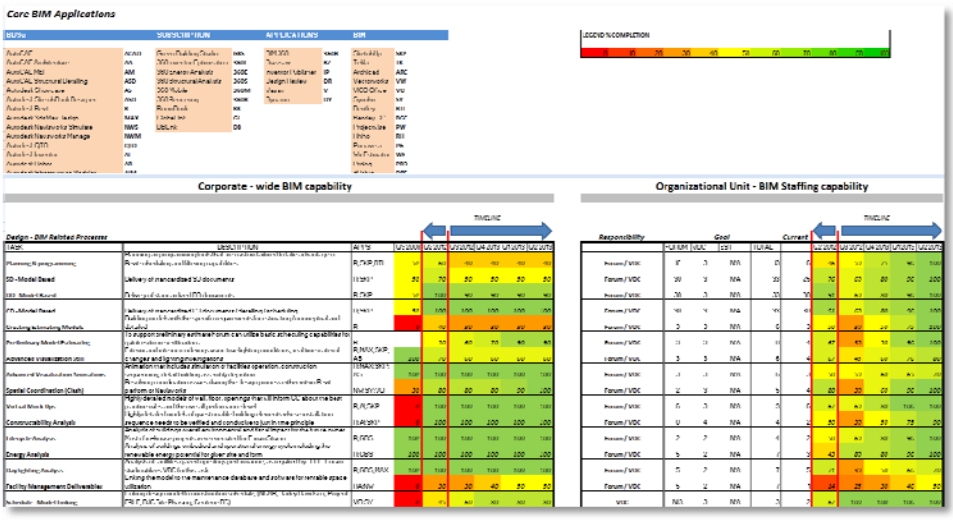


Figure 09

A clear example of one of these indicators is the ability to perform day lighting analysis during the planning or the design phase of a project, by utilizing both Revit and 3ds Max Design platforms. In the case for this specific task, the chart bellow will show that this particular knowhow has been fully adopted by Clayco, however only 3 out of required 8 individuals are capable of performing this type of the analysis, meaning their distribution on concurrent jobs could be questioned.

Another conclusion that can be derived from having this type of information is how many jobs can rely on this particular task to be an integral part of the project delivery. This type of metric is particularly sensitive for tasks for which duration is proportionally larger as the overall ration between the task duration and the project schedule.

Day lighting Analysis	Analysis of facilities glazed openings performance, as required by LEED. Forum studio utilizes VDC for this task.				R;GBS;MAX	*100*	*100*	*100*	*100*	*100*	*100*
Forum / VDC	6	2	N/A	8	3	*38*	*50*	*55*	*65*	*70*	

Figure 10

The second indicator measuring the overall applicability of the required software solution is dependent on the available human resources and on our ability to level them across multiple jobs that require those same specific tasks. (*Figure 10*)

After careful examination of BIM enabled jobs over the past 5 years at Clayco, it has become apparent that over time these jobs called for an ever increasing number of applications and required more time to be allocated to the maintenance of both model embedded information and the fidelity of geometry translation.

The below example is based on one of the more recent projects and clearly depicts the overall sense of confusion and increased concerns that BIM project leads have to match with greater time allocation toward information management. (*Figure 11*)

APPLICATIONS			
PLAN	**DESIGN/PRE-CON**	**CONSTRUCT**	**OPERATE**
AutoCAD Architecture	AutoCAD Architecture	360 Structural Analysis	Assembe System
Autodesk Navisworks Manage	AutoCAD MEP	AutoCAD	Autodesk Navisw
Autodesk Revit	Autodesk QTO	Autodesk 3ds Max Design	Autodesk Revit
Bentley	Autodesk Revit	Autodesk Inventor	BIM 360
Buzzsaw	Autodesk Showcase	Autodesk Navisworks Manage	FM Systems
dRofus	Buzzsaw	Autodesk Revit	Green Building St
GIS / ArcView	Green Building Studio	BIM 360	
Green Building Studio	Projectwise	Green Building Studio	
Primavera	Prolog	Primavera	
Prolog	Rhino	Projectwise	

Figure 11

Since the introduction of Building Design Suites, and in particular since Clayco Inc. has decided to standardize on BDSu as the default suite that is distributed to the core VDC team and to project BIM leads, it has become essential to map the relationship between the project deliverables and the suite titles. This standardized mapping is illustrated in the figure bellow, which was used to direct a multidisciplinary design team by providing visual clues in regard to

process definition as outlined in the BIM execution plan for Centerpointe Hospital, in St. Charles Missouri.(*Figure 12*)

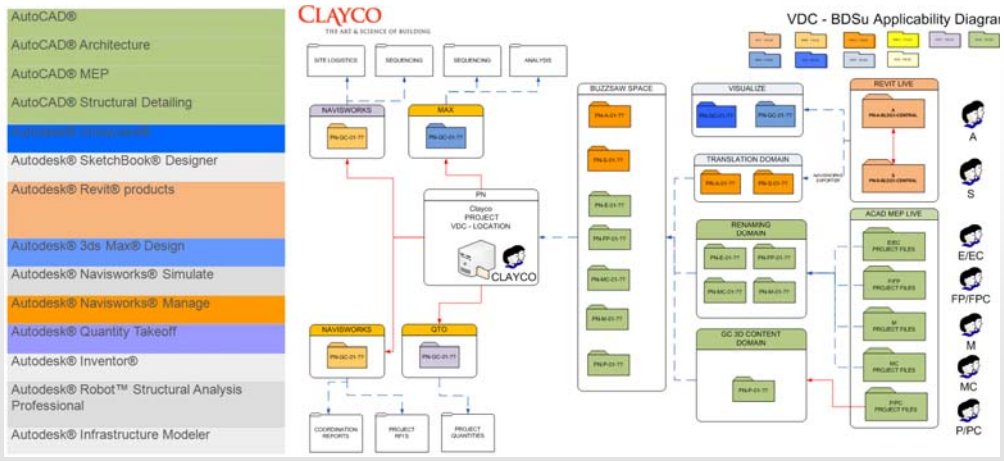


Figure 12

Do's and don'ts of multi discipline information exchange as seen from the client's perspective

It has been our experience that the more transparent the process of implemented BIM methodology is, the more likely a client will agree to the added cost which is often associated with deliverables beyond what might be considered as "instruments of service", a term used loosely to describe a set of standard BIM deliverables.

Use of BIM for construction documentation, accurate quantities and project components enumeration, and fully coordinated record models and schedule verification, are what we regard as our "way of doing business".

Venturing into the realm of added value BIM, which extends beyond the cost of general conditions, requires a clear understanding of each platform's capability, the exact scope of added services and ultimately the client's willingness to commit to BIM compliant deliverables.

When an organization decides to direct a significant part of their effort toward the use of a digital tool-set, parameters need to be set in place that will assure the following clarity in the dialogue as outlined during the Owner's projected use of BIM.

- Identify owner's level of BIM experience
- Identify owner's readiness to deploy BIM as the default methodology for any of the facility lifecycle requirements
- Identify the default BIM platform that will serve the required purpose

Some common mistakes that are often committed when BIM becomes the focus of an evolving discussion, starting with the planning phase, are:

- Inability to determine what the real need for BIM is on the project and how that need translates into a value added service for the client
- Inability to clearly identify the scope of data that will define this deliverable
- Inability to clearly define the integration and the use of that same data from the owner's perspective
- Inability to identify the required cost savings associated with BIM against the lifecycle cost in order to justify the effort
- Inability to provide BIM as the part of the overall service solution such as training and implementation with owners that are not quite there yet.

The outlined advantages as identified can be further delineated according to their relation to BDS software tiles and the expectations as seen both through the perspective of geometry fidelity and data integration, including the ability to assure BIM redistribution and access

In order to deliver on the promise of BIM from an owner's perspective, outlining the following comparison has been instrumental in conveying the value of BIM as transposed over Clayco projects in conjunction with some documented metrics:

- **PreCon**
  - Spatial Coordination
    - 70% shorter meeting time — Revit
    - Real time model / documentation updates — Navisworks
    - Improved accountability — AutoCAD
    - More likely to realize where design can be improved
  - BIM Based Estimate
    - 70% faster takeoff — Revit
    - Target cost analysis — QTO
    - True cost loaded scheduling — Navisworks
    - Same model from concept to detailed estimate — Max
    - Prerequisite for location based scheduling
    - Building envelope analysis results in more cost effective solutions
  - Scheduling
    - Visual Schedule verification — Navisworks
    - 40% faster look ahead meetings — Max
    - Better control over the site logistics
    - Every schedule will get changed and improved after model based verification

- **Construction**
  - Spatial coordination LOD 400
    - Prerequisite for prefabrication — Revit
    - Just in time delivery when connected to schedule — Navisworks
    - Up to 90%$ waste reduction through prefabrication — Inventor
    - Production in controlled environment - Quality/Speed/Safety/Light site presence
    - LOD 400 first prerequisite for As Built model
    - Reduction in RFI numbers by 70 to 90 %
  - Field BIM
    - First prerequisite for paperless job site — Autodesk / BIM 360
    - Documents available at the place of current work activity (always the most current set) 80% time reduction in document verification — Buzzsaw, Revit
    - If RFI needs to be issued it can be done on the spot, based on model verification — Navisworks
    - Mobile BIM
  - Issues tracking
    - RFI from the field and in the model — BIM 360
    - Checklists — Buzzsaw
    - Work Log — Navisworks
    - One point of entry
  - Virtual Mockups
    - 90% savings — Revit
    - Almost no cost for options — Inventor
    - Constructability resolved offsite
    - Specifications integrated
    - No time waste to verify the next condition
    - Best practices as part of the modeling approach pushed to design

- **Owner / Operations**
  - Asset management
    - Assets tracking and replacement scheduling - 80% time reduction — Revit / COBIE
  - Computer Aided Facility Management (CAFM)
    - Accurate documentation — Revit
    - Ability to deliver project through phases — Navisworks
    - Less time consuming information input and querying, up to 70%
    - Space allocation/ Management & Tracking
      - Reduced occupancy costs by 15%
      - reduced churn rate by 50%
      - reduced annual move spend by 80%
      - increased onboarding capacity by 60%
  - Building Systems Analysis
    - Tracking the actual performance vs Model — Revit
    - Post occupancy analysis and Energy Use optimization — GBS
    - Ready to use OM, model based
  - CMMS
    - Accurate as-built - equipment finding and maintenance planning — Navisworks
    - Better efficiency when issuing work orders
    - More efficient Cost Modeling and process planning
  - Project Management
    - Real time access to Models / Construction Documentation — Buzzsaw

Overcoming pre-construction myths of BIM enabled project delivery

When describing the role of BIM, with respect to the functionality and interoperability of available software solutions, parallels should be drawn between the phases of the project delivery cycle and the capability of each platform to support those same processes.

The biggest stumbling block when it comes to BIM enabled project delivery is reflected through an organization's capacity to deliver and perform on BIM enabled projects. When the need for adequate project staffing arises, most companies solve this issue through an all hands on deck approach, and BIM centric staffing is questionably rendered as secondary to immediate availability.

At Clayco/ Forum one way of circumventing the staffing issue is associated with the ability to understand our internal capacity from the perspective of our ability to deliver a project with consistent quality as it relates to BIM compliant deliverables.

The second most dominant factor is related to how well we can exchange information during the design and pre-con processes, which very often run in parallel, especially with fast-track jobs. This is the situation when the wishful thinking behind LOD implementation falls short of its promise.

This brings us to the point where the entire concept of template development should be regarded as a fundamental exercise prior to making any attempts to capitalize on a multi platform workflow.

The glue that binds the consistency of BIM deliverables is the capability of the Pre-Construction department through their commitment and the ability to adapt the processes connected to project and cost control to the new BIM paradigm.

Within any pre-construction department, due to their typical project load, it is always very difficult to mandate or expect to encounter a level of BIM proficiency sufficient to meet project demands. The alignment of the VDC group with those objectives will result in a workflow that focuses on short term achievable goals, and long term planning.

Those short term goals when paired with the capability of each individual BDSu applications are most likely to be found in areas where the level of interoperability is greatest, and where the individual platform exhibits greater maturity.

For pre-con, Site logistics, Design coordination, Schedule Linking, and Prefabrication planning are best served with the current set of BDS applications.

The area where BDSu falls short is in the transition from conceptual to detailed estimating and the time frame associated with this, and in the area of project management.

Some of these problems can be partially solved though the previously mentioned pairing up of specialized teams, but that in itself is not a long term solution.

Overcoming the divide between design and construction, even in a DB firm, is not an easy task, but nevertheless is one that needs to be done in order to properly enable BIM. To do this we deployed the following strategy:

- The Estimator is always right and BIM will prove it…
- 2D take-off is great and BIM will make it shine…
- No need for a detailed schedule = no need for BIM
- The cost of BIM will never exceed the cost of mistakes
- State your project objectives clearly or don't bother to state them
- Bring pre – con to BxP meetings

Beyond that, as with anything else when it comes to significant paradigm shifts and new shiny toys, make sure that there is never a lack of patience, understanding and good coffee.