Measuring the value of BIM for Infrastructure:

Return on Investment

Value and ROI in infrastructure project delivery and lifecycle management

Horizontal BIM, VDC, and CIM (which stands for different things depending on where you are in the world) are all being used to describe the way companies are deploying model-based technologies and workflows on civil infrastructure projects.

The McGraW-Hill Construction SmartMarket Report on The Business Value of BIM for Infrastructure reported in 2012 that BIM use in infrastructure will be adopted at faster rates than when BIM was first introduced for vertical building projects. Along with this adoption comes the desire to assign values to BIM for Infrastructure benefits or even better, to calculate the Return on Investment (ROI) of implementing BIM. The long history and solid credibility of ROI has made it a necessary evaluation step prior to many capital or labor-intensive business investments, such as BIM adoption.

Some firms want to calculate a return on investment ratio to assess the economic benefits associated with process change, while others find making this calculation too difficult or labor-intensive. Many note that rigorous economic measurement is often challenged by project complexity and uniqueness.

With all of its strengths, ROI analysis is often unable to represent intangible factors that are important to a project or a firm, such as avoided costs or improved safety. While there is no industry-standard method for BIM ROI calculations, the benefits of BIM for Infrastructure manifest in a variety of ways, many of which we'll explore further in this ebook.

[2] McGraw Hill Construction (2012) and see "Autodesk 2013 BIM ROI Customer Perception Study" in A appendix

ROI factors—investments and benefits

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Calculating investment

Both the results of the McGraw-Hill SmartMarket report and a recent BIM ROI Customer Perception Study indicated that firms understand the costs associated with BIM adoption. However, there is significant variation in the practice of measuring or tracking BIM investment as a separate cost, distinct from business operations as a whole.

Investments occur at different points along a timeline of BIM adoption as firms grow more sophisticated and project use expands. Investments may be of varying duration, particularly strategic initiatives aimed at transforming the business.

Startup investments
- Technology platform (hardware, network, storage and cloud capacity)
- Software capability (licenses, subscriptions)
- Training/re-training
- Communications, data-sharing infrastructure
- Workspace modifications

Project-specific costs
- Project management adaptations
- Disruptions in workflows
- Team process changes
- Accommodate data/model requirements

Strategic costs
- Planning initiatives
- Standards development
- Monitoring, documenting, measuring impacts
- Customization, Innovation
- Additional headcount and/or new roles (e.g., BIM manager, IT support)
- Leadership and culture investments

ROI factors—investments and benefits

There are typically two types of BIM investments in the infrastructure sector: 1) startup costs to implement technology; and 2) longer-term costs supporting strategic business changes.

Startup costs

Particularly in the startup phase, technology investment is deemed a significant expense by over 50 percent of the survey respondents, yet is considered an unavoidable price of remaining competitive and current in the industry. Investments in software that supports BIM and new or upgraded hardware required to operate BIM software are two of the top areas of focus of BIM for Infrastructure investments.

Direct labor expenses are seen as the largest component of any project, but are not believed to be appreciably different for BIM-centric versus traditional CAD projects. Firms are aware that the costs of professional development, which include initial training in the use of BIM software and new workflows, must also be considered in the investment calculation. As one engineer from Clark Nexsen said, “There probably was an additional cost, but down the road, as we get more experienced and faster, I anticipate that will be less of an issue.”

Costs of professional development, including initial training in the use of BIM products and instruction in new work methods, must be considered in the investment calculation.

ROI factors—investments and benefits

Longer-term costs

Additional labor investments are needed to tailor BIM to the processes of the firm, such as investing in standards development or customization. Such costs can be difficult to quantify. Companies find it challenging to measure costs associated with workflow disruptions and inefficiencies during adoption and early implementation. Efforts required to change internal processes—in other words, to integrate data and information in the model earlier in the design development process or to incorporate modeling during preconstruction—must likewise be considered to build a complete investment calculation.

Keep the faith. Although initial projects maybe challenging, the data show that benefits and ROI increase in relations to increasing experience.

Early adopters of BIM for Infrastructure have noted that to transition from 2D design to BIM workflows it may take a few years to fully complete. As such, it is challenging to measure costs associated with workflow disruptions and inefficiencies during adoption and early implementation.

Value supported by results

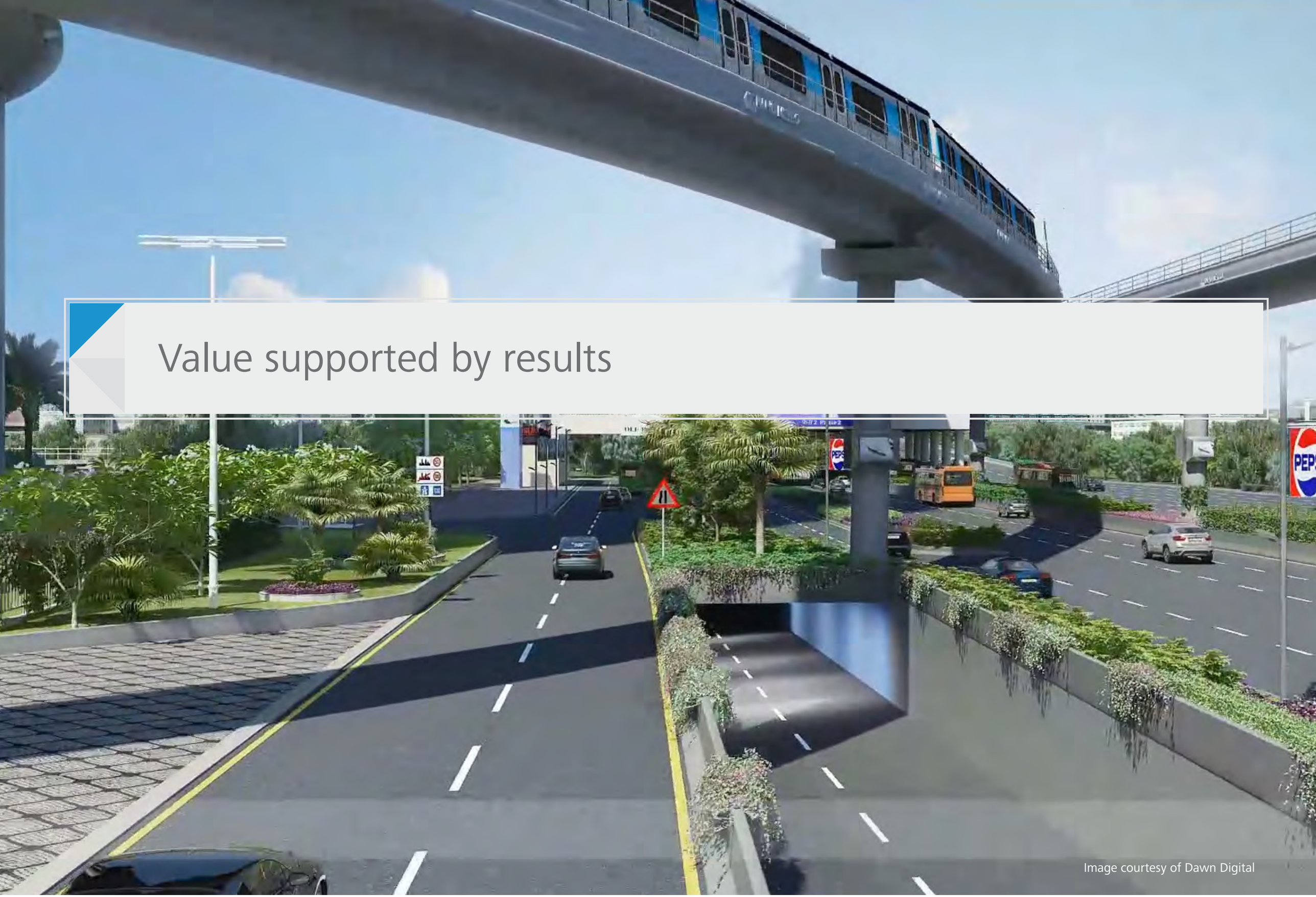

Image courtesy of Dawn Digital

Value supported by results

Case studies have identified many benefits that support the value of BIM for Infrastructure.

Cost savings

"Approximate 25% savings on cross-section generation."
– Engineer at Cole Engineering

"With the ability to study 12 different alternatives, BIM made it possible to identify a solution that saved approximately $15 million dollars."
– Huitt-Zollars

Time Savings

"From a manager's point of view, being able to make design changes more quickly was instrumental to meeting the deadline - especially when you multiply those savings over the lifetime of the project. We can't begin to measure how much time we saved."
– Design Manager, Gremmer & Associates

"We are experiencing a 30 percent schedule reduction by using BIM workflows on our infrastructure projects."
– Vice President, American Structurepoint

Better Results

"There were a few big advantages to having a BIM for Infrastructure design process, one of which was being able to product a lot more information at a much earlier stage, which helped us put a lot of the design concepts in front of the team, in front of the client, in front of the contractor, the the design-build project. It also helped the team to construct the project without a single utility confict through the 5-mile alignment."
– Engineer - Dewberry

"BIM give us a more accurate representation of the highway and a deeper understanding of the project during construction."
– Engineer, Skanska Balfour Beatty Joint Venture

Value supported by results

How stakeholder roles impact assessment of BIM

Infrastructure projects create the opportunity for a number of benefits resulting from BIM that differ from building projects.

Modeling existing conditions

A variety of data sources including GIS data, LiDAR data, underground radar, traditional survey data and aerial photography can be used to develop an in context model of the existing civil conditions with which teams will be working. Once the model is in place, it can be leveraged for analysis, simulation and visualization to optimize designs.

Simulation

Once existing conditions, both above and below the ground, are modeled, engineers can simulate the impact of their proposed designs.

Stakeholder engagement

Large civil projects are sometimes controversial and can require evaluating many alternatives before a final option is approved. Numerous stakeholders and special interest groups are given the opportunity to comment on the options, but have difficulty understanding the differences between alternatives by looking at traditional engineering drawings and renderings. BIM provides the means to produce compelling visualizations and animations which can accelerate the evaluation process.

Marketing new business

The ability to create visualizations of design proposals during the selection phase has proven to be a competitive differentiator.

Quantifying the impact of process change

Quantifying the impact of process change

What BIM benefits are being achieved?

In conversations with design, construction, and client teams around the world as they strive for collaborative process change, Autodesk has gained insight into individual firm benefits. To apply ROI to decisions about technology adoption, companies assess and prioritize opportunities to achieve returns based on a list of target BIM benefits ranging from preconstruction to operations.

Design and communications

- Well-understood scope of project design
- Higher-quality end product, fewer warranty problems
- Design productivity, parametrically coordinated documents
- Model-based analysis, including drainage and traffic analysis

Scope control

- Optimize overall design duration
- Fewer RFIs
- Fewer design change orders
- Fewer owner changes

Preconstruction

- Easier, quicker visualization for GCs, subs, inspectors
- 3D and 4D visualization logistics/sequencing efficiencies
- Organized, efficient document management

Construction workflow

- Team size, focus
- Reduced costs of printing, packing, copying, shipping/receiving, distribution
- Lower general conditions for GC and subcontractors
- Reduction in project schedule
- Reduced prices, less anticipated risk by subcontractors
- Improved field safety, control, survey, crew tracking

Operations/maintenance

- Digital facility information to support maintenance efficiency

Quantifying the impact of process change

Design and Communications	*Process Change Options*	*Desired Outcomes*	*Potential Measures for Return*
Well-understood scope of project design	Share 3D model and data among stake-holders	Design and construction bids reflect accurate scope, and the scope and geometry are more stable	SAVING: Fewer scope changes
Higher-quality end product, fewer warranty problems	Information added to design model in more detail	Design that supports construction efficiency; design with reduced errors	SAVINGS: Fewer RFIs. Reduction in change orders and associated costs. HOURS SAVED, AVOIDED COSTS: Addressing errors
Design productivity, parametrically coordinated documents	Changes in one sheet automatically reflected in all documents, Earlier More Comprehensive Coordination, Consistency from Sheet to Sheet	Efficiency in design alternative generation and coordination	HOURS SAVED: Time spent developing design, documenting, coordinating. Fewer change orders and rework.
Model-based analysis, including drainage and traffic analysis	Fast and efficient drainage calculations, traffic analysis and visuals	Improved stormwater management and a safer, more reliable transportation system	SAVINGS: Time invested in design. Less rework and manual reentry.
Scope Control			
Overall design duration	Opportunities to develop additional design alternatives	Improved quality, client and occupant satisfaction	VALUE OF QUALITY: Client and occupant satisfaction surveys; project recognition
Fewer RFIs	Develop joint model strategy, clarify responsibility, level of detail, interop strategy	Efficient use of resources, expertise. Fewer delays waiting for information.	HOURS SAVED: Time invested in responding to RFIs; Number of RFIs
Fewer design change orders	Fewer RFI-generated COs; fewer field issues	More in-depth design understanding; ability to resolve constructability issues	HOURS SAVED: Time spent redesigning in the field. Savings: less rework
Fewer owner changes	Increase communication to owner/client to clarify project scope and methodology	Owner has comfort level with progress and program	VALUE OF QUALITY: Owner/client feedback

Table 1a: BIM benefits mapped to process change, outcomes and measures

Quantifying the impact of process change

Preconstruction	*Process Change Options*	*Desired Outcomes*	*Potential Measures for Return*
Easier, quicker visualization for GCs, subs, inspectors	Widen stakeholder access to diverse set of project views	Increase understanding of project specifics	VALUE OF DELIVERABLES: Visualizations created, employed; stakeholder assessment of visualization usefulness
3D and 4D visualization logistics/sequencing efficiencies	Test and clarify logistics and sequencing of construction methodology, safety and systems	Improve understanding of design & systems; construction field efficiencies	VALUE OF SCORE: Design and systems understanding feedback Savings: reduced rework
Organized, efficient document management	Conduct meetings electronically with digital markup, comments, review	Efficient use of professional labor	HOURS SAVED: Time invested in recording and documenting decisions, communication
Construction Workflow			
Team size, focus	Increase specialization of BIM team	Efficient use of resources, expertise	HOURS SAVED: Time invested in specific tasks by phase
Reduced costs of printing, packing, copying, shipping/ receiving, distribution	Reduce emphasis on paper deliverables	Efficient documentation and information transmission; team all knows current scope	SAVINGS: Cost of duplication and shipping/ receiving
Lower general conditions for GC and subcontractors	Reduce contingency by accurately anticipating scope	Efficient use of resources, expertise	SAVINGS: Variations in scope, cost avoidance
Reduction in project schedule	Reduced dependence on fluctuating scope documentation	Reduced risk, reduce rework.	SAVINGS: Amount of time-variable Finance costs
Reduced prices, less anticipated risk by subcontractors	Process to mock up crew overlap and sequencing	Reduce claims and liens	SAVINGS:Lower prices at bid, claims and liens
Improved field safety, control, survey, crew tracking	Improved planning, increased monitoring	Predictability, Reduced risk	SAVINGS: Layout and control savings, field issues, accidents
Operations/Maintenance			
Digital facility information to support maintenance efficiency	More efficient data interoperability to streamline owner facility management transition	Use of digital models to support operations and maintenance.	HOURS: labor to create and maintain as-builts Savings: lower maintenance costs

Table 1b: BIM benefits mapped to process change, outcomes, and measures

Conclusion and key takeaways

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Key takeaways

- **Recognize** that practices for measuring and assessing ROI vary widely. Metrics for the benefits and ROI of BIM are increasingly important to spur the investments required for adoption and greater implementation.
- **Employ ROI measurement** to aid in assessing the value of different options, in advocating with internal and external stakeholders and with clients as your firm expands use of BIM to new applications.
- **Apply a framework** of three dimensions for BIM for Infrastructure return on investment—cost savings, time savings and better results—as your firm develops its road map for BIM-enabled services.
- **Launch an internal regime** of measurement for current projects to create the necessary platform for ROI and BIM maturity evolution going forward.

References

- McGraw-Hill Construction. “The Business Value of BIM in North America: Multi-Year Trend Analysis and User Ratings (2007–2012)“ http://bit.ly/ViCIzO.
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