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Amara's Law: How BIM's Future Benefit Can be Measured Today

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Amara's Law: We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.[1]

INTRODUCTION

Much like wood, iron, rock and oil, information is a resource that is gathered such that it can be utilized in an application. However, information enables its possessor to make better decisions rather than better products. Building Information Modeling (BIM) is encouraging the collection of information and providing a repository for the collection of this resource. Yet a toolbox of the finest tools has little value if there is no craftsman to apply them. Information in BIM has little value without practitioners apply to it.

It is well documented that construction stakeholders recognize that BIM's full benefit is realizable over the entire building life cycle. The McGrawHill SmartMarket Report "Building Information Modeling" released in late 2008 noted, "architects and engineers place the highest emphasis on [Lifecycle Value of BIM]. The data created during their early involvement in BIM projects can live on long after their work is complete."[2]. Other notable benefits of BIM's application include:

- Easier bonding;
- Fewer Lifts (safety and liability);
- Fewer code violations and punch outs
- Reduced number of RFI's and quicker RFI turnaround;
- Fewer change orders; and
- Reductions in crew down time.

Certain hurdles to the application of BIM in greater capacities have been the limitations of financial measurement. Owners are reluctant to expand the scope and role of architects, engineers, and contractors without understanding the expected benefit. Charles Hardy a deputy director with the U.S. General Services Administration's Office of Property Development stated in an August 2007 interview, "in the end, there has to be a strong business case, focused on ROI and value added, for all parties involved, to commit to BIM use."[3] BIM, as an information repository, now has the functionality to provide this analysis such that more informed decisions can be made.

Matt Cramer, President of Dee Cramer, a Michigan based heating, cooling and ventilation contractor notes, "as a contractor we are experiencing significant gains in the form of increased productivity and other measures. In fact, we have been able to pass along these savings to owners in the form of reduced bids/quotes. That being said, we have also observed that owners are reluctant to adopt BIM without a better understanding of the magnitude of the benefit they could expect to receive from its use. As the industry is able to better measure the short- and long-term savings provided by BIM, its adoption and application is sure to increase."

With BIM's 4D and 5D capabilities[4] the models possess the financial information necessary to estimate the value of the project in the design phases. Further, this information (when intertwined with information regarding the building operation and design) enables owners, designers and contractors to make informed decisions about building design and component product usage based on the change in value of the building project over the building life cycle, not simply the cost reduction in the construction of the facility. Utilization can be envisioned to model facility management costs, energy usage, tenant space usage and occupancy cost management.

Valuation of New Building Investment

		Design, Engineering and Construction Period		Early Use - Stabilization Period		Stabilized Period
		Year -1	Year -2	Year 1	Year 2	Year 3 & Beyond
Revenue		0	0	2,500,000	2,750,000	2,832,500
Operational Expense		0	0	875,000	962,500	991,375
Repair and Maintenance Expense		0	0	750,000	825,000	849,750
Net Income (After Tax)	35%	0	0	875,000	962,500	991,375
Less: Capital Expenditures		0	0	100,000	100,000	100,000
Design, Engineering & Construction Expense		1,000,000	5,000,000	0	0	0
Future Profits		(1,000,000)	(5,000,000)	775,000	862,500	891,375
Discount Factor	15.00%	0.93	0.81	0.71	0.61	
Present Value of Future Profits		$ (933,398)	$ (4,058,252)	$ 546,982	$ 529,135	
Total Present Value of Future Profits (Year -1 to Year 2)		(3,915,533)				
Present Value of Residual Cash Flows		4,557,075				
Total Future Profits		641,542				

Discount Rate	15.0%
Less: Long-Term Growth Rate	-3.0%
Capitalization Rate	12.0%
Residual Cash Flow Value	$ 7,428,125
Present Value Factor	0.61
Present Value of Residual Cash Flows	$ 4,557,075

THE THREE APPROACHES TO VALUING ASSETS

There are three general methods of valuing an asset; the cost approach, income approach and market approach. While all are applicable in regards to the benefits of BIM, this piece will focus on the income approach to valuation.

THE INCOME APPROACH TO VALUATION

The income approach is premised on value being measured by the present value of all future cash flows generated by the asset (building). Essentially, there are two components to this valuation approach, 1) the cash flows generated and 2) the risk of receiving them. This method calculates the present value of the cash flows at time zero (i.e., the present date). The income approach can be applied to building construction because of the ability to forecast the cash flows based on the future revenues and expenses the building will produce and incur over the entire life-cycle of the building. Further, this analysis can be completed in the concept and design phases of construction such that the [lifecycle] value of the project can be measured and managed, rather than simply managing construction costs.

CASH FLOWS

The cash flows generated are typically measured as a) revenues generated less b) expenses, and giving consideration to non-cash items such as capital expenditures, asset replacement, working capital investments, etc.

REVENUE

Revenue can be forecasted based on several factors; the geographic region, performance of the specific industry, the underlying purpose of the building (i.e. commercial rental units), market rates of commercial rental buildings in the area, as well as other factors. Many times revenue may be forecast giving consideration to phases of the life-cycle such as pre-stabilization and post-stabilization.

EXPENSE

The modeling of expenses over the building life cycle may yield the greatest benefit. Value management utilizing BIM technology will enable stakeholders to make design changes and product choices that may cost more in initial outlay but may add significant value over the building's life cycle. BIM not only provides a repository for financial information, but its ability to evaluate the interaction of design changes with the operating systems of a building have brought together the design and financial capabilities.

In addition, if BIM models can be used by owners and facility managers throughout the lifecycle, the detail contained in the model provides for a more informative and accurate process of repair, maintenance, and changes to the physical space (e.g., finishes).

The expenses applied in the income approach include all costs incurred to build and operate the building. Essentially, there are two categories of expense to consider when measuring the value of the building; a) the cost incurred during the entire construction of the building from design to completion, and b) the operational costs incurred during the entire operational life of the building.

RISK

The measure of risk estimates the cost of the uncertainty associated with receiving future cash flows. A discount rate is applied to the cash flows to capture the discount an investor would apply to future cash flows to determine what the value would be if the cash flows were paid in a lump sum payment today. Each year's cash flow is discounted using the computed rate of return specific to the asset being valued to arrive at the annual present value of distributable cash flow. The sum of these cash flows yields the total present value of cash flows for each individual represented in the model.

AN EXAMPLE

Scenario 1 (on page 30) provides a framework for a base set of design and construction costs as well as ongoing revenue and expense from the operations of the building. The values reflected herein are simply for example to illustrate the potential value adding abilities of BIM. Important to note are operating margins of 35 percent, combined construction costs of $6 million, and a discount rate of 15 percent.

Scenario 2 (on page 31) illustrates the change in Value calculated by reducing the design and construction costs 10 percent. These costs would conceivably be generated with a reduction in construction claims, clash detection, and increased trade coordination.

Scenario 3 (on page 31) illustrates the contribution to Value that results from BIMs ability to allow for the construction of a building that generates improved operating margins; this model reflects a relatively modest improvement in operating margins from 35 to 38 percent. It is important to note that BIM may also provide for cost savings through reduced repair and maintenance expense, lower capital expenditures, and reduced risk. This would further contribute to the Value of the building.

Valuation of New Building Investment

		Design, Engineering and Construction Period		Early Use - Stabilization Period		Stabilized Period
		Year -1	Year -2	Year 1	Year 2	Year 3 & Beyond
Revenue		0	0	2,500,000	2,750,000	2,832,500
Operational Expense		0	0	875,000	962,500	991,375
Repair and Maintenance Expense		0	0	750,000	825,000	849,750
Net Income (After Tax)	35%	0	0	875,000	962,500	991,375
Less: Capital Expenditures		0	0	100,000	100,000	100,000
Design, Engineering & Construction Expense		1,000,000	4,400,000	0	0	0
Future Profits		(1,000,000)	(4,400,000)	775,000	862,500	891,375
Discount Factor	15.00%	0.93	0.81	0.71	0.61	
Present Value of Future Profits		$ (933,398)	$ (3,571,262)	$ 546,982	$ 529,135	
Total Present Value of Future Profits (Year -1 to Year 2)		(3,428,543)				
Present Value of Residual Cash Flows		4,557,075				
Total Future Profits		1,128,532				

Discount Rate	15.0%
Less: Long-Term Growth Rate	-3.0%
Capitalization Rate	12.0%
Residual Cash Flow Value	$ 7,428,125
Present Value Factor	0.61
Present Value of Residual Cash Flows	$ 4,557,075

CONCLUSION

BIM's technical capabilities gives owners and general contractors the ability to determine how the estimated value of a building can be enhanced with products changes, system changes, and structural changes. While BIM has been utilized to reduce immediate construction costs, a majority of a building's value is captured in the cash flows that exist for the decades following its construction. Adding 5D cost information to BIM models, and related financial models, allows owners and contractors to evaluate modifications to the building process. This evaluation enables parties to determine if proposed modifications add value, or simply reduce building construction costs.

FOR FURTHER INFORMATION

For a full list of references for this article please email editor@matrixgroupinc.net. ■

Valuation of New Building Investment

		Design, Engineering and Construction Period		Early Use - Stabilization Period		Stabilized Period
		Year -1	Year -2	Year 1	Year 2	Year 3 & Beyond
Revenue		0	0	2,500,000	2,750,000	2,832,50
Operational Expense		0	0	800,000	880,000	906,40
Repair and Maintenance Expense		0	0	750,000	825,000	849,75
Net Income (After Tax)	35%	0	0	950,000	1,045,000	1,076,35
Less: Capital Expenditures		0	0	100,000	100,000	100,00
Design, Engineering & Construction Expense		1,000,000	4,400,000	0	0	
Future Profits		(1,000,000)	(4,400,000)	850,000	945,000	976,35
Discount Factor	15.00%	0.93	0.81	0.71	0.61	
Present Value of Future Profits		$ (933,398)	$ (3,571,262)	$ 599,915	$ 579,747	
Total Present Value of Future Profits (Year -1 to Year 2)		(3,324,997)				
Present Value of Residual Cash Flows		4,991,502				
Total Future Profits		1,666,506				
Percentage Increase in Value from Operational Expense Savings	48%					
Cumulative % Increase in Value from Use of Bim Techniques	160%					

Discount Rate	15.0
Less: Long-Term Growth Rate	-3.0
Capitalization Rate	12.0
Residual Cash Flow Value	$ 8,136,25
Present Value Factor	0.6
Present Value of Residual Cash Flows	$ 4,991,50