ACCELERATING GREEN BUILDING MARKET TRANSFORMATION WITH INFORMATION TECHNOLOGY

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ABSTRACT

The green building movement seeks to transform the way that built environments are designed, constructed, and operated. Over the last decade, the tools of this transformation have included market interventions such as professional training and accreditation, project rating systems, and the third-party certification processes. These interventions have made a demonstrable difference on the industry with levels of participation exceeding 10% of new commercial construction in leading metropolitan areas. Today, the movement is envisioning the interventions it will need to dramatically scale-up and extend this impact. The foundation for these new approaches will rest on information technology and analytics – tools that will provide unprecedented insights into market activity and allow near real-time comparison and benchmarking. These emerging capabilities will create new dimensions for market competition, competitive advantage for high-performing projects, and increasing risks for low-performers. Taken together, these approaches will accelerate and intensify the movement toward high-performance, green buildings and communities

Keywords: green building, market transformation, performance, information technology, benchmarking

INTRODUCTION

The green building movement seeks to advance the design, construction, and operation of built environments to promote human health, wellbeing, and the restoration of the natural environment. The contemporary green building movement began two decades ago with a powerful mental image and a simple idea. The image was a classic curve -- the distribution of practice across the industry ranging from a few scofflaws, through the average-performing majority, to a small group of innovators -- a variation on a pattern recognized across many industries (Rogers 1962). The idea was use to strategic market interventions to permanently shift this distribution toward higher performance. At the time, very little information existed to define this conceptual distribution of practice and there was little experience with specific market interventions.

The lack of experience or data did not deter the movement. The nascent green building industry set course and went to work with passion. The early areas of focus included efforts to create a broad-based

industry coalition, grow a trained workforce, create assessment tools, and reward buildings based on performance and achievement. There are clear signs of success in each of these areas. Here, we will focuses on new opportunities related to information and analytics related to projects.

Green building practice rests on tools and processes to design and assess high-performance, green buildings and communities (i.e., projects). These tools and process allow practitioners to identify and communicate about relative merits of green building strategies (e.g., integrative design, energy efficiency, or water conservation, the achievement of milestones (e.g., facilities management policies), and, ultimately, the performance of whole systems ranging from interior spaces to neighborhoods (e.g., whole building energy performance).[1] These tools and processes are codified in building rating systems, such as the US Green Building Council's Leadership in Energy and Environmental Design (LEED™[2]) and a number of analogous systems around the world (Cole 1999).

LEED provides practitioners with a platform to advance the consideration of issues related to location and transportation, design and engineering processes, construction activity, site planning, energy, water, materials, indoor environmental quality, and innovation. One of LEED's fundamental benefits to the market is greater transparency about the achievements and performance of buildings with regard to these previously invisible characteristics.

Over the past decade, the day-to-day tools underlying LEED have been a simple paper scorecard and, at the end of the process, a glass plaque displayed in a building lobby. It is remarkable to consider the impact that these simple elements have had on the building industry. Today, we have the opportunity to build on these fundamental goals and concepts with information technologies that can vastly accelerate and scale-up their impact. This paper describes one vision for this new phase of information-powered, analytically-driven market transformation.

MARKET EFFICIENCY

Classical economics assumes that market participants have equal and immediate access to information (Fama 1970, Malkiel 2003). Markets use this information to set prices and value assets. Today, real estate markets have developed sophisticated tools to provide information on the financial aspects of individual buildings and portfolios. Commercial information services provide data and benchmarking related to capital cost, sales price, tenancy, and a myriad of other factors. Markets for this information are sophisticated and highly segmented. However, there are no readily accessible, consistent, or comprehensive resources to address the non-financial dimensions of assets, such as energy use, water consumption, or occupant experience in or around the property. The absence of this information

[1] In this context, the term "performance" refers to a measurable, typically quantitative metric, such as energy efficiency, renewable energy generation, water consumption, or occupant satisfaction. The term "achievement" refers to binary or qualitative activities, such as policies, procedures, or discrete choices (e.g., green cleaning, commissioning, or the use of third-party certified building products). The terms are often used together as "performance and achievement" to reflect the typical range of green building practice.
[2] See www.usgbc.org/leed for more information.

contributes to inefficient markets, impairs innovation, and, in some cases, contributes to market failure (Gillingham et a. 2009).

The most direct remedy to this situation is to create public and private mechanisms to provide information on the non-financial aspects of assets, i.e., the green dimensions of homes and commercial buildings. This can be accomplished through public labeling programs and private efforts to create asset dashboards and Key Performance Metrics. The development of these programs is accelerating, witnessed by the success of building-level Energy Performance Certificates in the European Union, green building certification, and, in a few major metropolitan areas, municipal energy benchmarking (IEA 2010). However, these efforts are only scratch the surface. Ultimately, we need to connect information about energy performance with detailed information about project attributes (e.g., technologies, management strategies, etc.) and utilization (e.g., occupancy schedules, occupant density). These data must then be embedded in tools and services explicitly designed to foster constructive competitive and accelerate market transformation.

ACCELERATING THE DIFFUSION OF INNOVATION

Information about outcomes and performance are the foundation and currency for the next generation of green building. However, by itself, this is not sufficient to propel the next generation of market transformation. Information alone does not drive the change. It needs to be interpreted and attached to mechanisms that create clear market opportunities for high-performing projects and, by extension, competitive risks for low-performers. This is where our interest here diverges from agnostic market analytics. The green building movement seeks to use this information to drive permanent, self-sustaining change. Simply providing richer reporting on the status quo is inadequate. Our success will ultimately be measured by the rate and magnitude of change.

This means that we seek to use information technology to actively accelerate the diffusion of innovation. This concept refers to the rate with which new practices are taken up by market participants. Some industries have a long tradition of embracing diffusion theory and working across research, development, and deployment to accelerate change. For example, programs to increase appliance efficiency have raised the bar repeatedly over the past decades and achieved notable success (Nadel et a. 2003, Gillingham et a. 2006).

The building sector as a whole has not traditionally embraced these concepts, particularly for whole buildings or real estate portfolios. Yet, information technologies create opportunities for new, scalable market interventions. We recognize and address four key dimensions in our work:

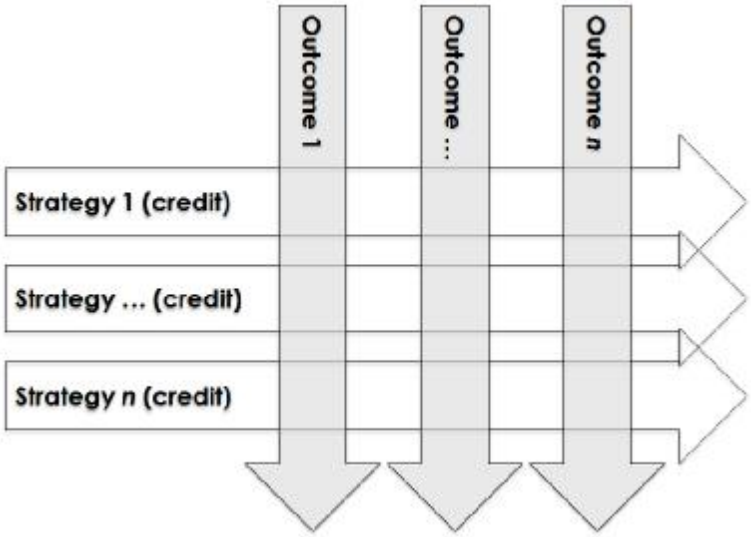
- Define outcomes – dimensions for performance and evaluation: Green building is not, in isolation, an outcome. It is a framework, and we have developed new approaches to defining and evaluating specific outcomes expected from green buildings. These outcomes provide the basis for market competition and differentiation.

- Understand and reward high-performers: These new performance dimensions can be used to sort and rank projects, discover their underlying practices, products, and services, and create performance-based reward systems.
- Inspire and assist low performers: Conversely, this information creates the opportunity for low-performing projects to identify higher-performing peers and

OUTCOMES

Over the last decade, green building has been rooted in a single, simple perform dimension: the total number of points a project achieves with respect to the criteria of a rating system. This dimension is segmented into categories, such as LEED's Certified, Silver, Gold, and Platinum. The act of certification and, at times, the level certification became a goal in itself.

Over the last several years, we have explored new approaches to expand this traditional focus, including developing and implementing a multi-dimensional framework linking green building outcomes and practices. Our terminology has evolved with our understanding. An initial version of this framework was released as part of a package in LEED 2009 (USGBC 2008). In this framework, every green building "credit" (a.k.a., strategy) is quantitatively associated with 13 environmental "impact categories", such as greenhouse gas emissions, resource depletion, and smog formation. This is used to assign weights (points) to individual credits. It also allows credit achievement to be used to track specific outcomes – literally unpacking information collected during certification.



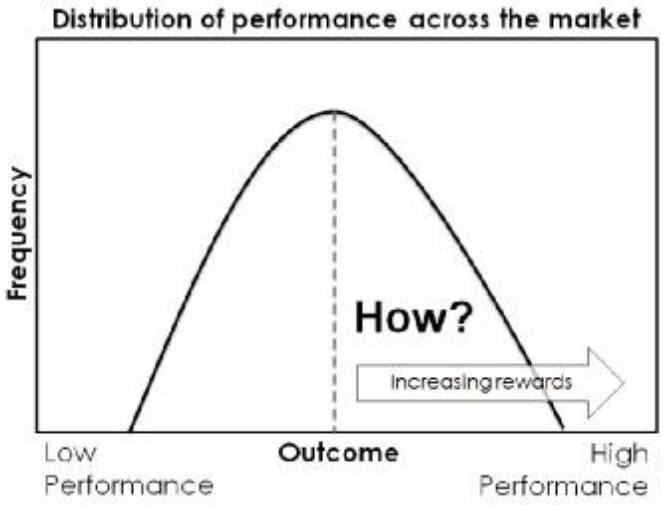
In LEED 2012, these categories will be adapted to include seven core green building outcomes (e.g., greenhouse gas emissions reduction) supported by a set of over 30 metrics (e.g., energy efficiency, renewable energy production). The bottom line is that the design of the next generation of ratings systems with be closely tied to specific outcomes. In turn, these design tools will create opportunities for advanced analytics relating project performance and achievement to specific outcomes.

Taken together, a paradigm is rapidly emerging that will allow green buildings to be defined and analyzed across a set of well-defined, sometimes standardized, performance dimensions or outcomes (e.g., UNEP SBCI 2009). These outcomes or performance dimensions can be as "simple" as energy use intensity (e.g., annual energy use per square unit of floor space) or much more complicated, synthetic

measures, such as the 29 weighted factors included in the LEED 2009 GHG Index. Each of these metrics provides a new dimension to rank and sort green building projects with respect to different goals and outcomes.

Higher Performers

Each performance dimension is populated with real projects using third-party verified data collected during the certification process. In every case, we have the opportunity to identify and reward high performers. Simply scoring based on performance is a first step. However, technology allows us to create and share more valuable information. We seek to understand the factors that contribute to a level of performance and achievement. Fundamentally, we want to understand *how* projects achieve a given level of relative performance. This means identifying and tracking relationships between people, organizations, practices, technologies, and a myriad of other factors. Each high-performing project has value as a model for lower-performing projects and a milestone for those that achieved it.



CATEGORY	POINTS	RANKING ?
Energy and Atmosphere	25/30	
Materials and Resources	10/14	
Indoor Environmental Quality	17/19	
Sustainable Sites	8/12	
Water Efficiency	7/10	
Innovation in Operations	7/7	
Total	74	

Today, we can use a demonstration information system called the Green Building Information Gateway (www.gbig.org) to begin to identify and explore high-performing projects across multiple outcome dimensions. For example, the table to the left illustrates the performance and achievement of an exemplary office building in Chicago, IL across six categories. The accompanying density plots compare the selected project (the dark triangle) with others certified using the same rating system, in this case LEED for Existing Building: Operations & Maintenance (more information is available from http://www.gbig.org/projects/10049661).

Our ambition is to use this type of data and information technology to shorten cycles between innovation, market uptake, operational performance, and positive recognition. This means creating increasingly-automated information systems that collect data on performance, practice, and technology in near-real time and provide dynamic, context-relevant benchmarking and recommendations. This will provide decision makers with clear and timely information for their market – green "comps" not current available in the real estate industry.

LOWER PERFORMERS

The green building industry has always been comfortable recognizing high-performers. The preceding approach to high performers accelerates this process and increases the timeliness and relevance of information flows as tools for market transformation. However, for every high performer there are a commensurate number of under-performers. Outside of Lake Woebegone, such under-performers are statistically inevitable.

Yet, we have been less aggressive in rigorously searching them out and trying to understand and assist them. We must find a way through or around our inhibitions regarding under-performance and low achievement. We must pursue an understanding of these projects that is equal or greater to our energies devoted to recognizing and rewarding high-performance.

CATEGORY	POINTS	RANKING ?
Energy and Atmosphere	1/17	
Materials and Resources	7/13	
Indoor Environmental Quality	5/15	
Sustainable Sites	7/14	
Water Efficiency	2/5	
Innovation in Design	5/5	
Total	27	

Fortunately, we can adapt the same foundation of information technologies to identify projects that under performance or achieve less than their peers. We can then dive deeper to understand *why* these projects lag their peers and recommend specific strategies for improvement based on practices used by comparable projects. We want to understand the challenges and, if necessary, create new or improved interventions to barriers such as technology limitations, technical understanding, or first costs.

Again, we can use the Green Building Information Gateway (www.gbig.org) to begin to identify and explore relatively low achieving projects across multiple outcome dimensions. The accompanying graphic illustrates selected metrics for a LEED for New Construction (version 2.2) project in Washington, DC (more information is available from http://www.gbig.org/projects/10100317).

Fundamentally, this is simple mirror image of our approaches to high-performers. We seek to use information technologies to "unpack" projects, identify similar, higher-performing projects, and use data analysis to flag potential problems. We have the opportunity to use information technologies to highlight strategies used by comparable higher performance projects.

CONCLUSION

The success of green building over the last decade attests to the ability for relatively simple interventions to produce demonstrable market transformation. The coming decade requires new tools and approaches to bring these concepts to scale and to generate the pace of change needed to achieve our mission of creating sustainable, healthy, high-performance built environments.

My belief is that this change will be powered by a new generation of information technologies specifically designed and deployed to promote market-based competition across multiple dimensions, understand and learn from high-performers, and recognize and improve low-performers. Every performance dimension we track provides an opportunity to competitive differentiation. Every high performing project we identify and rank provides an opportunity to learn, recognize, and reward. Every low performing project we touch provides an opportunity for education, investment, and improvement.

The critical technologies are in hand or rapidly emerging, including search, recommendation engines, distributed sensors, social media, service-based software architectures, and cloud solutions. We will engage orders of magnitude more projects and, ultimately, move from an episodic "certification event" to regime of continuous performance and real time monitoring. We can see the contours of this new world and envision its sweeping implications for green building practice.

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