Why Innovation Happens: Structured Actors and Emergent Outcomes in the Commercial Buildings Sector

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ABSTRACT

Why are contemporary commercial office buildings not dramatically more efficient than those constructed twenty years ago? Although this has generally been a question for engineers and architects, we are investigating from a social-organizational perspective the (non-)integration of green designs and technologies into commercial and institutional building projects. We focus on the socioeconomic and socioenvironmental factors associated with current practices at each stage of the development process from planning through construction. To the discussion of "performance," we hope to make suggestions concerning the organizational features of commercial building markets that facilitate and inhibit energy efficiency innovation and the subsequent incorporation of energy efficient designs/technologies into commercial building projects. In this paper we report some initial findings from our field studies and offer a preliminary account of where strategic intervention to promote energy efficiency may be the most productive.

Introduction

Commercial office buildings use significant amounts of energy. They could perform much better than they currently do in terms of energy consumption and environmental impacts. While a good deal of research has been conducted on improving the design techniques and technologies used in commercial building spaces in order to improve their overall performance little has been said to date about the social and organizational features of commercial office "development" and their impacts on building form. What's more, energy efficiency policy has begun to shift away from improving specific building projects toward improving the functioning of commercial office markets (i.e., transforming the market). In addition, international treaty commitments to reduce greenhouse gases to 1990 levels has spurred nations (and states in the U.S.) to begin to refocus policy attention on all significant energy uses and pollution sources—with large buildings being among the most visible.

In line with this "refocus," this paper and the research on which it is based emerges from a prior effort that sought to appraise the "state of knowledge" concerning commercial building markets and innovation in energy efficient building designs and technologies. That work, funded by the California Institute for Energy Efficiency, resulted in an important

Scoping Report titled *Commercial Buildings—Market Transformation Research Needs*, whose conclusions provide an important backdrop to our current efforts (hereafter referred to as the "Scoping Report" [Lutzenhiser et al. 1998]). Taking off where the Scoping Report stopped, we initiated this project to analyze empirically how commercial office buildings are conceived, constructed, and used. Specifically, we hope to develop a model of building markets that will aid policy maker interventions in ways that result in long-term market transformation toward more energy efficient practices.

Understanding Commercial Construction as Process

As noted above, we found that traditional energy efficiency analysis has tended to focus on building technologies, energy use, and costs. Its rendering of the parts played by human actors in energy use and conservation has been notoriously weak (Lutzenhiser 1993)––for the most part limited to notions of consumer/producer rationality, discount rates, market barriers, free riders, etc. This historically posed little difficulty, since demand side management (DSM) policy activity has involved planning and evaluating the cost-effectiveness of technology substitution supported by monetary incentives to energy users. Dramatic successes of these efforts have been few, but as long as marginal reductions in consumption continues, it was not necessary to inquire too deeply into why consumers and producers use energy and technologies as they do, why they repeatedly fail to adopt more efficient and cost-effective technologies, and why the most careful efforts to achieve "technical potentials" have so often fallen short. Based in the less than optimal performance of DSM programs, policy emphasis has changed towards the long-term transformation of the market and away from a short-term incentive based agenda.

As an outgrowth, the emphasis of past research and subsequent policy has resulted in a theoretical hole of sorts. In addressing this knowledge gap, the Scoping Report suggested that:

> New market connectivity and market transformation (MT) approaches to energy efficiency require a much better understanding of the dynamics of markets for energy-using goods than has been required by energy analysis and efficiency programs in the past. . . The design of effective MT interventions will require new mid-range theory and research on specific aspects of markets that are now poorly understood (Lutzenhiser et al. 1998: 4).

To date, the energy industry still does not know enough about how these markets work to intervene and promote energy efficient "inventions" in a way that promises that they are adopted as standard practice (i.e., that they in fact become "innovations" [Rogers 1995]). Some attention has certainly been given by energy analysts and social scientists to the attitudes and choices of consumers (see Lutzenhiser 1993 for a review)—and this knowledge base continues to be of value in MT. But, aside from a bit of work on tax and regulatory policy, relatively little attention to market-level processes or to changing patterns of energy and technology use at the societal level (Shove et al. 1998). These shortcomings handicap efforts to transform markets in the near future.

In particular, two assumptions which underlie much of the previous commercial building research confound a deeper understanding of energy-related innovation (and the lack thereof) in the commercial construction industry. The first assumption is rooted in the traditional energy view of the market. Through an almost exclusive research focus on those

actors involved in the design and construction process (architects, engineers, and contractors and to a limited extent "owners") much of the complexity of this market place has been ignored. The second assumption is that these market actors (firms and individuals) are autonomous and isolated in their decision making. These limit usual accounts of the complex, interactive, and socially rooted nature of decision making in this market context.

As a result, little attention has been paid to how "conventional practices" in the commercial construction industry both *organize* and *reflect* participant ideologies, customs, and social ties that stifle the introduction of innovative practices, designs, and technologies. We have, therefore, approached the study of the commercial construction market from the perspective of social embeddedness (Granovetter 1985). In that view, markets are seen as dynamic and evolving systems of social and commercial relations. Such market systems are characterized by multiple inputs and perspectives (in this case, financiers, owners, architects, builders, appraisers, regulators, etc.) whose interactions are structured in complex ways in the negotiation of designs and the production of buildings (Lutzenhiser et al. 1998).

A number of specific disciplinary and interdisciplinary literatures have led us to expect complexity in this market and have proven useful in our efforts to understand how and why particular financier-developer-designer-builder configurations do and do not adopt environmentally beneficial technologies in their building designs. For example, over the past half century organizational analysis and management theory have moved from a fairly mechanistic "tool-view" of organizational processes to theories focusing on bounded choice, informal networks, organization-environment interactions, inter-organizational fields/sets, and "neo-institutional" and "open systems" views of organizational behavior (Perrow 1986; Powell and DiMaggio 1991; Scott 1998; Hannan and Freeman 1984; Stichcombe 1965). Recent work in technology and innovation studies also sheds light on how technological choices are shaped in markets (e.g., Hughes 1989; Cowan 1989; Rogers 1995, Bijker, Hughes and Pinch 1989; Dosi 1982). Economic sociology (e.g., Smelser and Swedberg 1994) and several schools of economics, including transaction cost economics (Williamson and Winter 1991) and institutional approaches (Hodgeson 1993) provide other relevant insights into the behavior of actors and groups in market systems.

Informed by these literatures, we seek to better understand what "market transformation" could mean given the context within which buildings are actually built—the commercial construction market place, as an inherently social context comprised of overlapping and simultaneously distinct communities of practice. This has meant addressing the proximate questions of innovation and application given the conditions "on the ground" that must be contended with when participating in a construction project.

In this paper, we focus on the social and ideological factors associated with commercial building investment, project conception, and financing (extreme "upstream" components) and how these affect the designs and technologies that are integrated into building projects, as well as who participates in these projects. We present some of the consistent tendencies we have observed thus far in our current (and continuing) research efforts. Specifically, we explore real estate as a form of investment, discussing how this structures downstream design and production processes and gives the industry an inherently conservative and risk-averse outlook. We end by considering what this can mean for policy construction and the support of innovation in commercial building development. However, before we discuss our findings, a brief account of our methods is in order.

A research note: we have emphasized the production side of the production-

consumption equation. This is for two reasons. First, the research so far has shown that outside of high profile and build-to-suit projects most of the impetus for design derives from supply side decisions. Second, we have yet to research consumption issues fully, leaving any comments we could make concerning the interaction of modes of production and consumption premature.

Research Challenges: Research Sites and Methods

Traditional energy-efficiency industry research of the new commercial building markets has tended to rely on structured surveys and moderate size samples of design professionals, and in some cases owners. The analysis of these data has tended to be quantitative in nature. While such approaches offer a relatively high degree of reliability because results can be compared across sizable samples, we believe the findings have limited validity and offer little guidance for the development of effective energy efficiency programs. This is due to the limited ability of these research designs to ask questions of various market actors that get beyond superficial understandings and assumptions about the market. By using a more qualitative and in-depth method, we intend to produce a more thorough understanding of the new commercial building market.

We have investigated the commercial building market in two regions of the western United States. Over that past year, we have conducted our research in Northern California and the Pacific Northwest—two of the fastest growing regions of the U.S. We have pursued two simultaneous and complementary research trajectories in these locales. The first is a market-based interview and field work approach in which team members have contacted key informants throughout the industry to gather information on a range of questions related to general practice(s), roles of market actors, market characteristics and trends, and innovation.

The second research strategy uses a "cases-as-processes" approach. Unlike conventional static case analysis, our "cases" involve focal building projects, but as strategic locations—nodes that represent a convergence of important industry players. We then trace back and analyze the delivery systems and networks of market actors, identify both potential sponsors for and barriers to innovation in energy efficiency. Used in this way, the cases allowed us to examine (in the "real world") the combined effects of organizational relationships, standards and regulations, changing industry conceptions, economic cycles, and a range of other factors on building practice and resulting structures.

A Way to View the Commercial Office Building Market

We are first interested in general questions about how—given the complexity inherent to financing, designing, constructing, and marketing commercial office buildings—innovation actually occurs in this industry. We then ask more specific questions concerning innovation in energy efficient designs and technology. So in the following we consider how the commercial construction marketplace is organized, what buildings as investments represent in terms of risk and uncertainty, how this marketplace "hedges" against the unknown, and how these processes affect the adoption (and non-adoption) of energy efficient designs, technologies, and techniques.

Market organization

Our initial studies concerned how the market was organized. After some time in the field, it became apparent that the commercial construction market is in reality a plurality of overlapping sub-markets linked by shared purpose—the "specific" building project. That is, while tied together through participation in discrete projects, each segment (financiers, developers, appraisers, brokers, architects, contractors, and so forth) also pursues their own interests and cultivates practices and professional orientations specific to their craft. These *communities of practice* are bound together (informally and formally) by shared expertise, expectations, collective understandings, and tacit knowledge(s) (Wenger and Snyder, 2000). Professional groups of this kind are characterized by cliques (experts, cartels, insiders, networks), obligations and reciprocity (familial, friendship, communal, professional), and values (what is bad and good or right and wrong, given formal and informal professional codes of ethics). In short, commercial construction processes take place within the confines of a *market place*, but organized around specific communities of practice that converge, overlap, and yet also remain distinct.

In a most general way, as decisions about building *form* are made upstream (primarily decisions by developers and financiers about budgets, location, revenues, target markets, and so forth), downstream participants are increasingly constrained in their options concerning *content* (what designs and technologies will be implemented and what services will be rendered). In this sense, each input structures the alternatives of subsequent participants. Thus, as a building project advances, choice becomes increasingly constrained. More precisely, as a project moves from conceptualization, to financing, to design and construction, the opportunity for innovation generally—and specifically in terms of energy efficiency—decreases. Another way to say this is that decisions are made within the confines of boundaries erected by previous decision sets.

Buildings as investments

Therefore, the question is what are the elements that structure decisions down the line? At important junctures in a project, but especially in the initial conceptualization and design phase, negotiations determine the form and content a building will take. Typically, in commercial office development, unless it is build-to-suit,[1] decisions concerning a building's form will be strongly influenced by industry conceptions of what the "market will bear," what is "risky," what is "profitable," what is "functional," what is "flexible," and so forth. Each of these fits into a larger conception of uncertainty reduction and profitability that plays an enormous role in structuring the outcome—buildings and the "efficiencies" that are planned (or not planned) into them (more on these below).

Specifically, a building begins with conceptualization and planning. Depending on the motivation behind a project, which can be the outcome of an owner/developer's desire for profit (i.e., buildings as an investment) or based on a firm's "need" for a workplace, different objectives operate. In either case, initial decision-making involves relating prospective costs, given general project outlines, to value, which involves assessing impressions of "marketability" or owner need (Harris 1993: 225). This takes place as early as site selection

[1] For example, in the case of corporate headquarters the investment takes on a different meaning and intention altogether.

(i.e., location) and land planning—where the costs and constraints posed by local zoning restrictions, building codes, and environmental regulations must be taken into account if the property has not already been "infrastructurally" prepared by land developers.

The most common scenario involves initiating a building as an investment opportunity. The preliminary phase of investment and conceptualization (the "headwaters" of commercial development) involves an array of important steps that include appraising regional growth potential, local vacancy rates, local rents, specific infrastructural demand, market standards (i.e., value, aesthetics, and so forth), local regulations, codes, and permits, as well as a host of other factors in order to predict profits and from that structure a financial package (i.e., loans). In order to fund such capital-intensive ventures, projects are commonly "pitched" to and funded by individual banks, retirements funds, life insurance companies, and conduits (i.e., bank consortia) in a two-part process.

Initially, funding typically comes in the form of short-term construction loans. These are paid out over a brief period of time and are expected to roll over and be mortgaged (i.e., bought out) as soon as the stipulated construction period is complete (generally in one, two, or three-year periods, depending on the project and lender). While there are too many variants to cover in detail here, a brief account of the structuring effects of short-term construction loans on building processes is important to what follows.

When a lender considers whether to cover the expenses of a construction project through short-term loans, their risk primarily lies in assuring that their interest is "purchased" at the end of the construction period. In functional terms, this means that the building achieves (or at least is assured) full tenancy (is completely leased up) or is purchased outright. While these initial lenders are only involved for the short-term, they must be assured of a project's long-term viability, for mortgage lenders do not ordinarily invest in properties that do not promise stable rents (more on this below). In order to assess a project's potential, lenders peer through the lens of "past achievement" as a metric from which to calculate the odds of success or failure. At the heart of the appraisal process is an assessment of whether or not the project conforms to what has succeeded in the past. Lenders are very reluctant to invest in projects that do not fall inside the lines of what has been "profit generating" before—seeing new, untested, and novel items as adding uncertainty, rather than value, to a proposed development.

If short-term loans hinge on whether a prospective property will be purchasable either by conduits, life insurance companies, retirement funds, or mortgage outfits (all typical investors in commercial properties), what are the traits that characterize the longer term interests of these buyers? The promise of stable, relatively predictable, and long-term returns is paramount. In terms of ideology, investment in commercial property represents for many investors something that is material and that has relatively safe growth potential. To bring this point home, it is useful to quote a broker who characterized what about commercial office buildings was attractive to his clients as an investment option. He compares the "profile" of commercial real estate to that of "less tangible" investments such as securities (stocks and bonds):

> The motivations for real estate? One is that it's a diversification of investments for corporations and individuals. Secondly, there's a pride of ownership and a manageability issue with regard to real estate that does not exist in paper, stocks, bonds—you really buy it and hope for the best . . . Real estate is much more manageable, I think there's some long-term concepts that we all kind of gravitate to,

which is *I own it. It's my ground, it's my building, it's all mine, it's something you can touch and feel. And you can do what you wish.* So, there's that motivation. There's (also) some tax issues which don't exist in other investment vehicles… during the time of the hold, you can write off the depreciation. So, there's multiple reasons for owning it. (Italics author's emphasis)

The way that participants conceive of commercial properties as an investment has important ramifications for subsequent phases and ultimately for what is built. Real estate of this type is a distinct sort of asset to the potential investor, embodying a number of attributes that define it as a sound investment opportunity. In the following, we touch on several of these, as noted by our informants, which should shed some light on what it is that lending institutions, firms, and individuals are looking for when investing in commercial property, and the downstream implications of this for other project participants.

Hedging against uncertainty

First, industry players noted commercial property has a *tangibility* that attracts a certain kind of investor, tangibility that securities lack (i.e., stocks and bonds). It represents a real investment in place and time (i.e., *real* estate) that can be owned, visited, and if desired modified. Second, this tangibility imbues the investment with *stability*. Property values tend to be relatively stable, compensating for the fact that its returns are slower to accrue than in more "risky" ventures. Third, this lends property a relative amount of *predictability,* and hence gives an investor a sense of control. All three of these elements allow for returns to be calculated into the near and long-term. As a result, potential income streams promise a consistency (at least on paper) that other investments cannot assure with the same degree of confidence. In this regard, both financing and building development reflect this investment profile. Decisions typically hinge on conservative assessments of form and function in order that stable returns are (more) assured.

As should be apparent, a basic component of this investment type is *risk aversion.* Investors go to great lengths to avoid and diminish the uncertainties involved with buying, selling, and developing properties. Those ideological underpinnings have real consequences for both project design and the machinations that characterize commercial development projects. Unpacking this preoccupation with risk and liability, as well as how the industry further hedges against it, is crucial to understanding decisions that are made throughout the typical development project.

Function and flexibility. In many ways, developers and the buildings they produce reflect the investor conservatism, articulated above, through their reliance on categories of functionality and flexibility.[2] Developers plan and financiers "grade" projects with the buildings function in mind. Investors and developers typically evaluate and advance plans from a *satisficing* perspective; doing only what is deemed necessary and avoiding the superfluous assures predictable returns with lower risks of losing investment monies.

In addition to function, according to a Sacramento area commercial office developer, "flexibility" and "past performance" are key qualities to the investors of his projects:

[2] Most developers are co-investors, or the primary investor, in the projects they champion. When banks lend on construction loans, they typically require between 10-30% equity up front, depending on the developer's track record (for comments on "track-record" see next section).

> In virtually all the cases, the conventional type cases, they are looking back to *historical records of what has been successful in the past.* And so, we're kind of compared to those benchmarks. What are our economic returns? What's the product? What's the product finishes? *How flexible* is it if that particular idea doesn't work? And, you can't get that specific type of tenant? *How flexible* is it for putting a different tenant in it? How much rent will that tenant pay? And will that support the costs that you are going to incur on the project? (Italics author's emphasis.)

The "flexibility" of a proposed project assures a wider pool of prospective buyers and/or leasees and in so doing reduces the uncertainty of "unloading" or leasing a property when a project is completed, as well as throughout a building's lifecycle. When they are considering speculative and owner-driven development projects, banks, developers, and prospective owners must plan with the long-term in mind.[3] Tenant improvements (or TI's) are a substantial cost that will have to be confronted in the future. As such, planning flexibility into a building—for instance, strategizing floor plate dimensions or keeping internal systems simple—opens it to a larger array of customers (both purchasers and leasees), simplifies upgrading the building later, and thus adds value (assures income and raises potential returns). This reliance on "what has been successful in the past," as the above informant related, has the effect of inhibiting innovation in building designs. In this context, innovations are seen as compromising the functionality and flexibility of buildings and are associated with raising the costs of tenant improvements for potential and future clients.

Trust and track-record. Function and flexibility are not the only conceptual elements that lie behind producer decisions. Track-record and trust, as briefly alluded to above, also play an integral role, providing a means to judge markets, structure loans, and choose participants for development projects. Through formal and informal procedures and networks, individuals and firms limit the "unknowns" of their undertakings. For example, banks give better rates to those they have successfully worked with in the past. Developers tend to use the same banks and contract specialists for the same reasons (lower rates and already existent working relationships). And designers, contractors, and subcontractors, while called into projects based on their expertise, are often referred and then chosen based on the social ties they share and the accompanying "trustworthiness" that this brings.

In interviews with institutional lenders, developers, and brokers, the above elements were repeatedly expressed together showing their convergence and coherence for decision-makers. In the following quote, a loan officer at an international bank speaks of the elements he considers when appraising a project's viability. These include both market assessments and project participant "reputations:"

> Is it a downtown office building that you're going to build? A high-rise product, or is it going to be a suburban two or three story? Knowing where it's located tells me something about what to expect in terms of how it's going to look. And also knowing enough about the market dynamics it'll tell me if it's in a sub-market that's doing well. Because Sacramento is not one big market, but it's a bunch of small sub-

[3] The trend away from purely speculative development seems to have resulted from the late 1980s and early 1990s recession. Banks and other lenders had many clients who defaulted on their loans, leaving them with developed and partially developed properties with no leasers or buyers. Thus, lenders now shy away from speculative development.

markets or neighborhoods. So you've got the downtown area, which implies the high-rise office buildings and then you've got the suburban markets . . . they can all be influenced . . . depending on what's been built and what's (in) demand. So where you're building... what you're building. Who are the players that you've identified as being involved in the project other than yourself. Who is the contractor, what's their reputation? Who is the architect, what's their reputation?

This quote illustrates one of the important dimensions that social ties play: they reduce uncertainties, in a risk-averse industry, by providing interpersonal, inter- and intra-firm interactions with predictability and stability (see Hannan and Freeman 1984). This knowledge of and experience with others brings already manifest working relationships and tacit knowledge (the outgrowth of previous experience) to a project. Thus far, we have found that most project participants are chosen, most of the time, on reputation, social ties, and referral.[4] Moreover, generally 70-80% of the business in the firms we have studied cite repeatedly going to the same sources for money, catering to the same customers, rehiring the same contractors, and so forth.

This uncertainty-reducing strategy is mirrored up and down the commercial construction "value chain." Stable working relationships built on history produce trust that further reduces the risks surrounding such managerially and technically complex undertakings. When possible, people do business with persons with whom they are acquainted. Knowing intuitively, based in past-experience, what to expect from other participants is a form of "proof" that reassures financiers, developers, designers (and others down the line) that it has "worked before" and thus increases the odds that "it will work again." In essence, these terms provide a metric against which a project's total "viability" can be measured. Falling outside the lines of the foregoing, by industry definition, entails greater risk, which has negative ramifications for financing new projects as well as for selling or leasing already-built commercial property.

To briefly summarize: according to our informants, real estate represents a material, robust, and predictable investment relative to other potential money making ventures. Flowing from this is an inherent conservatism that manifests itself in an explicit industry aversion to risk—a de facto "fear of failure" investment mentality.[5] That is, investors in commercial properties have done so in part to avoid the uncertainty inherent in investments that lack the *tangibility* and *stability* ascribed to commercial property(ies) development. Moreover, commercial construction/property development ideologically represents a tactile venture that promises relatively stable and hence *predictable* long-term returns. To assure these qualities and further reduce the uncertainty of their investments, the industry relies on the ideological constructs of functionality, flexibility, and track record to promote buildings that avoid "costly" and "superfluous" expenditures and have proven themselves to "add value." In line with this observation, a principal in a major west coast Real Estate Investment Trust (REIT) that develops commercial properties in the Sacramento and Seattle region, noted his company's aversion to constructing "icons" or incorporating superfluous design

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[4] While the public sector differs from the commercial market through "fair practice" competitive bidding procedures, social ties, referral, and working knowledge of other industry actors still plays a major role in selection processes.

[5] It is useful to compare this kind of orientation to that which currently dominates the high tech sector of the economy, where the risks associated with innovations is a way of life. No such innovative spirit exists in the locations we have studied.

considerations into their buildings:

> "We have a . . . model that we use internally. . . We're sort of utilitarian . . . We look at it (a building) and we say no, no, I don't give a damn what it looks like on the outside right now. Let's make sure on the inside that (the) . . . lay out for the tenants (is correct)... and put your money into the common areas. So we put the money into the lobby, into the restrooms, into the corridors, into a gym, into a conference center. . . . if we win an architectural award, I'm going to get a call . . "damnit, why did you waste that money!" That's not where you make money.

As is easily observable, doing what is different, being a first mover, or taking chances is not part of this REIT's market strategy—and we would add, most others in the commercial real estate market place. We now turn to what this means for innovation, since that bears directly on whether or not (and how quickly) energy efficiency concerns are adopted or left on the shelf.

Perspectives on Innovation

Given the nature of the commercial office building market described above and its aversion to risk, it would appear that the prospects for innovation are limited. However, innovation does occur in the commercial building market. It is important to remind ourselves that innovation need not be a disjunctive affair as energy efficiency advocates (and as the authors of this paper) might expect or hope. That is, while the industry is resistant to disruptive design/technological/techniques its has incrementally changed overtime and for the better in many ways. Specifically, our research while in its early stages has pointed to some areas where innovation has occurred as well as the outlines of why it has happened. In this section, we present some initial observations on innovation that may offer opportunities for market intervention.

Innovation and Income. Innovation must respond to the industry's focus on stable income. The risks associated with energy efficiency innovation has associated them with undermining stable and predictable returns. This outweighs the gains promised by "reduced operating costs." To overcome this, energy efficiency innovations must respond to specific market needs that translate into increased income streams not reductions in operating costs. While a small semantic turn, it nonetheless is a significant one when appraising a property's potential. Specifically, we have observed two market sectors that provide the potential for energy efficiency related innovations: the increasing demand for Smart Buildings and the demand for quality workspace environments to that attract and retain quality employees.

Innovation and the Development Process. The building industry—in line with the speed-up of our current U.S. economy—is in a state of flux as it attempts to meet the exponential increase in demand that has accompanied this economic heat up. Some in the industry have responded by transforming their delivery systems in ways that speed up the production process and reduce the uncertainties associated with project costs.

On the surface, short construction timelines and design-build type delivery processes would seem to limit innovation in commercial buildings. However, by understanding these trends, opportunities for energy efficiency innovation may exist. In particular, two trends

seem important: the increasing involvement of design professionals and construction contractors in the early phases of project conceptualization, and the expanding use of computer and communications technology to streamline the construction process and simplify the implementation of what have been complicated internal systems.

Innovation and Relationships. The building industry reliance on relationships and communities of practice to conduct business and reduce risk can act as a barrier to innovation. This is in part because industry actors are not willing to risk their relationships by suggesting new ideas, technologies, or designs that do not fit expected or accepted conventional practices. However, it is also important to recognize this sword cuts both ways. Innovations can also spread and become accepted through existing relationships and networks. Successful innovations are most likely to be adopted when the members of a development team know and trust one another and come together to develop a response to a market need in a creative and innovative manner. In such cases the "now known" innovative products/practices are demystified and thus are more likely to diffuse to other projects as the participants themselves move on.

Innovation and Market Niches. The building industry strives to produce buildings that will appeal to large segments of the market and generate income in the long-term. As we have noted, this also tends to stifle innovation, particularly if the innovation has limited flexibility in the marketplace. However, by targeting market niches that are more "conducive" to accepting energy efficient types of innovations, diffusion into resistant sectors is possible. For example, innovation in owner-occupied or build-to-suit buildings for public and private sector organizations who seem more inclined to consider energy efficiency innovations is an important conduit through which testing and diffusion occur. Thus far, our research has found some promising examples of this kind of "leap" from one market niche to another as designs and technologies "tested" in one context find their way into more conventional structures.

Conclusion(s)

Constructing buildings that are more efficient will require a significant change in the commercial construction industry's standard practices. Previous attempts to improve the performance of buildings through incentives (i.e., rebates) and appeals to environmental sustainability have thus far neither provoked widespread or deep changes in industry processes or outcomes (buildings and their efficiency). It is our opinion that they have not quickly penetrated this market place (i.e., "radical" adoption) because of the conventional skepticism that commercial investors and developers have for designs, technologies, and modes of construction that do not "add value" in terms that are *ideologically salient* to this market context (for example, in terms of function or flexibility). As we have discussed above, the aversion to what is new and the reliance on past experience starts at the very begining of a development project with conservative investors seeking to hedge their investments against uncertainty and assure themselves steady and long-term income streams.

As an outgrowth of these initially conservative undertones, the intermediate actors (architects, contractors, and structural and mechanical engineers, and so forth) in the development process "inherit" a very limited range of options from which to make decisions

concerning a building's form as well as its content. Again, this is founded in the industry's aversion to risk, which has structured participation in such a way as to bias the industry against new and innovative designs, technologies, and techniques. As currently practiced, then, innovation and/or newness, whether it be in the form of ideas, materials, or personnel falls outside the lines of history and track-record and the predictability that the "already known" brings to a project. Thus, even downstream, through the way project participants are selected (i.e., based on their "reputations" which is social shorthand for one's "track-record"), their social ties to others, the mutual expectation that this brings to a project (I know what he/she wants—they know what I want), and the trust that this promulgates secures one sort of advantage (stability, predictability, and from that risk reduction) and tends to preclude another (innovation and newness [see Hannan and Freeman 1984; Stichcombe 1965 on the "liability of newness"). All these elements predict that innovation would receive a chilly reception from an industry whose economic bottom line is expressed not only through their concern with costs (which it most certainly), but also in the social and cultural organization of the industry and its mirroring of this industry's aversions to uncertainty.

However, despite this seemingly pessimistic view, we believe there may be opportunities for encouraging energy efficiency innovation by understanding industry trends and responding to the opportunities these trends present. The essential point is that innovation must respond to market needs and must use existing industry mechanisms for minimizing risk. Our initial findings suggest there may be opportunities for encouraging energy efficiency innovation by taking advantage of market needs for quality workspace environments (to encourage employee retention) and the demand for state-of-the-art building system infrastructure for communication and technology systems. Trends in the building development process intended to reduce project risk, such as the use of computer and communications technology, and the early involvement of design and construction professional in conceptual development, are mechanisms that could help support innovation in the direction of energy efficiency.

Through continued research and refinement of our understanding of innovation in this market context, we are striving to develop a model of the office building development process that will capture how inputs are structured in such a way as to produce buildings with specific forms and features. Our intent is aid policymakers in developing strategies for successful market transformation in these markets.

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