


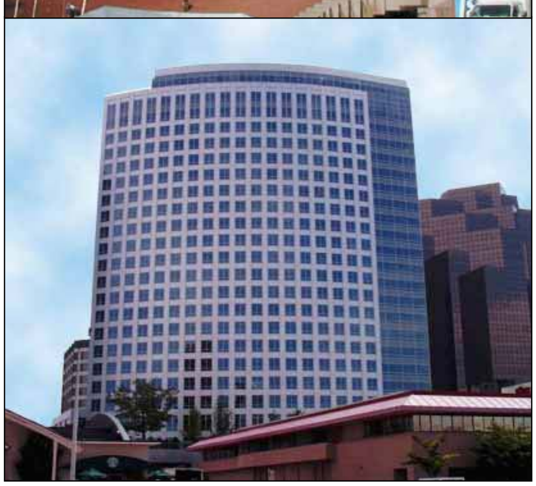

MARKET STRUCTURE AND ENERGY EFFICIENCY:

The Case of New Commercial Buildings

A Report to the
California Institute for Energy Efficiency

Market Structure and Energy Efficiency: The Case of New Commercial Buildings

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EXECUTIVE SUMMARY

Why aren't commercial office buildings more energy efficient? Several decades of energy efficiency programs have resulted in some gains, but overall increases in the energy efficiency of buildings have fallen far short of the 30 to 50 percent improvement that many efficiency advocates believe is possible (DOE 2000).

The purpose of our research has been to consider this "why" question by empirically examining the dynamics of new commercial building markets. Our intent is not to provide prescriptive or programmatic answers, but rather to develop knowledge about the market sufficient to support strategic interventions in it.

Traditionally, energy efficiency research and development (R&D) and demand-side-management (DSM) programs aimed to modify new buildings by encouraging the adoption of better technologies or improved design. Programs were based on a rather simple understanding of the market. Attention centered on building designers (architects and engineers) as key decision-makers in the adoption of more energy efficient technologies and system designs in buildings. The implicit model of the market was inhabited largely by building owners and designers who were assumed to have a great deal of autonomy from outside influence and their social networks when making decisions regarding energy and efficiency. This model overlooked many of the realities of the broader development process.

Recent interest in market transformation (MT) has spawned efforts to provide improved models that better reflect market barriers and opportunities for energy efficiency. However, the MT approach still sees the market largely through the lens of energy efficiency—a lens that focuses on a narrow set of concerns. Our current research takes a much broader view. We are interested in establishing a real-world context for energy efficiency by providing a more accurate understanding of how new commercial building markets actually work.

To do so, we have used multiple research techniques, including qualitative field observation and interview methods that allow for a more in-depth understanding of complicated market processes. Our research has focused primarily on new office buildings and has been centered in four regional markets: Sacramento, San Francisco, Seattle, and Portland. Our findings, summarized below, identify key dynamics of commercial office building markets, describe how change and innovation occurs in commercial development, discuss the implications for energy efficiency, and suggest next steps.

Commercial Office Building Markets

Commercial office building markets are dynamic. They reflect local geographic markets and economies, but they are also driven by broader economic cycles. In particular, they are driven by growth in business activity and the creation of jobs. As a result, the office building industry goes through boom and bust cycles. Building booms occur in response to growing demand for office space in the face of limited supply. Low vacancy rates and rising rents support investment in new construction by promising strong economic returns to investors. All four building markets we investigated have experienced a boom phase of the cycle in the last several years, reflecting strong regional economies (although recent troubles in the high tech industry have led to some cooling in these markets). A bust phase occurs when supply outstrips demand, and building vacancy rates increase and rent levels decline, restricting investment in new buildings. In the early 1990's, the markets we examined were in a bust phase due in part to the worldwide and national recession at that time. Local space markets and economic conditions also have a great deal of influence on what sorts of buildings are built.

Real estate development requires three things—users, capital, and land. There must be users that require building space, there must be investors willing to provide the capital for the building project in exchange for a financial return, and there must be land that can be used in a manner that supports the project goals. Successful office building development cannot occur without all of these three elements. What is ultimately built is shaped by the availability of each and the requirements and constraints that each imposes.

Buildings are investments. They represent tangible assets that provide predictable income streams to conservative investors. This fact fundamentally structures and constrains the building development process. Developers strive to deliver buildings that produce reliable income to investors. They tend to use models that have worked in the past as a way to reduce uncertainty and increase profitability. They take a utilitarian approach to building design by stressing function and flexibility so that their buildings appeal to the market place and maintain their value. They rely on trusted networks of industry professionals with a proven track record for delivering the predictable sorts of buildings that they desire.

The commercial building "industry" is in fact a series of linked industries arrayed along a "value chain" or "value stream" where each loosely coupled link contributes value to a material building in process. Each link, while aware of the other links in the process, is a somewhat separate social world with its own logic, language, actors, interests, and regulatory demands. 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.

We have defined six major industry groups involved in commercial building markets—providers of capital, developers, design and delivery firms, community/political/regulatory interests, real estate service providers, and users (see Figure 1). Each of these groupings represents an independent industry and within each grouping there are separate industry groups. The building development process brings these groups together to deliver a building product that meets capital, land, and user requirements. Developers orchestrate the development process and represent the interest of providers of capital. The nature of these interests will vary depending on whether the project is build-to-suit, build-to-hold, or build-to-sell. The building is produced by architects, engineers, and contractors in the design and delivery group. Community/political/regulatory interests shape what can be built through zoning, codes, review and other community processes. Real estate service providers offer marketing, sales, leasing, investment, management, and operations services and represent the interests of many market actors. Users are the firms and organizations

Figure 1. A Way of Viewing the Building Development Industry: Categories of Actors and Forms of Organization

Providers of Capital

Those that invest in buildings

Investors	Owner-Occupied
-Financial Institutions	-Public Owners
-Institutions/Pension Funds	-Private Owners
-Financial Markets/Wall Street	
-Real Estate Investment Trusts (REITs)	

Developers

Those that orchestrate the development of buildings in response to investment requirements, user requirements, and local and national requirements

Build-to-sell   Build-to-hold   Build-to-suit

Design and Delivery

Those service providers (design professionals, contractors) that deliver buildings in response to developer requirements

Design-bid-build   Design-build   Design-assist/cnstr. mgr.   Hybrids

Community/Political/Regulatory Interests

Local and national requirements (codes, land use, design review) that shape buildings and development

Pro-development   Progressive   Restrictive

Real Estate Services Providers

Those real estate professionals (property managers, general managers, investment managers, facility managers, brokers) that represent the interests of various market place groups

Marketing/Sales   Leasing   Investing   Management/Operations

Users of Buildings

The organizations and firms that occupy and work in buildings

Lease   Owner-Occupied

that occupy the buildings. There are also a variety of other groups not directly represented in this figure (e.g., product vendors, manufacturers and insurance providers) that influence the development process.

The building development process organizes the various industry groups and market actors to produce a building product that responds to capital, land, and user requirements. The approach used by a developer for a particular project balances cost, value and speed, all within the context of reducing risk and producing predictable outcomes. Different development approaches organize the market actors in somewhat different ways. There are a variety of design and delivery methods, but current industry trends are leading to hybrid delivery approaches that combine elements of design-bid, design-build and construction-manager-at-risk delivery methods. These hybrid approaches (sometimes called “design-assist”) require the involvement of most market actors early in the conceptual process to reduce risk and control cost while producing a high value product quickly. Much about the building form is determined very early in the conceptual process. The original concept is then refined and further developed in a dynamic process responding to constantly changing circumstances and striving to meet capital, land, and user requirements. This dynamic process involves the various industry groups and market actors identified in Figure 1.

For the most part “upstream” actors constrain the choices and actions of “downstream” actors. In general, as decisions about building *form* are made upstream 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. Consequently, as a project moves from conceptualization, to financing, to design, and finally to construction, choice becomes increasingly constrained.

Innovation in Commercial Building Markets

The nature of building development also constrains innovation. The building industry strives to reduce risk and produce reliable economic returns by using standard approaches and models that have worked well in the past. This works against trying new ideas. Yet, buildings do change in response to new market requirements. We have identified three factors that we believe stimulate innovation in commercial buildings—owner/occupant needs and requirements, market influences and requirements, and local conditions, requirements, and constraints. Through the unique circumstances of a particular project, combinations of these factors can result in situations that dictate the use of non-standard approaches and innovative ideas.

Innovation in the building industry is incremental. Each new building frequently incorporates small improvements and innovations in response to market place requirements. A risk-averse building industry resists radical change, but the sum of many incremental improvements does result in significant (and sometimes dramatic) changes that lift the standard of building practice and diffuse more broadly through the market place.

The process of innovation is complex, involving market actors at many levels in the development process on both the demand and supply side. Innovations result from a proactive dialogue between users and developers. Real estate professionals (brokers, property managers, leasing agents, etc.) act as intermediaries in this conversation, both delivering user requirements to developers and selling the developed product to users. Developers work with project teams (designers and contractors) to deliver a building product that meets market requirements. The degree to which innovation occurs in the building project flows from the project vision and is established at the beginning of the project during the assembling of the project team and the initial conceptualization of the project. The delivery of an innovation is a dynamic process of choices and ongoing refinement by the project team in response to new and changing circumstances. At the same time, several important building industry trends support innovation in the development process by contributing to greater collaboration, better communication and improved information for decision making. These trends include: new hybrid delivery processes, application of information management technologies, and vertical integration of the real estate industry.

The build-to-suit market segment is most conducive to innovation because the buildings are being developed for specific users and are thus less risky. Large organizations and institutional users are important for establishing the user requirements for these buildings. These can translate into broader market requirements and create new market demands that developers will respond to and incorporate into their standard product. The building delivery firms (designers and contractors) incorporate these new approaches and practices into the services and skills that they offer.

Implications for Energy Efficiency and Market Transformation

So what does this all mean for energy efficiency in new commercial office buildings? Given what we have learned about building markets and the nature of building industry interests, it is clear that increasing the energy efficiency of buildings is of little value to the building industry. In terms of the parameters important to the building industry, buildings *are* energy efficient. There is really no value to the building industry in making buildings more energy efficient—it is risky. The perceived market risks of doing energy efficiency are much greater than any potential benefits. Current industry views about energy efficiency constrain the ability to produce buildings that are more energy efficient. Historical approaches for encouraging the development of more energy efficient buildings have failed to effectively link to issues and standards important to the building industry. This limits the potential for creating transformation in the market towards greater energy efficiency.

Furthermore, it is important to recognize that building markets are embedded in much larger systems and that the dynamics of those systems—which clearly influence building markets—are difficult to anticipate, let alone control. The most salient of these systems are: environmental systems, macro-economic systems, energy systems, and political-regulatory systems. Social scientists tend to view firms and networks of firms as adaptable to change in macro and local systems—although the failure to adapt is also a recurrent theme in the literature. Many of the larger forces being exerted upon the markets of interest may encourage increased energy efficiency. Others do not.

We cannot predict whether successful market *transformation* is possible in office buildings markets. However change has and will occur there, and it can likely be prodded in more, rather than less, socially desirable directions. Past success in achieving energy efficiency in this sector should be recognized, and some past DSM efforts and approaches should be retained in the MT context. We believe, however, that effective DSM or MT efforts in such a complex, multi-actor, multi-interest system cannot be simple, but need to attack the problem on multiple levels, in concert with the efforts of multiple market and non-market allies. It is simply not enough to introduce new energy efficient technologies into the market place. The mechanisms through which energy efficiency is incorporated in the building development/design process must change.

We believe the change process must occur at three levels: making energy efficiency relevant to the market, encouraging demand and institutionalizing energy efficiency in the market place, and standardization within the development/design process (supplying buildings that are energy efficient). Clearly, these levels are not independent—the success of each one is linked to the success of the others. However, we believe that making the distinction between these levels is helpful for organizing programmatic strategies and ensuring that program approaches are well targeted to achieve the desired impacts. The following describes each level in greater detail.

1. *Making energy efficiency relevant*. Our research has shown that increasing building energy efficiency has little value or relevance to the building industry. In order to establish the relevance of energy efficiency for market actors, the primary approach ought to be the linking of MT efforts to complementary building industry trends and interests, with the idea of making energy efficiency more visible as a tool for meeting industry goals. Current trends that we believe are relevant to energy efficiency include:

    - the movement toward more green and sustainable buildings,
    - the growing interest in providing quality work environments to attract and retain employees,
    - the application of advanced building technology and controls, and
    - the impacts of energy price volatility and requirements for more reliable energy supply.

2. *Encouraging demand and institutionalizing energy efficiency in the market place*. "Demands" are not abstract urges or wishes that can be shaped by information. They are concrete expressions of willingness to act in particular ways by concrete actors on the ground. Therefore, they are best encouraged and facilitated by

efforts directed to specific actors in real markets. A key problem for energy efficiency market transformers, then, is creating an impetus for change in the market that leads to demands by owners, occupants, and investors for more efficient buildings.

While we are not able to offer detailed prescriptions, we can identify several areas in which energy efficiency activity has taken and is taking place, and where MT initiatives might effectively focus. These include:

- work in progressive markets (for example, institutionalize community interests in sustainability by creating incentives for sustainable development),
- build-to-suit projects (for example, take advantage of complementary user interests),
- large institutional users (for example, develop work environment standards for improved productivity),
- vertically integrated property developers and managers (for example, institutionalize practices in organizations that control large segments of property),
- institutional investors (for example, encourage interested investors to demand socially responsible buildings), and
- policy and regulatory approaches

3. *Standardization within the development/design process*. Historical approaches to energy efficiency have involved the application of energy codes or efforts to encourage innovation in the building delivery process and adoption of new technologies and design tools. These approaches do not consistently result in more energy efficient buildings. Tendencies in the building industry to standardize and make things routine must be taken advantage of, rather than focusing on constantly trying to get the industry to accept innovative ideas.

   We suggest that the routines themselves be examined for ways in which they can be modified to enhance the energy efficiency of buildings. Opportunities for developing feedback mechanisms and performance metrics need to be developed (examples include the Green Building Council LEED program, and Energy Star Buildings, although these need to be adopted by the building industry). Building industry trends such as more collaborative delivery processes, the vertical integration of firms, and the use of information technologies provide opportunities to better integrate energy efficiency into building development. Tools such as building commissioning provide a mechanism for standardizing quality assurance mechanisms. Regulatory and code mechanisms, peer-based industry standards, and standard packages of building specifications are other mechanisms for standardizing approaches.

Next Steps

Further discussion and targeted research need to take place in order to systematically consider the possibilities for policy and program development if serious MT efforts are to be considered in this arena. Participants in these discussions should include members of the following groups:

- market transformation agencies and energy efficiency advocates,
- universities,
- the building industry,
- political actors,
- regulatory agencies,
- government and institutional property owners, and
- building industry movement actors.

To better understand particular elements of these markets, focused research would be useful in the following areas:

- the professional activities, culture, and practices of important market actors such as brokers and appraisers,
- the standard specifications used by large institutional property owners,
- communication about energy use to enhance its visibility,
- the implications of market cycles,
- the potential for partnerships with building industry groups,
- other commercial building sectors, existing buildings markets, and
- the linkages between various new and existing commercial building markets

The goal of these discussions and mini-studies would be to secure lasting commitments to clear, realizable MT goals which could be pursued by coordinated action in the market place. To an important degree, just what the most appropriate actions might consist of in any given city will depend upon the local culture and networks available to support coordinated MT efforts there. Therefore, it is crucially important that key actors from those networks be responsible for shaping discussions about their own problems and for devising locally appropriate solutions.

1. INTRODUCTION: PROBLEM AND METHODS

Our research has investigated the structure and dynamics of commercial buildings markets—specifically markets for new office buildings. In order to better understand these markets and the opportunities for energy efficiency, we have asked fundamental questions that focus on how these markets are organized, how the development/design process unfolds, how innovation of any sort takes place, and how energy efficiency is regarded there.

We report our findings in the following four chapters on "markets of interest," "real-world buildings as conservative outcomes," "innovation in the industry," and "implications for energy efficiency." Our concluding chapter offers an empirically based market theory, a model of market change, and a preliminary assessment of market transformation potentials and opportunities in commercial buildings markets.

1.1. The Problem

Commercial buildings use significant amounts of energy. According to estimates by the Energy Information Administration, commercial buildings account for about one-sixth of total U.S. energy consumption and 32 percent of total national electricity consumption. Commercial building electricity consumption has doubled in the last 18 years and if current trends continue will increase by another 25 percent by 2030 (DOE 2000). While there is evidence that building energy efficiency has improved over the last 20 years, the potential exists for buildings to perform much better than they do in terms of energy consumption and environmental impacts (Lovins 1992, Interlaboratory 2000). The Commercial Buildings Technology Roadmap (DOE 2000) suggests that a 30 percent improvement in energy efficiency could be achieved using existing technologies and 50 to 80 percent improvements could be achieved with more aggressive implementation of the ideas suggested in the roadmap. In an effort to achieve some of this potential, a good deal of programmatic work and research over the last 20 years has been directed toward improving the design techniques and technologies used in commercial buildings in order to improve their overall performance. However, little attention has been paid to the social and organizational features of commercial office "development" and their impacts on how buildings are constructed and equipped[1]. Until recently, this has not been a serious problem. But since the mid-1990's energy efficiency policy has been shifting away from improving specific building projects toward improving the functioning of commercial office markets in energy efficiency terms (i.e., toward "transforming" the market). The reappearance of energy crises, particularly in California, is refocusing attention on how the society uses energy. In addition, international treaty commitments to reduce greenhouse gases to 1990 levels have spurred nations (and states in the U.S.) to begin to focus policy attention on all significant energy uses and pollution sources—with large buildings being among the most visible.

While we know a good deal about what is technically possible in terms of new commercial building energy use, we know relatively little about how to actually

[1] Lovins (1992) report on Energy Efficient Buildings: Institutional Barriers and Opportunities is an exception

change the ways in which buildings are designed, constructed and operated. What's more, we are captive of traditional paradigms that limit our understanding and our policy options.

1.1.1. The Energy Efficiency Paradigm

In traditional energy efficiency analysis, research focuses on building technologies, energy use, and costs, while holding constant or ignoring a range of other factors involved. Its rendering of the parts played by human actors in energy use and efficiency choice has been notoriously weak (Lutzenhiser 1993)—for the most part limited to simplistic models of producer and consumer choice, discount rates, market barriers, free rider problems, etc. This has 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. New commercial building energy efficiency programs focused on resource acquisition and achieved energy savings of 6 to 20 percent in participating buildings (Johnson and Nadel 2000). The scope of these efforts was limited due to funding and policy constraints, but as long as small reductions in consumption continued, it was not necessary to more fully understand 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 often fallen short. In part because of the desire to more effectively achieve greater energy savings and demand reductions (and in part because of utility retreat and regulatory pressure), policy emphasis is shifting in many localities (and particularly on the U.S. West Coast) toward the long-term transformation of the market and away from a short-term incentive-based agenda focused on specific building projects[2].

With the turn to market transformation, however, it becomes clear that the emphasis of past research and policy has left us with large gaps in our understandings of how buildings choices are made, and how they might be changed. In addressing these knowledge gaps, Blumstein, Goldstone and Lutzenhiser (2000) suggested that:

> *New market connectivity and market transformation 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.*

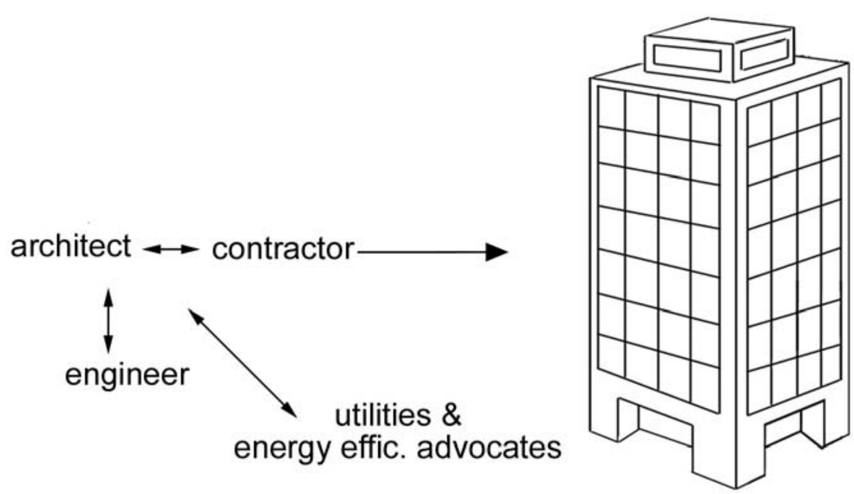
In order to develop this "new mid-range theory," there is a need to more fully understand how these markets work and what interventions promote energy

[2] Recent energy shortages in California and the West Coast have again focused attention on short-term demand reduction. While we expect this emphasis to continue in the near term, there still is interest in creating long-term market transformation. This is the intent of this research - to improve our market understanding in order to more effectively facilitate market change towards greater energy efficiency. This informs both short-term demand reduction and resource acquisition efforts as well as longer term market transformation activities.

efficiency in a way that promises it will be adopted as standard practice (i.e., that they "diffuse" into the market place in ways outlined by Rogers (1995) and others). Some attention has certainly been given by energy analysts and social scientists to the attitudes and choices of energy users (see Lutzenhiser 1993 for a review)—and this knowledge base continues to be of value in market transformation. But, aside from a bit of work on tax and regulatory policy, relatively little attention has been given to *market-level* processes, or to changing our patterns of energy and technology use at the societal level (see Shove et al. 1998, Wilhite et al. 2000 for a critique and research agenda). While much good research has occurred, it is often limited by existing energy efficiency paradigms. These shortcomings handicap efforts to transform markets toward greater energy efficiency any time in the near future.

In particular, two assumptions underlie much of the previous commercial building research that confound a deeper understanding of energy-related innovation (and failure to innovate) in the commercial construction industry. The first—which is rooted in the traditional energy view of the market—sees the problem as centered in *design*. As a result, efficiency programs and research have tended to focus on those actors involved most intimately in the design and construction process, namely architects, engineers, and to a limited extent contractors (see Figure 2). In the process, much of the complexity of this market place has been ignored. The second assumption is that these market actors (firms and individuals) have a great deal of

Figure 2. Energy Efficiency Model: Focus on Design



autonomy from outside influence and other social networks when making decisions. These assumptions limit our appreciation 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 beliefs, customs, and social ties—and how they retard introduction of new practices, designs, and technologies. We have, therefore, approached the study of the commercial construction market place from the perspective of actors and firms embedded in both the formal and informal social networks that strongly influence decision making processes (Granovetter 1985). In this view, markets are seen as dynamic and evolving systems of social and commercial relations. Such market systems are characterized by multiple players (financiers, owners, brokers/marketers, architects, builders, appraisers, regulators, etc.) whose interactions are structured by their relation to one another vis-à-vis current as well as past projects.

1.1.2. The Applicability of Social Science Knowledge

Over the past half century, organizational analysis and management theory has developed an extensive body of knowledge on how problems are defined, solutions generated, and choices made in organizational and industry contexts (Simon 1997, March and Simon 1958, Perrow 1986, Scott 1987). This research has 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.

We will not attempt to review that work here. Some key insights, however, can be found in research that has shown the surprising influence that the "informal" dimensions of organizations and organizational networks—i.e., social norms, informal associations, and beliefs—actually have in organizational decision-making processes (e.g., Friedland and Alford 1991). We also see that the ways in which individual firms evolve depend upon the industry environments within which they are located, as well as the strategies that they use to adapt to changes in those environments (Aldrich 1999, Hannan and Freeman 1984, Fligstein 1991). And, we can better understand how *non-economic* factors explain a good deal about how industry trends start, proceed, and end when seeing organizations as "open systems" that interact with the market places within which they function (Perrow 1986, Powell and DiMaggio 1991).

Recent work in technology and innovation studies also sheds light on how technological systems are shaped in market contexts (e.g., Hughes 1989, Cowan 1989, Rogers 1995, Bijker, Hughes and Pinch 1989, Dosi 2000). In this research, new ground is being broken that reveals how materials, hard technologies, and actors are "lashed together" through training, sunk costs, and participant beliefs that can sustain a technology in the face of what traditional economics might see as "inefficiencies" (e.g., Utterback 1996, Gould 1987). Finally, economic sociology (e.g., Smelser and Swedberg 1994) and several schools of economics, including transaction cost economics (Williamson and Winter 1991) and institutional approaches (Hodgson 1993), provide other relevant insights into the behavior of actors and groups in market systems.

Informed by these literatures, we have sought to better understand what "market transformation" could mean given the context within which buildings are actually built—a commercial construction market place that is inherently social and comprised of linked, yet also distinct, communities of practice. This has meant addressing the problem of innovation given the conditions "on the ground" that must be contended with by market actors when participating in a construction project.

1.2. Methods

Survey methodologies are not appropriate for this sort of research, since they require a detailed knowledge of the phenomena in which we are interested before questions can be posed to respondents. Through preliminary literature reviews and consultations with industry observers, we realized that very little empirical research has been conducted on commercial buildings markets. From those sources we also came to realize that the systems involved were likely quite complex and nuanced in their operations. Focus groups might be used to help shed light on the problem, but again, unless a good deal is known about the phenomena of interest in advance, focus group techniques can elicit a range of opinions that may or may not relate closely to the underlying realities.

We opted for a mixed method approach that combined data gathered from documentary sources, in-depth key informant interviews, observation of market actors' behavior in public and private settings, and a series of *case-process* studies that allowed us to examine questions of industry practice in the contexts of actual development/design/construction projects. In addition, we examined industry organization and market dynamics in four distinct locales (Sacramento, San Francisco, Portland, and Seattle) in order to provide a broader range of cases and informants than we would have available to us in a single local market, and to provide comparison cases.

The work was theory-informed, but not guided by firmly held hypotheses about market organization or behavior, although some sensitizing hypotheses emerged from our early discussions with CIEE and CEC staff (see Appendix C). We did not follow a strict "grounded theory" methodology (Glaser and Strauss 1967), as we might have if we knew nothing about the subject matter. But we did enter the field with few preconceptions. This allowed the data gathered from a range of industry sources to speak to us from the actors' own points of view. Only after we had accumulated a large number of interviews, articles and observations—and had begun to hear the same accounts over and over again—did we attempt to make sense of these data and compare our findings with the predictions of social science theories of organizations, networks, markets, and innovation.

1.2.1. Data Sources

Our data sources included: 1) findings from an extensive literature review, 2) published documentary materials, 3) observation and interaction with market actors, and 4) in-depth ethnographic interviews with key industry informants.

The literature review included published work in the social sciences (e.g., organization and management theory, institutional economics, innovation and technology studies), as well as work in architecture, urban planning, real estate development, and construction management. We also examined the "gray literature"—papers presented at applied conferences, energy program evaluation reports, market transformation commercial sector "baseline" studies, and other market studies.

Documentary data sources proved to be quite valuable. These included MT focus groups conducted by California and Northwest market transformation research and planning efforts (Heshong Mahone Group 2000, NW Alliance 1999) as well as articles in the real estate development, architecture, engineering, and construction trade presses. The general business press and local newspapers (e.g., *Puget Sound Business Journal*, *Seattle Times*, *The Oregonian*, *Sacramento Bee*, *San Francisco Chronicle*, etc.) also carry a number of articles focusing on issues, controversies and trends in real estate development and commercial property, as does the national press (e.g., the *Wall Street Journal*, *New York Times*, *Washington Post*). From nearly all of our interviews we also collected marketing materials, brochures, internal studies, market outlook reports, and so on. Quite detailed analyses and program information was obtained as well from a variety of sources such as the U.S. EPA, the U.S. Green Buildings Council, the Urban Land Institute, and the Design-Build Institute.

Research team members attended a number of industry conferences and workshops, where we were able to observe formal presentations and engage the participants in informal discussions. We toured a number of commercial office building projects, both completed and under construction. We interviewed informants in their offices and were introduced to co-workers and given briefings on past and current projects undertaken by that firm and its network partners. We were invited to observe design team meetings, and were able to observe developers' efforts to sell their projects to potential partners.

Our most important data source, however, was a series of personal interviews. These included interviews with industry observers, including academicians (who had backgrounds and current contacts in development, architecture, construction, and finance), as well as energy efficiency (utility, energy office) staff, and Federal program officials. All of these informants were able to provide valuable "macro" views of markets and historical context information. However, a much larger series of interviews with actual industry actors provided a more "micro" view of markets from the ground level. These informants included bankers, developers, owners, real estate brokers/marketing agents, appraisers, property managers, architects, engineers, energy efficiency and sustainability consultants, community and national NGO movement actors, builders, and regulators. Extensive notes were taken, and many of these interviews were recorded for later analysis.

Our case process studies relied most heavily on interviews with participants involved with the selected development projects. These interviews were conducted with developers, owners, contractors, architects, and engineers and focused on issues within the context of a particular development/design/construction project.

While limiting our preconceptions, we did enter the field armed with some plausible hypotheses and questions from our initial literature review and our planning discussions with CIEE, CEC and utility staff, as well as from our project advisory committee. Our interview guides focused on informants' particular roles and responsibilities in the development process, their relationships with other actors, their views of the factors that shape building form (including issues such as regulations and codes, financing, and building value), their perceptions of change in building delivery processes and the organization of market actors, and issues surrounding innovation or non-standard approaches. And we were convinced that a larger array of actors and interests were involved in the market than is often imagined by energy efficiency planners (see Figure 3).

We were careful to use open-ended interview protocols that would allow our informants to describe their everyday worlds in their own words. We discussed energy efficiency with them, but only after they had reported extensively on their understanding of "business as usual" in their industry. While differences of opinion among individuals are inevitable—and differences in perspective are expected of experts approaching the problem from different angles—our informants were all quite knowledgeable and they were often very reflective about what they did and didn't know. For the most part, we treated our informants as participants in the research—as collaborators who agreed to help us and our sponsors to better understand a complex system, and to assess the prospects of improving it. Several key informants agreed to serve as reviewers of this final report to reflect on its accuracy and relevance. Some also agreed (often eagerly) to join later discussions about the implications of our findings in terms of what can and should be done in these markets.

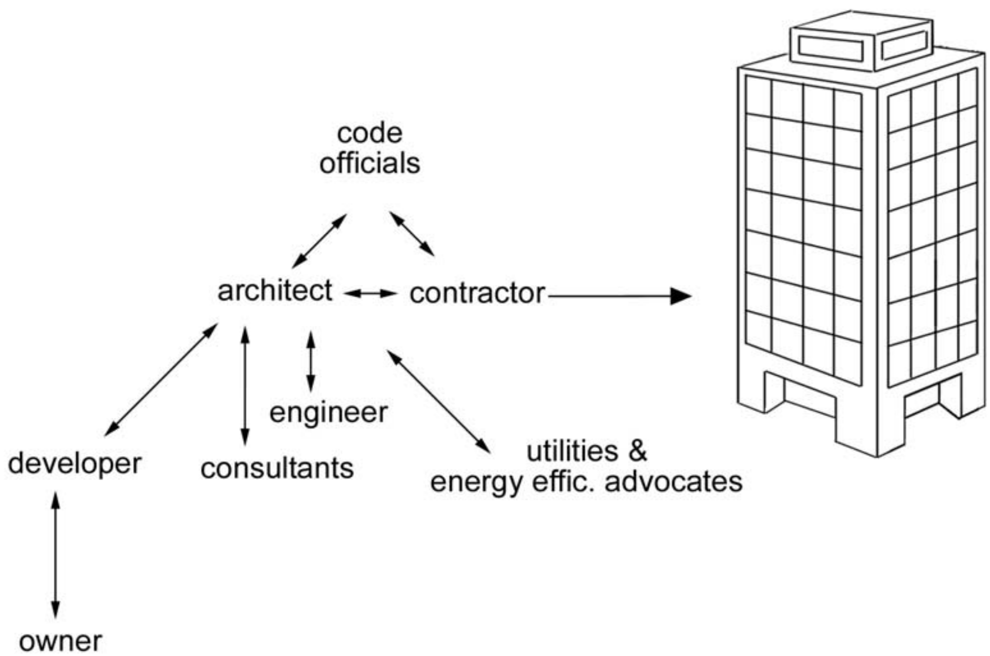
1.2.2. Sampling

Our sampling used classic "snowball" techniques (Babbie 2000), asking informants to refer the interviewers to other knowledgeable persons in their firms/agencies and networks who could also contribute knowledge, insights and experience to the research. By relying on multiple key informants in different markets, we entered the market at different points to avoid gathering information from a limited circle of contacts. We conducted interviews with market actors in each of the categories identified in Figure 1. We completed over 80 in-depth interviews with industry observers and actors.

In our case-process approach, we asked informants about particular projects underway or recently completed, and selected from among those that seemed to promise useful insights (e.g., because of particularly innovative features of the buildings or the development process and the involvement of key firms in the market). We then collected detailed accounts of the development process for that building, and were referred to others in the network of actors who also worked on the project. This gave us the ability to gather information in the context of *concrete cases*—as opposed to observations about buildings and development processes in general (which have been shown to often be misleading)—and from the *points of view of multiple actors* in the networks involved. We conducted case process studies on four building development projects.

As noted, field studies and interviews were conducted in four cities: Sacramento, San Francisco, Portland and Seattle. These locales were chosen because they present a good range of similarities and differences across a number of potentially important dimensions of geography, economy, culture, and politics. While all have traditions of interest in energy efficiency, all have produced their share of not-so-efficient buildings. The limits of funding and personnel did not allow us to investigate more than these four sites. However, we were able to examine each of these in some detail—both in terms of market history and macro-dynamics, as well as the micro contexts of development underway in those places. We tended to focus on key market actors and firms in these markets, thus emphasizing medium to large scale development projects. These projects reflect a large portion of development occurring in these locations. While not an exhaustive sample of cities or market players on the West Coast, we believe that the range of locales and projects chosen assure adequate variability and a fair degree of generalizability.

Figure 3. Energy Efficiency Model: An Expanded Set of Actors



It is important to understand that the sample selected for this research is not a "representative" sample. Our more flexible "snowball" sampling technique allowed us to utilize our market informants to guide us to the large array of market actors that could inform our research. This provided us with the opportunity to ask the more detailed questions necessary to begin to develop a deeper understanding of the commercial office building market. By using a mix of methods and the data analysis techniques described below, we were able to develop valid and reliable findings that provide a basis for future research and development work.

1.2.3. Data Analysis

Interview notes and documentary materials were collected, summarized, shared, and ultimately categorized in terms of industry structure and dynamics, the delivery process, trends, innovation, and energy efficiency, with a host of subcategories under each heading. Analysis began part way through the data collection process, with our efforts to "make sense" of a growing body of information. Our ongoing analysis was conducted via routine one-on-one discussions, frequent conference calls, periodic team meetings, and a consensus summary working paper (Beamish et al. 2000) presented at the 2000 ACEEE Summer Study. At those meetings, and in other settings, our work in progress was discussed with other researchers and MT practitioners.

As we began to hear common themes reported in our interviews, we were also able to test our emerging understanding with more focused questions of industry informants (e.g., "We're starting to believe _X_ about how architects relate to developers. Does it work this way on the project you're working on right now? If not, how does it work?" or "We're finding this trend in Seattle. Is this going on in San Francisco as well?"). By the time our fieldwork was completed, we had developed and refined our understanding of the market and how it worked.

As our interviewing began to wind down, the core team was assisted in its efforts to build a model of the market and its transformation potentials by the members of our extended team (see Appendix A), who were able to help put our findings in context, and add details and more refined ways of thinking about the market.

The present document reflects our findings as we complete this project, but does not claim to paint a definitive picture of the market and where it is heading. We believe, however, that this report presents a much more thorough depiction of the commercial buildings market place than anything produced to date. It draws upon extensive field studies and incorporates the best social science thinking about inertia and change in networks of economic organizations. It demonstrates the value of more detailed and methodical studies of markets than are the norm in the market transformation community. We hope that the findings we present will provide a basis for continued discussion, research, and development (see Chapter 6).

2. MARKETS OF INTEREST: AN OVERVIEW OF THE OFFICE-BUILDING MARKET PLACE

This Chapter introduces the social history and organization of the commercial office building market. Our discussion is organized in four parts. First, we provide a brief history of the physical structure of the office building as it has evolved over time. Second, we describe the major groups involved in constructing office buildings, and outline how they come together during the process of construction. Third, we analyze the basic dynamic of commercial office markets, one which tends toward cycles of boom, overbuild, and absorption. Finally, we discuss the four urban markets in which we did our research. Throughout this Chapter, we introduce many topics that are more fully developed in subsequent Chapters. The material presented in this opening discussion largely reflects views of the building market taken from building industry sources and references. Our findings in subsequent Chapters further enhance our understanding of the market by drawing upon the experiences of the building professionals in the markets that we investigated.

2.1. A History of the Physical Office Building

The first offices were usually government counting-houses, which have existed for thousands of years. The first buildings separated from retail or residential functions and devoted exclusively to providing offices for commercial activity appeared in Europe and the United States in the 1830s from the stimulus of the Industrial and Commercial Revolutions. The first such buildings were only a few stories tall, but by the 1880s inventions such as flush toilets with stink traps, gas lighting, elevators, and, most importantly, steel-girder skeletons made from inexpensive steel enabled the construction of taller buildings. These developments supported the first big building boom in downtowns across America. These large office buildings concentrated business functions in the downtown districts of cities, known as central business districts (CBDs); these districts therefore concentrated economic power. In the twentieth century, electric lighting and steam heat in radiators made buildings much more comfortable. Air conditioning for hot summers was invented in the 1920s, but only became common in the 1960s. This intervention also made shorter floor heights and larger floor plans possible; until then, the need for heat and cigar smoke to rise and access to natural ventilation had made ceilings of ten to twelve feet and smaller, narrower floor plans necessary. Air conditioning was combined with an electric heating system to create an integrated heating, ventilating, and air conditioning (HVAC) system. This provided nearly complete control over the inner environment (Shales and Weiss 1993)[3].

The federal government started building an interstate highway system in the 1950s and 1960s, a development which promised speedy travel between and within cities. This highway network enabled the suburbanization of the workforce, and in the 1960s office buildings started following their workers to the suburbs to avoid the increasing congestion of CBDs. Suburban office buildings had large parking lots and

[3] See also *The Architecture of the Well-Tempered Environment* (Banham, 1984) and *American Building: The Environmental Forces That Shape It* (Fitch, et al., 1999).

landscaping, and were often clustered in "campuses" or "office parks." This contrasts with downtown buildings that tended to have little landscaping, and parking is often placed below the building. Originally workers enjoyed quick commutes and CBDs suffered, but suburbanization eventually reproduced the congestion formerly encountered in downtowns, and now CBDs and suburbs compete in commercial office markets.

Commercial office buildings vary in a number of ways, such as location, size and height, and quality. The highest quality buildings are called "trophy buildings" or "icons." Usually they are unique and have extremely prestigious tenants. Trophy buildings are correspondingly rare. Class A buildings are investment grade buildings; they are conveniently located, well-built, well-managed, and have high-quality tenants. They have the highest level of building services and building systems and the highest value. Class B buildings are utilitarian and ordinary, and have average maintenance and average tenants. Class C buildings are basic, usually old, and have below-average maintenance and low prestige. Buildings are also classified by their use and ownership. Buildings that are single tenant, multi-tenant, or mixed use require different types of buildings. Likewise, different needs exist if the user is an owner-occupant, government, or a tenant (Goettsch 1993).

2.1.1. The Commercial Office Building Industry

Building an office building is a tremendously complex process involving a long list of actors. We offer a preliminary summary of commercial development here, saving a more systematic and detailed account for Chapter 3. However, only a few major groups drive the process; the other groups involved support these major actors. We cannot emphasize too early in this report that an office building is primarily an investment. Since it is extremely expensive and complex to build, office buildings are generally built with the prospect of a steady and reliable return on investment, so all the major actors in the construction process are influenced by the investment nature of buildings. The major participants are developers, investors (providers of capital), designers and contractors (design and delivery), and real estate services providers along with regulators and users of the buildings (see Figure 1). Each group has a different time horizon and a different role in the development process.

The developer is at the center of the process. Without developers, most office buildings would not get built. As the *Office Development Handbook* (Gauss 1998: 19) puts it, "In general, the developer's role in an office project is to orchestrate the development process and bring the project to completion." Development comes in a number of forms. Speculative developers attempt to build quickly, lease quickly and completely, and sell out quickly (build-to-sell). Owner-developers "build-to-hold" and manage their properties. The hired developer usually works for a company which wants to own and occupy the building; this kind of developer attempts to provide what the company wants, and takes a fee for work done (build-to-suit). The company then occupies and manages the building (although in some cases the developer may continue to manage and even own the building).

Investors also come in many types. Construction lenders are interested only in short-term lending in order to get the building built. Most investors, however, are involved for the long-term, and hope to enjoy a steady income stream from the operation of the building. The developer knows this and will not build a building if its operation will not result in a long-term profit for the buyer. Mortgages are structured in various ways, since the range of investors includes real estate investment trusts (REITs), real estate limited partnerships, life insurance companies, mortgage bankers, banking consortia or conduits, business corporations, pension funds, and foreign investors (Krugman and Furlong, 1993: 65).

The design team includes an array of consultants and design professionals that are responsible for initial planning, analysis, and building design. This team typically consists of architects, engineers, and planners and is traditionally headed by an architect. The developer hires the architect; the architect, therefore, must pay attention to what this client wants. As Krugman and Furlong put it, "The architect's job is to provide an office building design that maximizes the use of space, and thus maximizes revenue, while minimizing costs" (Krugman and Furlong, 1993: 73). Nevertheless, the architect, and the associated engineers and other design personnel, are key players in the process. Although popular conception of architects has them building unique structures ala Frank Loyd Wright, trophy buildings are rare because developers rarely want them; designers typically rely on designs that have worked well in the past making minor adjustments to fit each new project.

Contractors manage the actual construction process, and developers are their clients, as they are with architects. Their relationship can be structured in a variety of ways; the major forms of the contractor-developer relationship are design-bid, design-build, construction manager/general contractor or construction-manager-at-risk (design-assist) and hybrid combinations (these varieties are discussed thoroughly in Chapter 3.) The general contractor (or construction manager) usually subcontracts with specialist contractors for framing, constructing the curtainwall, installing the various systems, and so forth.

A group of real estate professionals are also critical in the development process. Market consultants study local office space markets to help developers decide whether to build at all. Appraisers estimate the value—for the developer, banks, and other lending institutions—of the land before and after the building is built. Attorneys identify risks for their clients (who are usually developers). Real estate brokers are part of the important marketing campaign, which involves finding potential tenants and leasing space to them; brokers also represent tenants looking for space to lease or purchase. Asset managers deal with investment portfolios. Property managers are involved with the operation and management of the buildings. Title companies ensure the validity of a property's title, while surety companies bond the contractor.

While not directly involved in the delivery of development projects, regulators representing community and public interests enforce a variety of codes, land use, zoning, and review requirements. These requirements have a significant influence on the development process.

The building users may or may not be directly involved in the development process. For owner-occupied or build-to-suit projects, the users often establish requirements that the building must meet. Otherwise, real estate service professionals indirectly represent potential users and their requirements during project development.

2.1.2. The Development Process

The first stage in building an office building is *conception*, in which a developer considers opportunities and uses for a particular piece of property. During the conception of an office building, the developer requests a feasibility analysis from a market consultant and key development team members to evaluate the local office space market and to assess the economic viability of the prospective office development. The test of feasibility, according to the Gauss, (1998: 34) requires, at a minimum, the satisfaction of three criteria:

1. The building will meet all local zoning and building code requirements
2. The building will be designed to meet the needs of the target market
3. The building will generate a net cash flow that satisfies lending requirements and a reasonable return for equity investors.

The formal feasibility process involves evaluating the potential profitability of a prospective building within that market. Complicating this analysis (which we will cover in more detail below) is the fact that buildings take years from conception to commission, so part of the decision involves evaluating whether the office space market will be strong enough when the building is finished. There are two parts to feasibility analysis, market analysis and financial analysis. Market analysis involves investigating the relationship between present and future demand and supply. This involves looking at present and projected vacancy rates and absorption rates[4], present construction of office buildings near the site, inflation assumptions, and other factors such as tenant transportation and local lifestyles. Financial analysis is very complicated, but the major question—the "bottom line"—is whether the projected revenue stream from office space rental will be high enough above the costs of paying the mortgage and other expenses to provide a sufficient profit for the investor(s).

Once a developer decides to build, he or she must find short-term and long-term investors. The short-term investor finances the construction phase, while the long-term investor "takes out" (pays off) the construction loan and provides permanent financing for the building. Mortgage brokers may be used to help the developer find financing, usually from mortgage bankers. The latter usually require a certain percentage of the space to be pre-leased simply to fund the process, so the developer must already be contracting with marketing and advertising people in order to sell space in a building that is not yet built. Mortgage bankers "underwrite" the loan, which involves evaluating the profitability of the projected building, and they always require the developer to put a certain amount of equity in the project. Developers that are part of Real Estate Investment Trusts or large real estate firms (that own and manage property) often have access to internal capital to self-finance all or portions of their projects. Use of these internal funds requires the same careful analysis that a mortgage banker would apply.

The financing stage overlaps somewhat with the planning and design phase. Designers consider many issues, including the configuration of the building (its size,

[4] The rate at which space available to the market is being leased.

shape, and number of floors), site planning (including vehicular and pedestrian circulation, parking, landscaping, and weather management), regulations (zoning, traffic), exterior design (materials, entrances, windows, lighting, and "curb appeal"), systems (HVAC, electrical, plumbing, communications, safety), interior design (restrooms, lobbies, corridors) and potential tenant improvements.

Marketing and leasing as a distinct phase can occur before, during and after the financing of a project. It involves advertising to potential tenants by various means, and then leasing the building. Pre-leasing space during the development and construction phase of the project is critical for project success.

After financing is obtained, the contractor initiates construction, contracting to specialists for particular building systems. The design may be complete or largely complete before construction begins, but in many "fast track" office projects, design occurs concurrently with construction—the construction of building systems that have completed designs occurs while other building systems are being designed. Throughout the design and construction process, the developer, the design team, and the contractor must work with local building officials to obtain the necessary approvals and to ensure that the project meets all local land use requirements and building codes. Once the building shell is completed, tenant improvements are made to the building to prepare the space for those tenants who have signed leases. During this time, the building is commissioned and occupancy permits are obtained. The space is ready for occupancy and the operation and management phase of the development process begins. According to Gauss (1998), operation and management has three main aspects: property management, asset management, and portfolio management. As mentioned above, property management involves maintenance, tenant relations, and operations (HVAC, security, communications, etc.). Asset management is a second level of management. It involves treating the building as an investment, and therefore involves managing its financial performance. Portfolio management means that the building is managed as an integral part of an investment portfolio.

2.2. Office Space Markets

Since the market for office space determines whether a building is or is not built, it is worth looking at the general principles on which office markets operate, and at the specific markets in which we did our research. The major factors in such markets, of course, are demand and supply. Demand is usually indicated by office occupancy rates, including present vacancy rates and recent absorption rates, while supply is indicated by the amount of office building construction presently occurring, although the factors involved in each of these concepts are very complex. In addition, since buildings take so much time to build, analysis of both demand and supply must project into the future, a notoriously difficult thing to do.

Before further exploring the issues of supply and demand, it is important to recognize several other factors that significantly affect the building market and the supply and demand for office space. Regulatory requirements (codes, zoning, environmental regulation, infrastructure improvements, etc.) influence the availability of land for development, how it can be used, and the costs to develop it. The financial markets and the availability of capital influence expected rates of return and whether investors are willing to provide funding for development. Both these factors impact where development occurs and what projects are feasible.

The first step in a market analysis is to define the market area; "market," therefore, is an inherently geographic concept. The market area can be defined in two ways, either by the area it will serve, or by its competition—the specific buildings with which the planned building will compete for tenants. Once the markets of interest are defined, the background to demand and supply can be analyzed from a macro-market and then a micro-market perspective. Macro-market analysis usually means comparing two market areas, or comparing sub-markets within a single metropolitan area. It involves looking at the underlying economy of the area, the growth potential for the office-using sector of that economy, and local historical trends and current indicators of the relationship between supply and demand for office space. Micro-market analysis means analyzing a sub-market for a particular piece of land, and involves looking at the location of competitive buildings, local traffic patterns, commute times from residential areas, proximity to mass transit, and psychological or perceptual barriers to access (such as "bad neighborhoods"). Furthermore, the specific usage of office space affects who the competition is—medical office buildings, for instance, function more like retail than like commercial office space.

Supply is not easy to analyze, but it is easier to understand than demand. Supply includes existing space, vacancy rates, and likely future additions. That is, one looks at present inventory, present vacancy rates, and buildings being built or firmly planned. Space, of course, can be broken down into class type (A, B, or C), ownership, location, types of tenants, and amenities. Factors which also affect supply include current rents, the cost and availability of financing, land costs, and local government policies.

Demand is by far the more difficult factor to analyze. As Gause, et al. (1998: 56) say, "New demand for office space comes primarily from new office-using jobs." The way job data are reported do not make this easy to understand, but new job data, net absorption data, and vacancy rates are the three main factors used to analyze the demand for office space. Office space per employee, which has recently been going down, also affects demand. Furthermore, markets can be broken into niches, because there are two types of tenants for each building: principal users, which are usually large companies needing whole floors, and complementary users, such as PR firms, graphic artists, and attorneys, often supporting principal users. The overall economy affects which companies within specific industries will lease as principal tenants, which in turn affects the complementary businesses in an area.

The American economy is now primarily a service economy, so many jobs require office space. Since the market for office space depends on new office-using jobs, office space demand follows business cycles very closely, so the office space market also goes in cycles: "Experience shows that this cyclic movement of the general economy is by far the most powerful influence on office space demand and therefore market activity as a whole" (Downs, 1993: 160). There are three phases in the office market cycle. First, there is a building boom, which starts well after general economic expansion has started. The second phase entails overbuilding, due to a lag between the initiation of construction and actual occupancy; in this lag time the economy undergoes a downturn. Finally, during economic recovery the excess capacity is gradually absorbed; when enough space has been absorbed, and if economic expansion continues, another building boom starts.

The first boom in the U.S. office space market occurred in the 1880s, with the invention of the steel skeleton frame. Another occurred in the earliest years of the twentieth century, and yet another happened in the 1920s. The Great Depression nearly halted office construction, and World War II stopped it completely. Because of this lack of construction, occupancy was near 100% in the late 1940s, and another building boom started in the 1950s. The next cycle lasted from the mid-1960s to 1973, the year of the first oil shock. The subsequent boom, one of the longest in American history, lasted from 1979 to 1989.

The 1980s building boom remains painfully seared in the memory of many in the present office market because of its ultimately negative consequences. Supply remained ahead of demand every year after 1982, and there was mounting evidence of overbuilding after 1987, but construction actually accelerated that year (Gause, et al., 1998: 16). The market finally collapsed in 1990, causing many failures in the industry. Overbuilding occurred for two reasons. First, due to the deregulating efforts of the Reagan administration, there was an overabundance of capital looking for investment. Second, demand/supply analysis was often poorly done, and "in some cases there was no analysis at all" (Gause, et al., 1998: 16).

According to Gauss, et al. (1998: 31), "Since the real estate crash of the early 1990s, the development environment has become far more conservative." Because mortgages are now being bundled and sold as securities in financial markets (a process called "securitization"), office market mortgages are said to be "subject to the discipline of the market" for securities—demand and supply analysis are supposedly being done more rigorously. Residential mortgages have been traded on securities markets for decades, but this is a relatively new practice for commercial mortgages. Although mortgage lenders have made their requirements for lending more stringent, it is wise to remain skeptical about how conservative the office market in general has become. The U.S. office market has enjoyed another tremendous building boom in the late 1990s, and this boom continues today.

The bust in the early 1990s, and the boom of the last five years, is clearly reflected in the following analyses of the markets in which we did our research. We conducted interviews in Seattle, Washington; Portland, Oregon; Sacramento, California; and the San Francisco Bay Area (including world-famous "Silicon Valley," a tremendous user of office space). The following brief macro-market analyses will highlight the importance of the composition and geography of local economies, will reflect the office market cycle, and will suggest the nature of West Coast economic development. All four markets are increasingly affected by, and even driven by, high technology industries, including hardware, software, Web design, and subsidiary industries.

2.2.1. Market Profiles

The following market profiles provide an overview of each study market, allowing a preliminary sense of the similarities and differences between them. We follow these profiles with a discussion of commercial building trends in these markets.

2.2.1.1. San Francisco Bay Area

The metropolitan region surrounding San Francisco Bay is known as the "Bay Area." Six counties constitute the core of the region—San Francisco on the west side of the Bay, San Mateo to the south, Santa Clara farther south, Alameda to the north on the east side of the Bay, Contra Costa further north, and Marin on the west side of the Bay, north of San Francisco. The Bay Area is expanding into Napa, Sonoma, and Solano counties to the north, and to the previously empty areas of Santa Clara and Alameda counties in the south. San Francisco is the financial center of the West Coast, but the city's main industry is tourism, due to the region's scenic beauty. Pacific Rim trade moves mostly through the Port of Oakland in Alameda County, which has a strong industrial base, but is also developing high-tech industries. To the south, world-famous "Silicon Valley," actually the Santa Clara Valley in northwest Santa Clara and southeast San Mateo Counties, is the national center of high technology and is "the core of the U.S. economy" (ULI Market Profiles, 1999: 275). High-tech is also spreading into southern Alameda County. The northern and western parts of Contra Costa County are industrial, while the central county contains many corporate offices that relocated from San Francisco during the 1980s. Major office space centers exist in downtown San Francisco, Silicon Valley, and the Contra Costa and Alameda suburbs. Other, smaller centers of office space are in downtown Oakland and the eastern shore of San Mateo, and a little exists in Marin County. Although the area is ringed by bridges and freeways, served by a heavy-rail commuter system known as Bay Area Rapid Transit (BART), and is carrying out many commuting improvements, commute times and traffic congestion are still increasing, lowering the quality of life in the region. The high barriers to construction in San Francisco, Berkeley, and Walnut Creek have given them anti-growth reputations, but other cities, such as Cupertino, are also beginning to restrict economic development on quality-of-life grounds.

The total office inventory in the San Francisco metropolitan region in 1999 was estimated at over 93.2 million square feet. About 68 percent was located in downtown San Francisco, with much of the remainder in San Mateo County. Annual new construction was a little over 2 million square feet in 1998 and 1999, much greater than the 430,000 and 200,000 square feet added in 1996 and 1997. Most of this new development occurred in San Mateo County, but strengthening of the San Francisco market in 1999 has led to more downtown development. The annual absorption of office space in 1999 was over 5.7 million square feet, reflecting a strong market at that time (ULI Market Profiles, 2000: 323).

2.2.1.2. Sacramento Metropolitan Area

Northeast of the Bay Area, the much smaller Sacramento metropolitan area is centered on the confluence of the American and Sacramento Rivers. It includes Sacramento, Placer, El Dorado, Sutter, and Yolo Counties, and is therefore also experiencing residential growth at the margins. Sacramento has a deep-water port connected to San Francisco Bay, an expanding airport, a growing light-rail system, a major rail switching yard, and surrounding cheap and abundant land. The city is a day's drive from anywhere in California on the three major highways running through the area, is seismically stable, and is the capital of the most prosperous state in the United States. It is therefore attractive to employers fleeing the congested and expensive Bay Area. Major industrial areas include West Sacramento, the area north of Natomas, the Florin area, and Rancho Cordova. The major clusters of office buildings are in downtown Sacramento, in the Sunrise area along with U.S. 50 corridor, in Folsom, and in Roseville (ULI Market Profiles, 1999: 237). The business community considers the region pro-development, and residents consider the quality of life high, although traffic congestion is starting to increase. The region is developing high-tech industries and is seeing a consequent increase in office-space demand, especially in the eastern metropolitan area.

In the Sacramento metro area the office inventory was estimated at a little over 43 million square feet in 1999. The annual construction in 1999 was 3.5 million square feet, more than twice the rate in the previous two years. The annual absorption in 1999 was also 3.5 million square feet (ULI Market Profiles, 2000: 286)

2.2.1.3. Portland Metropolitan Area

The Portland metropolitan area includes Clackamas, Multnomah, Washington, Yamhill, and Columbia Counties in Oregon, and Clark County in Washington, across the Columbia River, which joins with the Willamette River just north of Portland itself. The area includes cities outside of Portland such as Beaverton, Tigard, Tualatin, and Milwaukie. The region is rich in resources and natural scenic beauty. Until the 1990s, the region's three main industries were timber, fishing, and tourism, but the first two industries have suffered recently, and the region has begun to diversify into high technology manufacturing, finance, and international trade. The region's urban growth boundary (UGB), although continually debated, is helping prevent the sprawl occurring in other metropolitan regions, and developers and consumers are increasingly open to high-density development. Office markets exist in Portland, Vancouver, Washington, and in suburban areas, supported by the recent opening of the Metro Area Express (MAX) transit system. Quality of life is high, and the region attracts many California emigrants.

The office building inventory in the Portland metropolitan area was 26 million square feet in 1999. Annual construction in 1999 was estimated at 1.7 million square feet, slightly higher than 1998, but much higher than previous years. Annual absorption was a little less than 0.9 million square feet and vacancy rates increased, particularly in suburban markets (ULI Market Profiles, 2000: 276).

2.2.1.4. Seattle Metropolitan Area

The Seattle metropolitan area is distributed along the eastern side of the irregularly shaped Puget Sound. The area's counties include King, Snohomish, Island, Pierce, Kitsap, and Thurston. Seattle is in King County, which has half the region's population. From north to south, the major urban areas include Everett; Edmonds and Bothel; Seattle; Kirkland, Redmond, and Bellevue on the "Eastside" (east of Lake Washington, which is east of Seattle); Renton and Kent; Federal Way and Auburn; Tacoma; Lakewood and DuPont; and Olympia at the southern end of the region. The region is linked by a network of freeways, ferries, and bridges. Major industries include aerospace, forestry, defense, and international trade, while growing industries include software, biotechnology, services, and tourism. Office buildings are concentrated in the downtowns of Everett, Seattle, Bellevue, Tacoma, and in the suburbs of Redmond, Edmonds, and Bothel, and in an area just north of the airport. Expansion occurs under the Growth Management Act, with which cities must coordinate their efforts (ULI Market Profiles, 1998: 347; 349; 1999: 285).

Total office inventory in the Seattle Metropolitan market was almost 83 million square feet in 1999[5]. Annual construction in 1999 was a little over 4 million square feet, continuing an increase that began in 1998 and more than twice the average rate in the previous four years. Annual absorption was a little less than 4 million square feet in 1999. Vacancy rates rose slightly in suburban markets, but continued to decline in 1999 in urban markets (ULI Market Profiles, 2000: 342).

2.2.1.5. Recent Commercial Construction Trends

Over the 1990s, experience in the office space market of each of these regions has strongly supported the cyclic view of the market for office space. During the worldwide recession of the early 1990s, the Bay Area experienced a relatively severe recession, due to a drop in international trade and tourism, business downsizing, military base closures throughout the region, and the loss of defense contracts in Silicon Valley. The region's office markets were overbuilt in the 1980s, and it experienced high vacancy rates—as high as 19 percent in San Mateo County—in the early 1990s. The recession affected the Sacramento region less harshly, but vacancy rates were still high, around 15 percent, before 1995. The recession had less of an affect on the Portland region; the unemployment rate remained low, around five percent, and the timber industry suffered, although its laid-off workers were retrained. Office space demand dropped during the recession, but bottomed out earlier and less than other markets did. The Puget Sound region also suffered during the recession, due to losses in international trade, environmental restrictions on forestry, and major layoffs at Boeing, the largest single manufacturer in the region. These losses were mitigated by growth in software, biotechnology, military employment, and services. The office market experienced the same drop in demand and high vacancy rates of the other markets in the early 1990s.

The economies of most of these regions started improving in 1994 (Portland started earlier), and the continuing national expansion has benefited these regions' economies until quite recently. The office markets followed national and regional recovery closely. The overbuilding was absorbed first, and then construction started. Vacancy rates dropped after 1994, and have hovered around five percent for the last few years, with intra-regional variation. Annual allowable building in San Francisco is cumulative, and a backlog of allowable space had accumulated during the recession, so construction started downtown in 1998. Millions of square feet of office

[5] The inventory and construction totals for the Seattle market profile exclude single tenant, government owned, and medical dental buildings and only include King, Pierce, and Snohomish counties.

space were completed in 1997 and 1998 in Contra Costa, downtown Oakland, and Silicon Valley. Office space construction actually started in Sacramento in 1993, and has continued since then, keeping vacancy rates high into the late 1990s. Prospective tenants have found few blocks of contiguous office space, so construction has continued for owner-builders, especially for government buildings downtown, and for speculative developers in the suburbs. The earlier recovery of the Portland regional economy meant that vacancy rates dropped to nine percent in 1994, and "Portland's office market was a landlord's dream in 1996" (ULI Market Profiles, 1999: 213), with vacancy rates between four and seven percent. By 1998, over 35 private sector construction projects were under way or completed. The Seattle economy recovered slowly, starting in 1994, then accelerated. Office space followed; the overall regional vacancy rate had fallen to under five percent by 1997. By 1999, vacancy rates in some downtowns were less than four percent, despite the beginning of new office construction in 1995, earlier than in the California markets. Much of the construction occurred in suburban markets, where companies often built buildings for themselves.

During this recent period of growth (through 2000), high technology industries, especially the World Wide Web and the consequent "dot coms," have become major drivers of the demand for office space. Absorption has therefore remained higher than construction in the last couple of years, so that all four office markets were very "hot" as of October, 2000, with vacancy rates consistently, and sometimes radically, below five percent. The lowest vacancy rates—well below one percent—are in Silicon Valley. The vacancy rate in Sunnyvale and Cupertino, at the heart of Silicon Valley, is at an amazing 0.14 percent (Diaz, 2000), the lowest vacancy rate we found in all four regions and possibly in the country. Silicon Valley and downtown San Francisco rents are among the highest in the United States, since San Francisco also has a vacancy rate of under one percent, though it is marginally higher than Silicon Valley rates. Even Oakland, long considered a poor relation of San Francisco, has an all-time low vacancy rate of three percent. The Sacramento region is enjoying spillover from the Bay Area, since rents remain much lower there, although locals are beginning to suffer shock at recent rent increases. The downtown Portland vacancy rate was at 2.7 percent in October, benefiting from high-tech "refugee" companies from the expensive California markets. The vacancy rates of the Seattle and Bellevue downtowns were around one percent, and seven new office buildings were proposed in Bellevue alone.

The recent fallout in the high tech industry and its impact on the office building market is further illustration of the cyclic nature of commercial building markets. The high tech industry consumed large amounts of office space in the markets we studied, but now that those industries are cutting back, they are releasing space back to the market (Grant, 2001). Since October 2000, more than 5 million square feet of office space in San Francisco has become available (Muto, 2001). Likewise, in the Seattle/Bellevue office market, over 2 million square feet of sublease office space has been released into the market (Ernst, 2001). Vacancy rates are climbing back up into the 5 to 10 percent range, what many consider to be healthy levels. As a result, the markets have become more conservative. Many proposed projects are now on hold, although none in the Seattle market have yet been canceled (Bishop, 2001). Much of this adjustment was not foreseen in September 2000 when the Federal Deposit Insurance Corporation (FDIC) notified construction lenders that the Sacramento, Portland, and Seattle office markets were at risk of overbuilding (Portland also made the 1999 list). At the time, developers in all three regions disputed the warning, claiming that construction is profitable at a vacancy rate of five percent, that lenders are far more careful than they were in the late 1980s, since they now require higher equity involvement from developers, and that construction reflects real demand, as reflected in very high pre-leasing rates. It appears that the market is adjusting the supply of new development to reflect lower demand and lenders and developers are more cautious. Time will tell whether the markets stabilize or continue to soften.

2.3. Summary

The initial development of office buildings came from the need to provide space for commercial activities stimulated by the commercial and industrial revolutions that occurred in Europe and the United States in the 1830's. A variety of structural, material, mechanical, and electrical innovations have led to the sophisticated commercial office buildings we see today that provide space for a variety of business activities. Office buildings can be classified in terms of quality—class A buildings are investment grade buildings with high quality tenants, class B buildings are utilitarian and ordinary, while class C buildings are usually old and below average.

Building an office building is a tremendously complex process involving a long list of market actors. Key players in this process are developers, investors, designers, contractors, and real estate professionals. The building developer "orchestrates the development process," acting in the interest of investors and utilizing designers, contractors, and real estate professionals to deliver a successful building project. There are many steps in the development process, beginning with initial conception and feasibility analysis and including financing, design, construction, marketing and leasing, and finally commissioning and operation.

For a building project to be feasible it must meet all local and building code requirements, it must be designed to meet the needs of the target market, and it must generate a net cash flow that satisfies lending requirements and provides a reasonable return for equity investors. When analyzing office space markets to satisfy these criteria, the supply and demand for office space must be considered. This involves examining occupancy, vacancy, and absorption rates and new and existing office space available or soon to be available on the market.

Commercial building markets are dynamic. They reflect local geographic markets and economies. Building markets are driven by the broader economy—business growth and the creation of jobs. The office building industry goes through boom and bust cycles. Building booms occur in response to growing demand for office space and limited supply. Low vacancy rates and rising rents support investment in new construction by promising strong economic returns to investors. A bust occurs when supply outstrips demand and building vacancy rates increase and rent levels decline, restricting investment in new buildings. All four building markets we considered reflected these building cycles, experiencing a bust cycle in the early 1990's during a period of economic recession and a boom cycle more recently, reflecting strong regional economies. The very recent shakeout in the high tech industry has led to a softening of the office market as more space became available. Local markets and economies have a great deal of influence on what is built.

3. "REAL WORLD" BUILDINGS AS CONSERVATIVE OUTCOMES OF THE DEVELOPMENT AND DESIGN PROCESSES

The overarching focus of this Chapter will be on how the commercial construction industry is organized, paying special attention to the role that investment plays in both the form and content of commercial office buildings and in how buildings, as "consumables," are delivered to market. With that in mind, it is important to emphasize that we have found this industry to be overridingly producer-driven. That is, the capacity to define what is built is primarily located in the upstream and production-centered concerns of investors and to a much lesser extent in, strictly speaking, "consumer demand." We should also add that the distinction between "producer" and "consumer" is a difficult one because investors, owners, developers, landlords, and tenants straddle such categorical characterization. Producers of office space are also consumers and consumers can also be investors, owners, and developers. The distinction is nevertheless conceptually important and marked enough to warrant our conclusion that matters of producing office space for a profit, over the long term, govern decision making processes more than do the specific demands of office dwellers themselves.

We begin with a description and analysis of the upstream segments of the industry: the investor, developer, and initial design phase(s) of commercial office building projects. That is, our attention focuses on buildings as investment opportunities and the effect this has on innovation and innovative processes, as this is the typical scenario for commercial construction development. Next, we relate the means through which commercial buildings are delivered—how projects are organized to minimize uncertainty and deliver buildings on time and at the expected profit margin. Given the changes in delivery processes that have taken place over the last several decades, this Chapter also addresses what such transformations portend for innovation and industry standards.

Finally, before commencing with our analysis, it is also important to stress two interrelated points that we feel need initial reinforcement. First, though in the following pages we will emphasize the conservative and "anti-innovation" tendencies of this industry, we are neither saying invention in energy efficient designs and technologies *doesn't happen* nor that innovation *won't happen* (i.e., the diffusion of such inventions throughout a marketplace, see Rogers, 1995; Tushman and O'Reilly, 1997; Utterback, 1996). The case that we will make in this and subsequent Chapters 4 and 5, is that inventions do happen—with some consistency—but very few become industry innovations of the "radical type;" those that are quickly adopted, diffused, and become dominant designs/industry standard practice. More frequently, innovation takes the form of slow and incremental change, that to those in policy circles appears to advance at a glacial pace, if at all. This is an important finding in its own right, as it admonishes policymakers, and policy researchers like ourselves, to adjust expectations and develop new tactics for changing industry performance. As we will show, newness is generally eschewed by this industry for what is "known" for a number of standard and systemically based reasons. What this research uncovers, specific to this industry's machinations, is that it is a complex social system that relies on a handful of heuristics (conceptual shortcuts) that are used to reduce the uncertainties associated with commercial construction projects and in so doing the potential for negative outcomes. These heuristic devices tend to load decision-making (and hence "standard practices") against the introduction of unfamiliar designs, technologies, and participants and hence innovation and innovative processes.

3.1. The "Headwaters" of the Construction Process

To develop these and related points, we begin this Chapter by addressing real estate as both a short- and long-term investment opportunity. This view leads to an overriding concern with uncertainty reduction, and we touch on a number of "conceptual short cuts" used by industry players to reduce the risk of loss in their projects—risks that include immediate financial loss and long-term financial problems, as well as damage to reputation. Industry financiers, developers, and the like assess whether or not to move forward with loan monies and the building process by looking at the functional attributes of a project, the project's flexibility, and the past successes and reputation of those involved. In turn, definitions of functionality, flexibility, and reputation structure the opportunity for innovation in individual commercial construction projects, and bear directly on the adoption of energy efficient designs and technologies.

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, the members of each segment (such as financiers, developers, appraisers, brokers, architects, and contractors) also pursue their own interests and cultivate 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 (we discuss the roots of the commercial construction industry, essentially a craft-based enterprise, below). Professional communities such as these are both organized as intra-professional groupings as well as supplying stability to relationships that are inter-professional, say those that exist between banker and developer, developer and architect, architect and contractor, and so forth.

In general, as decisions about building *form* are made upstream by developers and financiers in their deliberations about budgets, building size and general type, location, revenues, target markets, and so forth, downstream participants are increasingly constrained in their options concerning project *content* (which for this discussion includes the buildings external appearance)—what designs and technologies will be implemented and what services will be rendered. In this sense, each input structures the alternatives of subsequent participants. Consequently, as a building project advances, choice becomes increasingly constrained. More precisely, as a project moves from conceptualization, to financing, to design, and to construction, the opportunity for innovation generally—and specifically in terms of energy efficiency—decreases.

The following excerpts from interviews with developers provide a view of how the "upstream" participants assure that the building they are financing and constructing turns out as they expect (from the investor-developer perspective). They do this by sharply circumscribing the inputs of those "downstream" (architect, contractor).

> *You'll have a superintendent on the job to schedule [the subcontractors] to see that they come in at the right time. Very important, these men are becoming premiums. They build up their own reputation [by] bring[ing] in a building in on cost and on schedule. Because when you're dealing with…25, 30, 40, 50 subcontractors who put this building together, you've got to have one or two people there every day watching that it's done right, that the schedule is being done…[Furthermore] you have an architect do what you want. You tell the architect that you're going to build a 50,000 square foot building. I want to be able to divide this thing up down to 2,500 square feet. We use a lot of them [architects]…I mean, there's all kinds…There's a niche that they…specialize in…that's how you choose them.* (Property Developer).

> *Once we've looked at the site…we bring in a general contractor with our architect up front. We will all sit down as a team and say, "Okay, let's make sure we can make this thing work." Then with the general contractor we will go through and finish all of the plans. Who you have on your team, typically…we'll choose up front…You can't delegate…all this stuff too far. I think certainly our architects do their jobs; the contractors do their jobs. They do their jobs better if we have somebody who is riding them all the time because no one's going to think of it from our [investor-developer] perspective…we're the decision-maker at the end of the day, but the architect obviously he will do his—he'll put as many embellishments…as you let him, because it will make it look good…So we've got to hold that back. The general contractor is always going to take everything out to beat the price down as far as he can. Because he doesn't understand [that] we've got to sell it. He just knows the owner's…happy if [he] keeps cutting the costs. So we're the guy who has to sit there and sort of make the judgment calls to find the balance…*(Property Developer)

The same informant continued, speaking of his efforts (and those of the Real Estate Investment Firm he represented) to keep a project on track:

. . . it can take us two months of sitting down there and saying, "Damn it, Bill [the architect], you keep throwing this column in there. I told you I don't want the column." And he's going to say, "You need the column. It's going to look crappy if you don't do it." And then I'm going to say, "Well, okay, are you going to get rid of these five things over there? Because we can't afford it." That's [the expense] going to be coming from the general contractor because we're going to…he's going to have to budget. It's dynamic tension [between participants]. It's good, so you've got to have good chemistry and a good rapport. Which is why we go back to people we've used again and again. (Property Developer)

In another instance, a construction manager—an individual (or firm) hired by the owner-developer to guarantee a project's costs and timely delivery—said of managing large commercial construction endeavors:

As a project manager…we're like the conductor of an orchestra…it's kind of a tiered relationship. We look at the financing, we look at the design, we look at the construction, we look at permitting issues or entitlement issues, and (we) coordinate between all of those. So we're on top of all of those trying to make the decisions that create the tradeoffs between various components to define the product. Then the architect would be tasked with designing it to our criteria. Our criteria might be determined by [the owner], but we're the one giving them direction. Then we have a [contractor] turn around and build it. We wouldn't be responsible for the day to day…we wouldn't hold the contracts with the plumber and the electrician. The general contractor would. But, at the same time, what the plumber and the electrician and everyone else is doing is of great interest to us, because it's going to affect the product that we're going to end up with. (Construction Manager at Risk and Property Developer)

As these quotes show, important decisions are made early ("let's make sure we can make this thing work") and at the "top" of the commercial construction value chain (investor-developer perspective). Corroborating these quoted excerpts, Gause et al. (1998), comments on the owner-developer's duties, "In general, the developer's role in an office project is to orchestrate the development process and bring the project to completion…it is the developer's responsibility to function as the team leader throughout the development process…owners and investors retain the ultimate responsibility for determining how to proceed" (p. 19).

3.1.1. Buildings as Investments

Given the developer's central role, what guidelines do developers tend to use to know how to proceed throughout the construction process? We have found that how participants conceptually frame the building process has important ramifications on the outcome—the buildings that are actually built. In particular, our focus in this sub-section will be the way that participants conceive of commercial properties as an investment, the effect this has on who participates in a project, how coordination occurs between participants, and ultimately 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. These include function, flexibility, trust, and track record. In the following, we develop how these attributes, as noted by our informants, influence what lending institutions, firms, and individuals are looking for when investing in commercial property, and the downstream implications of this for other project participants and ultimately innovation processes.

A building begins with conceptualization and planning. At important stages in a project, but especially in the initial conceptualization and design phase, negotiations determine the form and content a building will take. What a building will look like and where it will be located (questions of form) as well as structural and mechanical system components (questions of content) are decisions typically made by developers (in consultation with the project team) who are constrained by financial packages composed through both formal (pro-forma) and informal (experience and intuition) market assessments. Depending on the motivation behind a project[6] different objectives may operate. Nevertheless, while their motivations may be different, the logic of "buildings as investments" still functions as a guiding principle; only the nature of the investment changes. In general, 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 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. Such "assessments" guide development decisions and the subsequent parameters given to design teams (hence the resulting design propositions). They also provide the baseline from which contractors will address cost and feasibility concerns.

Unless it is build-to-suit,[7] decisions concerning a commercial office building's form will typically be influenced strongly 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. In short, decisions are made within the confines of boundaries erected by previous decisions and through direct intervention by development interests to assure that a project advances in time and takes the form that is expected.

[6] For example, motivations can be an owner-developer's desire for profit or a firm's need for a workplace.

[7] Again, in the case of corporate headquarters the investment takes on a different meaning and intention. Nevertheless, even build-to-suit projects are affected by the market dynamics already discussed. See Chapter 4 and 5 for more detail on these less conventional buildings and the dynamics involved.

The most common scenario involves initiating a building project for financial gain. Because of the great expense involved in commercial office construction (typically in the millions of dollars), financing plays a very important role in all aspects of the building development process. In a very direct sense, lender preferences are part of initial conceptualization. For example, an appraiser and two different developers comment on the power that "investment concerns" have on the conceptualization stage of the building process—in short what gets considered for deployment in the buildings they produce:

> *Typically a very important part of the process…does developing an office building create a profit? If it doesn't create a profit, then it's not financially feasible. There's not a reason to do it. And there isn't any reason to spend, you know, two and a half years of your life and risk your money to trade dollars. You have to make a profit. So, assuming that in highest and best use you come to the conclusion that it is financially feasible, then, what you're going to do is go through a process of forming a vision, valuing the property, coming to a conclusion*. (Appraiser)
>
> *We may not have a design at that point at all. It may still just be a one-page concept of a project that says this is what we're trying to build. Here are rough order of magnitude costs. Here's what rent someone could pay. And, from that amount, an investor can gauge whether they're interested or not. [If they] say, "no, the way you've got it structured, I'm not protected"…we go tweak the model a bit and we're going to go through that iteration a few times until it works [for the investor]*. (Property Developer)
>
> *So before we even talk to the bank we can guess how they are going to underwrite the deal and [we can] be dead-on or almost dead-on every time. So we will put together a building by a project pro forma…because of our familiarity with how the underwriting works [we know] what the bank requirements are going to be.* (Property Developer)

Determining what is and is not financially prudent is a complicated process. This process has a formal side, which involves the production of an official market assessment (called a *pro forma*), and an informal side that has lenders and developers relying on their experience and intuition to make difficult decisions. The initial phase, 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 (that is, 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). According to the same Fairfield, California appraiser quoted earlier, value in this market place is typically determined in three ways. The most compelling valuation for the commercial office sector is generally the assessed income potential:

> *This is [a] very fundamental thing. There's three approaches to value. The cost approach, the income approach, and the direct comparison approach [to other equivalent area properties]. ... Typically, for an office building, the better indicator of value would be the income approach…not always. You have to look at the quantity and quality of data. The whole thing about…doing appraisals is making decisions, forming judgments based on imperfect information…purchasing decisions and lending decisions are made on [assessments of]…operating income. That really drives the terms of office buildings…new office building* (Appraiser)

3.1.2. Financing Projects

Who are the profit-seeking investors in such capital-intensive ventures? Commercial office buildings 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. We take this up below, looking at both the short- and long-term components and how they structure participation and project inputs.

3.1.2.1. The Short-Term Investment

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 the following excerpts, a Seattle area banker remarks on the risky nature of new construction lending and a Sacramento banker comments on the interconnected nature of short-term investments and the longer-term viability of a commercial development project:

> *Construction lending is pretty risky, riskier than most other types of real estate lending because all you've got is a bunch of blueprints and some dirt and a big story; as opposed to permanent lending…three pieces of information that we really need [to] analyze*

for [construction lending]…or maybe four pieces…are the physical description of the property, the income analysis of the property…the cost, and then analysis of the guarantors behind the loan. These are the four main areas (Financier)

The bank's ultimate risk is…is the building going to lease? …The second element of risk is, how is the bank going to get taken out? You know, is there going to be a permanent lender who's going to come in there and get them out? You know, the construction money is short-term money…so they want to know, looking at the lease term…[is] a permanent lender going to come in and take us out? (Property Developer*)*

In order to assess a project's potential, lenders peer through the lens of "past achievement" as a metric with 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 and developers 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 additions as adding uncertainty, rather than value, to a proposed development.

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? (Property Developer)

(Q: How do you decide what's going to be built?) You know, a lot of it has to do with [the] past experience of the team. …"Remember, we did this building…we used this system on that building and it didn't…work as well as we thought it would…Let's go back to the, you know, true-tested" (Property Developer)

Financiers, developers, and others involved in planning development projects tend to move with conscious regularity toward what has worked in the past, avoiding systems that "didn't work as well as [they] thought." Yet these appraisals and the subsequent funding decisions are not entirely governed by formal assessment methods. Frequently, according to our informants, whether a project is funded or not hinges on a lender's "comfort" with a builder's project concept as well as with their reputation for successful or unsuccessful projects. The same Fairfield appraiser quoted earlier, after speaking in detail of the formal intricacies of value appraisal processes, also remarked on how often assessments and the decisions of financiers do not fall directly from "crunched numbers" but rather from "gut instinct," experience, and intuition:

> *The tricky part is you can't say it is specifically this [or that] number. You can't dissect that number. I mean, you can dissect it…but, then…it actually doesn't reflect what the market place does. Because one of the interesting things is…in subtle ways the market place often does not do what they tell you that they do. They tell you they do something. They tell you that this is important or this is the way they do it, but when it comes right down to it, even most analytical institutional investors, they…crunch numbers and they consider…this building in Pittsburgh and this one in Austin, Texas…but when it comes right down to it, they buy the one they like…for what their gut feeling is, "My gut feeling is, I can't tell you why, I think this is a better building, I think this is a better market. Look, Mom, this is the one I'm buying"* (Appraiser)

A Sacramento area banker corroborates the appraiser's impression of market place behaviors, speaking from a position of experience as it relates to lending money for commercial construction projects:

> *Decisions with lots of money riding on them a lot of times are made the first ten, fifteen minutes. Analysis of those decisions usually goes to support the decision-maker's gut instinct about a project. As much as the reverse ought to be true, where all this analysis goes into making the ultimate decision, a lot of times after guys have been doing it a number of years, they can tell pretty quickly if it's something they want to pursue, or something they don't want to pursue. So they make the decision and hopefully backfill it with all the proper analysis that supports it* (Financier)

This "intuitive" decision-making process is an important one, as both the above informants emphasize. As we will see in subsequent Chapters, this intuitive approach is more systematic than it may appear on its surface. In conjunction with formal appraisal methods, lenders, developers, and project management firms use a host of conceptual shortcuts to appraise a project's viability.

3.1.2.2. The Long-Term Investment

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 his clients found attractive in commercial office buildings 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.* (Property Broker/Operations Manager)

As should be apparent, 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.

3.1.3. Hedging Against Uncertainty

Industry players, such as the property manager quoted above, noted that 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 (it is "real" estate) that can be owned, visited, and modified if so desired. This tangibility imbues the investment with stability. Over time, property values have tended to be relatively stable, even if cyclical, with long-term increases in property values far exceeding short-term drops in value during business downturns (Downs, 1993). This compensates for the fact that commercial real estate returns are slower to accrue than are more "risky" ventures. 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 to ensure stable returns. In the following quotes, two developers relate both sides of this conservative outlook—the high price placed on innovation and the push by financiers to have all the uncertainty of a project shored up before they invest.

> *[Proposing something unusual] it's a huge burden. Because it's not in line with…history. It creates a huge challenge to us because*

> *being non-traditional costs more than conventional real estate projects would. And, with the added costs, everyone from investors to lenders goes, "Well, what if your idea doesn't work…in a year or two, three years, how am I going to get my money out? How are you going to get a return?" Because they're [investors] all economically tied to, not a one-year return, but five- or ten- or twenty-year return. So, the institutional money market, whether it's the investors or the lenders, are all terrified of anything different. We need to find ways of packaging it to minimize the risk and exposure to them, and take that risk and exposure and ascribe it to the people that would benefit from this unusual product and get them to finance it because the traditional forms and sources won't.* (Property Developer)

> *[I]f we get tenants to sign up…if you [can] get up to 65 or 70 percent, then we [can] go get a loan [spread] over 15, 20 years. And when you have these leases with—especially if they're national companies—you end up getting about 75 percent of the appraised value of the building.* (Property Developer*)*

It is important to emphasize the point that the second of the two informants quoted above is making. The amount of money he receives in the form of bank loans hinges on how much of the building he can pre-lease and present as part of his loan pitch. A bigger loan means the developer has to put less equity into the project. As we will see in the next Chapter, this is very important, since a building must be flexible enough to accommodate a range of different kinds of tenants so that it can in fact be "leased up" early on and in so doing assure the owner-developer a larger profit in the short and long term.

A basic component, then, 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 (Stinchcombe 1965a). 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, and why adoption of more energy-friendly designs and technologies is so slow.

3.1.4. Function and Flexibility

In many ways, developers and the buildings they produce reflect the investor conservatism discussed above through their reliance on categories of functional cost and building flexibility.[8] Developers plan and financiers "grade" a project's form and content with function in mind. Each aspect of a building, down to the details, is addressed from the perspective of whether it functionally contributes to the overall

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[8] 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 Chapter 3.1.5).

purpose of the project or whether it raises costs but provides no benefit (that is, it does not add value). Investors and developers typically evaluate and advance plans from a *satisfying* perspective; doing only what is deemed necessary and avoiding the superfluous assures predictable returns with lower risks of losing investment monies. In the following excerpts, informants speak to issues of function and flexibility as they relate to the bottom line, project costs:

> *I mean, there's not much magic in the construction business. No matter what anybody says, it's pretty straight forward. I mean, costs are costs. If you use polished granite it's going to cost X, if you use cheap tile it's going to cost Y. And part of the issue, then, is to bridge the gap and know where to spend the money and where not to spend the money. Generally, we will build a class A product. Now, in doing so it doesn't necessarily mean you put polished granite at number twelve floor. You're probably most cost effective if you could run that down to the first and second floor where people can see it and touch it. And then move to pre-cast concrete as you're moving up the building. That's just a function of value in general. Same thing with the lobbies. Spend the money where people will notice it as soon as they walk in, from curb to cab. The lobby area, the front doors. As you're standing in front of the elevator pushing the button, which most of the tenants will do, what does it look like? I mean, do you just have a painted wall or do you have a lovely wood wall? Or stone. Something that's memorable.* (Property Developer)

> *You've already got your costs…basically you look at them and figure out where [you] we can save some [money]. Well, let's look at…let's look at finishes inside. Okay, we're not going to go with granite in all the lobbies…Let's go with a flint granite, which is the rough-looking granite. Instead of doing it throughout, let's just do the granite on the border and we'll do a carpet insert. Instead of granite on the walls, let's go back to sheet rock, and maybe we do a nice wood wainscoting, okay, with a nice chair rail around…make that look real nice. … Keep it simple. You know, make it look clean…It's cheaper.* (Property Developer)

In addition to the importance of functional attributions, according to Sacramento area commercial office developers, "flexibility" is a key quality demanded by investors in their projects:

> *If you want to build…a two-three story office building in a sub-market that has a lot of demand and your project is flexible in terms of being able to accommodate a lot of different type of users…say it's 100,000 square feet [and] can it be broken down into four…parts; or is it only going to be available to one tenant that comes in and meets all the space? What kind of product [and] is it*

worth it? . . .How flexible can you be in the event things don't go exactly the way you'd expect them to go? (Financier)

Another key component of our model is we build non-specialized buildings. A lot of times you'll have a…tenant [that] wants to drive the process, "I want my building to look like X, Y, and Z." And then ten years later…your tenant moves out and you look at it and you say, "Oh, my God, how are we going to re-tenant this?"…There's a lot in the design of a building that allows you to be flexible or not…we are only going to buy or build buildings that are flexible…because the only thing we know is that whatever tenants need today will change in five years. (Property Developer)

(Buildings) are usually geared towards the tenant's use… . I need to be flexible enough with the design to where I can bring in an insurance company and be able to, with minimal changes in the building, lease it to the next tenant. So, in that regard, it's going to have to be somewhat flexible. For people that know what they want and they come to us and say, "This is what I want to build and these are the criteria, this is what I do and this is what I expect this building to function like," then it becomes pretty much a customized…and it's probably not going to be too flexible to others moving into that building. ... Flexible, flexible, flexible. Everybody wants flexible spaces. The biggest thing right now in the market is change. I mean, they're having their tasks changed, their job description changes, their office space is constantly under change, so flexibility is real important for them. (Construction Manager)

The "flexibility" of a proposed project assures a wider pool of prospective buyers and/or lessees and in so doing reduces the uncertainty of "unloading" or leasing a property when a project is completed and 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. 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 lessees), 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 an earlier excerpt 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. Yet adoption of new designs and technologies does occur. Foreshadowing a subject we take up in some detail in Chapter 4 and 5, given the context thus far related, how would innovation occur? As the following quote illustrates, the innovations that do occur in energy efficiency tend to fulfill criteria salient to industry participants, such as comfort, flexibility, and function, in addition to energy savings:

Here's a good example of that…currently it's still not cost-effective, but it has to do with cost versus values and really the life-cycle costs, and the initial costs…instead of having mechanical distribution from the ceiling blowing down, we're going to have an under-floor mechanical distribution where you're on a kind of a pedestal-type of computer floor…a lot of buildings are going to that. First of all, for comfort, second for energy efficiency, and third for flexibility in space, as far as people can re-configure their cubicles or whatever. And right now, it's always thought to be cost-prohibitive, but as people can identify and quantify what flexibility is worth, what energy efficiency is worth over the long run, and what ease of distribution is worth (such things will become more common). (Construction Manager)

3.1.5. Trust and Track Record

Function and flexibility are not the only conceptual elements that lie behind producer decisions. Track record and trust 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. One of the important roles that social ties play is that they reduce uncertainties, in a risk-averse industry, by providing interpersonal and 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.

In interviews with institutional lenders, developers, and brokers, the above elements were repeatedly expressed together, showing how closely related these properties are for decision-makers in commercial construction projects. In the following excerpts, a loan officer at an international bank and two developers speak of elements they consider when appraising a project's viability and selecting project participants. These include both market assessments and project participant "reputations":

Because Sacramento is not one big market, but it's a bunch of small sub-markets or neighborhoods. ...So where you're building, what you're building, [and] 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? (Financier)

Like I said, the last thing you want to do is have a bust in the deal and then have to go back to your client and say we need more money. Because you lose respect. And they lose confidence in you…You're always going to want to work with guys that you've worked with in the past… I have one general contractor in particular that I use…he's done 95 percent of my work and I trust him. I trust him with my kids…you just can't afford [a] screw-up. ... If I come in and walk the site, I'll grab the superintendent and I'll show him. I'll say, "Look at that, this is what we want." It takes time, a lot of times you don't want to use a new general contractor because then you've got to reinvent the wheel. So that's why I like forming alliances, you know…I've got my company team together, right? ...My general contractor, the subs, you know, the architects, the engineers. All right? And those are the people that you want to…they're like your extended family. (Property Developer)

Often…we will have a relationship with both the designer and the [developer]…(it adds) more credibility…before we actually sign a contract and obligate ourselves to deliver…we'll choose that architect and (the) contractor based upon their suitability to the individual task at hand. We have a relationship with a bunch of different architects and a bunch of different contractors, and each has a particular skill set. We try to choose the ones that are appropriate (for) a particular project. Someone I might use to design and or build a hotel (with a wood frame)…wouldn't necessarily (be) someone I would consider to build a 10-story steel-framed office building (Property Developer)

Thus far, we have found that most project participants are chosen, most of the time, on reputation, social ties, and referral.[9] Moreover, of the firms we have studied, our informants cite repeatedly going to the same sources for money as well as catering to the same customers time and again.

We have a pretty good customer list and market share, so we tend to work a lot with our existing customers, although we work with new prospects as well. Typically, it's a lot easier to work with an existing customer because you've known them, you've seen them perform and you've developed a relationship with them. (Financier)

Oh, we do our share of solicitation, but…it has [mainly] been word-of-mouth, and it's getting more that way, but usually, like, 63 percent of our work this year is repeat customers (Construction Manager)

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[9] 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 play a major role in selection processes.

We have a big marketing [department]…people whose job it is to be out there…talking to clients going to shows, doing conventions…then there's the whole source of our client continuity. Over…over the years we've had up to 80 percent repeat clients…in our…in our office, so the same clients are coming back…like Hewlett Packard goes and starts a dot com. If he liked working with us, he'll give us a call. On the other hand, you've got your marketers out there and your architect is talking to people all the time about what's. … Basically, in this business you've got to do good work all the time because…it's like the old sour apple or rotten apple syndrome. One bad job really…could cause you a lot of trouble (Architect)

I would say probably 50 percent of the private sector work is repeat work, you know, roughly…we have developers that we work with that just wouldn't consider working with anybody else…new people will come in the market…the first people they usually contact are brokers… . Well, we're connected…[to the] big brokerage houses like CB Richard Ellis…they'll say, "Yeah, well, LPA does office buildings and they're the best"…so they put them in touch with us…we're [also] connected to a lot of the larger contractors. … The same thing happens on our side. We'll be working on a project and our client will ask us for the name of three contractors. So we give them…names…Sacramento is…it's much more of what we refer to as a good old boy network and it takes you a long time to get into it. If you're new, it's harder to get into (Architect)

Such uncertainty-reducing strategies are mirrored up and down the commercial construction "value chain." Stable working relationships with both industry participants and "customers," 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.

You know, business is business and it's like money and dollars and returns and investments. When you get down to it, it's still people doing business, you know? And business relationships are a lot like personal relationships. …So, the people I try to enter into a business relationship with are those people who I perceive as being conscientious. I like to do business with people I enjoy being with. But, I want to win…the amount of risk I'm taking—not just with the bank's money, because for everybody things are personal, people are focused on what affects them personally. [For] people in banks…a bad move upsets their career and their reputation within the bank and the banking community and while I don't have any of my own personal money riding on the loan, I see my job as riding on making good loan decisions. And a lot of what I do and what my reputation's success is *riding on is engaging in business with people I have confidence in. So, I have to constantly judge people* (Financier)

Knowing intuitively, based on 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 past experience entails greater risk by industry definition; this 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. 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 development. It is useful to compare this kind of orientation to that which currently dominates the high-tech sector of the economy, where the risk associated with innovation is a way of life. No such innovative spirit exists in the locations we have studied. 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, trust, and track record to promote buildings that avoid "costly" and "superfluous" expenditures and have proven to "add value" (Stinchcombe 1965b). 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 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 . . . "Damn it, why did you waste that money?" That's not where you make money…* (Financier)

As we can see, doing what is different, being a first mover, or taking chances is not part of this REIT's market strategy—and, we would add, not part of the strategies of most others in the commercial real estate market place. This is also true for the selection of designs, technologies, and participants.

3.2. Delivering Buildings

Having discussed the conceptual side of commercial development, we now turn to a discussion of how development teams are organized and buildings are physically delivered. As introduced in Chapter 2, the “delivery system” works as an organizing principle through which the owner-developer organizes participation. According to Sanvido and Konchar (1999), a very important decision in any development scenario is the selection of a project’s delivery system. It is significant for reasons that parallel the “buildings as investments” view already outlined in preceding pages. Project delivery systems are the means through which owner-developers guide their projects to completion. For example, delivery systems reflect who makes the critical decisions, where intervention will and will not be effective, what kinds of exogenous factors influence project decision-making, and what relationship the investors, developers, and in some cases future owners have to one another and the building being constructed. For example, in Figure 1. A, Way of Viewing the Building Development Industry (end of Chapter 1), we outlined three different development scenarios each of which reflects a different project-to-investor/developer relationship. Build-to-sell are projects in which the investor(s)/developer(s) are constructing the building for sale as soon as the development is completed. Built-to-hold (also known as built-to-own) involves investor(s)/developer(s) who plan to own the property in order to either lease it, lease part of it, occupy it, or occupy part of it themselves. Finally, built-to-suit entails a developer constructing a building according to the prearranged specifications of a client/owner/future occupier of the space. In short, better understanding how building projects are organized in the commercial sector, and why, is essential to our discussion of innovation and market transformation toward more energy efficient practice.

In this section, we address the historical derivation of current industry practice, the place economic considerations have had on the social organization of the industry, the design and construction sequence, the prescriptive character of decision making practices, and how such processes fit the uncertainty reduction needs of an industry chiefly concerned with first time cost and long-term profit generating investments (i.e., buildings). We begin with brief attention to the historical derivation of current industry practice(s).

3.2.1. Historical Derivation

Project delivery systems have evolved over time. Until the Industrial Revolution, a master builder was hired to build and/or guide the building of an entire structure from start to finish. The vestiges of this system have, in many ways, continued into the present through such famous architectural figures as Frank Lloyd Wright (Sanvido and Konchar, 1999). In recent decades, buildings have become increasingly sophisticated and with that complexity has come specialization. Specialization led to separate firms handling specific task in the building process, depending on the type of building and materials required. This is in stark contrast to trends in the early and middle twentieth century toward vertical integration and centralized administration in heavy industry (Chandler, 1977). Such administrative practices through investment in bureaucratic processes and rationalized communication channels assure efficiency in mass production scenarios. Yet such an organizational scenario has proven uneconomical in a commercial construction context because of the cyclic nature of volume, product type, and geographic distribution of work (Stinchcombe, 1965a). In this scenario, craft administration of the sort historically dominant in commercial construction differs from more bureaucratic administration by substituting professional socialization and training for centralized planning and execution. In this setting, loosely coupling production segments and leaving socialization and training to professional craft associations and relationships allows for greater flexibility and lower long-term costs.

However, this loosely coupled system should not be viewed as "creatively flexible." The need for predictable and reliable performance from subcontracting bodies has engendered a necessarily rigid set of expectations on the part of industry participants. This is based on the liability that newness presents (Stinchcombe, 1965b) to the coordination of project participants and project inputs. Successful, timely, and cost effective completion of a project pivots on conventional practices that guide decision-making in parallel directions. Disruption of standard procedure with irregular inputs—new organizational arrangements, new designs, and new technologies—invariably adds to the bottom line in cost, time, and project continuity. This is a fundamental constituent of a change-resistant industry such as commercial construction.

3.2.2. Social Organization and Economic Cycles

In addition to issues of increasing complexity, economic conditions have also left an indelible stamp on the social organization of building construction. While the total square footage of commercial office space has expanded continuously in the U.S. since 1945 (Downs, 1993), this total expansion has occurred in bursts, as we related in Chapter 2. What has evolved over time to address the influence of the economic boom, overbuild, and absorption phases of the commercial construction business cycle, is an efficient means of administering work through craft-based subcontracted production. In this sector, the professionalization of manual labor is more "efficient" in that firms have stable sources of skill and expertise at their disposal without having to sink costs into permanent and expensive administrative structures. That is, they need not permanently hire employees and pay for them during down times, but have access to a ready pool of workers for projects when they do need them, and can simply contract with them on a project-by-project basis. The past and current configuration of the commercial construction industry is a logical response to the cyclic conditions the industry faces.

3.2.3. An Overview of the Design and Construction Sequence

The nature of the building delivery process, and the sequence of events in the process, varies depending on the delivery system used. An initial project concept is created and developed in greater detail throughout the steps of the design process. The construction process translates the building design into a physical structure and may occur in sequence or in parallel to design, depending on the delivery method used.

The design process usually consists of conceptual design, schematic design, design development, and construction drawings (Brennan, 1993). The conceptual or pre-schematic phase occurs during initial project planning and is part of the project feasibility analysis. During this phase, the design concept is formed and many of the building characteristics are established.

Once the decision is made to move forward with the project (which may take some time) the design team begins the schematic phase of design. Assumptions made in the conceptual phase are reevaluated. Plans and elevations are developed in greater detail. Options are considered for the major building systems such as the structural and mechanical/electrical systems. Initial cost projections are made and the design is adjusted to stay within the required budget.

Early in design development the selection of options for major building systems is established (the big ticket items). The design continues to be refined and developed in more detail, with cost estimates continuously updated and tradeoffs and value engineering used to stay within budget. The design is evaluated for constructability (to ensure the construction trades can actually build what is being designed).

The construction drawings and specifications are the culmination of the design process. They communicate all the information necessary for the contractor to construct the building. And they provide the documents and specifications for the bidding process for contractors and sub-contractors (if bidding occurs). The construction drawings are also used to obtain building permits.

The construction process itself includes pre-construction, construction, and post-construction activities. Pre-construction work includes site preparation activities to ready the site for actual construction. Construction begins with the building foundation, and ends with the tenant improvements that customize each space to meet the tenants' needs. Once construction is complete, there are a variety of testing or commissioning activities that occur to ensure that the building operates properly, and to obtain occupancy permits. Note that some of this testing is performed on some of the building systems while others are still under construction. The final step is a hand-off of the building to the facility managers and operators.

The staging of design and construction activities may be in sequence in a traditional design-bid-build delivery system, or in parallel in design-build, construction-manager-at-risk and other hybrid variations (Sanvido and Konchar, 1999). In the latter approaches, the building contractor is actively involved in the design process, providing cost estimates and constructibility review. In design-build projects, the contractor completes some or all of the design for the building or of a particular building system.

It is within this complex process that any innovation in building design or delivery must take place—and where any energy efficiency improvements, radical or modest, must be fitted. We turn, then, to the variations found in the delivery of buildings and how this impacts the relationships between parties and ultimately innovation in the commercial construction industry.

3.2.4. Delivery Systems and Current Building Practice

As the division of labor in the building process became more technical, specialized and distinct firms evolved that offered particular services and products to the owner-developer. This led to the conventional *design-bid-build* model of project delivery that presented the developer with a succession of discrete steps: a design for the structure, a bid for construction of the structure, then the actual construction of the building (Sanvido and Konchar, 1999). In the following excerpts, both a Sacramento contractor and architect describe the design-bid-build delivery system:

> *In the design-bid-build, what happens is a process where the design is completed basically without the input of a contract. You then go to a competitive bid process with general contractors. Presumably the low bid or whatever the corporate criteria is…results [in] an award and then you build…that contractor goes out and builds the project. This is a more traditional method of delivery. It has been the predominate method for the public sector for many, many years and to a large extent was the predominate method of delivery within the private sector, up until probably about ten years ago or so.* (Contractor)

> *. . . there's the classic design-bid where you do your design, you finish it, and you put it out to bid…Then you pick the best price or the best package, [the] best value. That's also the longest time to market. [But it's the] best value to the client because it gets the most competition on the biggest [cost].* (Architect)

In design-bid, the traditional project delivery system in the U.S., the owner-developer contracts with a designer first. The design firm typically provides a complete set of documents outlining the prospective building's appearance, function, and content. The owner then contracts separately with a general contractor, who enters into an agreement to construct the building in accordance with the plans as defined by the designer. Furthermore, the general contractor in this model generally sub-contracts part or all of the construction to "specialty" craftsmen for implementation. This form continues to be dominant in pubic works projects where state and federal law often prescribe competitive bidding in the name of fairness.

It is important to highlight the control an owner-developer exerts over a project's design and construction in delivery systems through participant selection. For example, through the competitive bid process the owner-developer seeks to assure that he or she receives the highest skill, as viewed in submitted designs (architects), submitted materials/cost estimates (contractors), and participant past achievement (everyone involved), at the lowest cost. The point is that developers choose participants because they meet already established expectations, given the project they have in mind. Throughout our interviews with developers and subcontractors, industry participants repeatedly told us they chose and were chosen for projects based on how well they "fit" owner-developers' intentions, or in the words of a Sacramento developer, "We'll choose that architect and we'll choose that contractor based upon their suitability to the individual task at hand."

As functional differentiation continued in the industry within and between segments such as finance, developers, architects and designers, and engineers, communication between firms or actors increasingly came only after design had been completed and construction processes begun. Given the low level of input that differentiated segments involved with implementation had in design-bid, many errors, disputes, higher costs, and extended production schedules resulted.

In the 1970s, developers started bringing on board construction managers to lend their projects the continuity they lacked. These construction managers acted as on-site agents for the owner-developer. Initially, these managers were not held accountable for cost or time to completion. In the late 1980s and early 1990s this relationship changed again as progressively more construction managers were contracted to assure that projects were delivered on time and at projected cost.

This arrangement has become known as a construction-manager-at-risk model (also called construction manager/general contractor)[10] and represented an attempt to further control the uncertainties that surround construction projects. In this type of relationship, of which there are several variants, the construction manager is involved in the initial design phase, can perform some or all the duties of a construction contractor, and contractually guarantees price and delivery schedule. A developer interviewed for this research, who uses the construction-manager-at-risk model, commented on the responsibility he entrusts to such managers of his development projects:

> *"You'll have a superintendent on the job to schedule [the subcontractors] to see that they come in at the right time. Very important, these men are becoming premiums. They build up their own reputation [by] bring[ing] a building in on cost and on schedule"* (Property Developer)

This method was an attempt on the part of owner-developers to link the design and construction segments that in the design-bid process remained largely separate. The construction-manager-at-risk model has the owner contracting the services of both a designer and contractor at the outset of a project; the contractor chosen has significant input as the design firm produces plans. Once the "blueprints" are sufficiently complete, the construction manager signs off, contractually guaranteeing a maximum price and delivery date. Any savings that is realized under the guaranteed maximum price can be shared by the owner and contractor or retained by the owner depending on the structure of their contract. As with the design-bid contractor, the construction-manager-at-risk typically sub-contracts all or most of the construction of the building to specialty outworkers.

In the mid-1990s, with the expansion of the national economy and the consequent influx of available funds, the desire for a more unified approach and faster

[10] Note that variations of the construction manager/general contractor model are being used in the public sector as a way to improve the quality of public building projects. Selection of firms is based on a combination of general conditions, fees, and qualifications.

delivery led an increasing number of owners to adopt what is referred to as a design-build model of contracting construction (see Sanvido and Konchar, 1999). In this third variant, project delivery is characterized by a single contract between the prospective owner and the design-build firm. That is, the owner contracts with a single firm to both design and build the prospective facility. According to the lead architect at a national engineering and design firm:

> *. . . design-build…is different in that typically…the contractor controls my contract and…together [we] give the owner a firm price on what we're going to design and build. So instead of waiting as we bid things and being a team, now the contractor says I'm going to build this for ten million bucks. Architect, you work for me. The positives are the owner gets a guaranteed price. The negatives, for the owner, he doesn't control the architect, so the architect is not watching the contractor for the owner [as in the traditional design bid model]* (Architect)

While design-build has been associated with a significant owner-developer loss in direct control over design specification (as the above quoted architect notes), the faster completion times and monetary savings, based on pre-construction planning and coordination, have made it an increasingly attractive option to some developers (Sanvido and Konchar, 1999). Having touched on the general outlines and logics underlying the prevailing delivery models as they appear in theory and in some cases in "fact," we turn our attention to a hybrid delivery system that has over the last decade come to dominate the commercial development sector. As Sanvido and Konchar (1999) note in their account of the dominant delivery systems across the U.S., variation on these general construction models is the rule, not the exception.

In our regions, the delivery process most frequently spoken of was a hybrid approach sometimes called "design-assist." It represents a combination of the design-bid, construction-manager-at-risk, and design-build delivery systems. In design-assist, the owner hires a design firm and construction manager at the same time using the "dynamic tension" that exists between designers and construction contractors, as one developer described it, to achieve better designs, to coordinate, to speed up, and to cut the costs of projects. In other words, all the major participants contract with the developer at the outset of the process, so the developer remains at the center. While the design-bid, construction-manager-at-risk, and (true) design-build are all used, as pure forms, they are less typical of commercial construction in our regions. In the following quotes, both a prominent Sacramento contractor and the lead architect of a major national design firm describe the design-assist delivery system as applied by their firms:

> *. . . what evolved [over the last decade]…and this is over-simplification…is this design-assist program…typically a client will go hire a design firm and…[a] general contractor…early in the project and they work together during the design. The designer is designing and the contractor's pricing [and] looking at the constructability of the project. [Eventually]…they will bid [the project] out, but the*

contractor will bid it to the sub-contractors. The general contractor has been selected at that point and time. He carries it all the way through and builds it (Contractor)

In design-assist…we typically…[have] a project definition. Then we go out with the client and negotiate a contract with a contractor…that contractor becomes a part of our team. So now it's a triad. [The] contractor becomes responsible for the cost of the project we're designing… The owner takes a little bit of a chance there because he…doesn't get a hard bid. He gets pieces of the bid as the design progresses…we [architects] have to control cost a lot more that way in the design process. (Architect)

The "choosing" of a variant reflects the "opportunity costs" of any of a number of variables the developer confronts. Significantly, the choice of one delivery system or another also reflects exogenous market place conditions such as demand and the availability of labor and materials. As this informant remarks, the accessibility of contractors and subcontractors to staff his firm's projects plays a pivotal role in how he delivers them:

Which approach [the delivery system] you take depends on the market. If my subcontractors are all too busy you've got to say, "How do I get their attention?" You may have to go design-build up front where you let them in the door so they know they're going to make the money…if they have many opportunities, they may say, "Why the hell am I going to go bid a project against four other guys [i.e., design-bid model]? I've got a 25% chance of winning and I'm too busy anyway. I'm going to take the business that somebody's committing to me up front." So it depends on the labor markets… So sometimes when you're moving really fast, you're better off just to picking your guys up front…[Also in] the bidding process, you'll lose a month in delivery. So sometimes when you're moving really fast, you're better off just to picking your guys up front and saying we're all going to go fast because…as a landlord, you know…[if] they're leasing 150,000 feet…[and] paying you almost $300,000 a month…you can go through the bidding process to save twenty grand and lose $300,000 of income (Property Developer*)*

At the moment, industry movement toward more upfront planning (i.e., the increasing use of design-build and design-assist models) reveals a willingness to a pay more money for decreased time-to-market. In particular, the ascendance of the design-assist approach would seem to reflect good economic times, when more money up front is deemed worth the reduction in uncertainty provided by pre-planning and coordination. In short, this trend shows that the boom in local, regional, and national economies has sponsored a transformation in building practice. Moreover, as the informant quoted above notes, in a tight labor market competitive bid processes create more problems than their potential price reductions warrant (Krizan, 1997; Schriener, Tulacz, and Angelo, 1995)

As outlined in the preceding Chapter, project delivery systems are the structural means through which industry participants are organized, mobilized, and buildings are created. Yet within the general parameters outlined above, implementation remains relatively fluid. Owner-developers reduce uncertainty by choosing a delivery system that addresses the conditions and context that surround their particular building projects and their firm's building style. The same factors touched on in the "markets of interest" Chapter also influence the choice of delivery system. These include the general status of the economy, necessary time to completion, project complexity, project location, projected costs, and prospective project participants, among others. In other words, owner-developers choose an organizational system based on a host of conditions in conjunction with personal/firm preferences. What is consistent across these variants is the logic that underlies owner-developer decision-making. Choice of project, project delivery, and participation are all conducted within an uncertainty reduction paradigm that seeks to limit the unknowns and in so doing to assure that a quality building is delivered according to their expressed preferences.

We think that the picture we have drawn stands in marked contrast to typical energy industry conceptions of building development, where the most visible participants, such as architects and design team members, are often implicitly assumed to have more autonomy than what we observed in our interviews and field research. We have found that such autonomy for the design team is the exception in today's commercial construction sector.

3.3. Summary

Real estate represents a material, robust, and predictable investment. It offers a tangibility and stability that provides investors with predictable, long-term returns. This view of buildings as investments leads to a conservatism and aversion to risk that fundamentally structures and constrains the development process. Developers strive to deliver buildings that produce reliable income to investors. They tend to use models that have worked in the past as a way to reduce uncertainty and increase profitability. They take a utilitarian approach to building design by stressing function and flexibility so that their buildings appeal to the market place and maintain their value. They rely upon trusted networks of industry professionals with a proven track record for delivering the buildings they want.

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. The commercial building "industry" is, in fact, a series of linked industries arrayed along a "value chain" or "value stream" where each loosely coupled link contributes value to a material building in process. Each link, while aware of the other links in the process, is a somewhat separate social world with its own logic, language, actors, interests, and regulatory demands.

For the most part, "upstream" actors constrain the choices and actions of "downstream" actors. In general, decisions about building *form* are made upstream by developers and financiers in their decisions about budgets, location, revenues, target markets, and so forth. As a result, 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. Consequently, as a project moves from conceptualization to financing, to design, and to construction, choice becomes increasingly constrained.

Delivery systems are the structural means through which industry participants are organized, mobilized, and buildings are created. The "delivery systems" used today evolved from a craft-based building industry that has become increasingly specialized and fragmented as buildings have become more sophisticated. This led to the traditional design-bid-build delivery model that sequences activities and roles in the development process. In response to limitations in this fragmented delivery model that resulted in errors, extended production schedules and higher costs, the building industry has developed construction-manager-at-risk (also called construction manager/general contractor) and design-build delivery models over the last 30 years. Current industry trends are leading to hybrid type delivery approaches that combine elements of design-bid, design-build, and construction-manager-at-risk delivery methods. These hybrid approaches (sometimes called "design-assist") involve most market actors early in the conceptual process to reduce risk and control cost, while producing a high value product quickly. The particular approach used by an owner/developer addresses the conditions and context that surround their particular building projects and their firm's building style

In the design/construction sequence, much about the building form is determined very early in the development process during the conceptual design phase and initial feasibility analysis. This original concept is refined and further developed in the schematic design, design development, and construction drawing stages of the design process. This is a dynamic process responding to constantly changing circumstances and striving to meet capital, land, and user requirements. Typically, the project contractor provides cost estimates and constructibility review during the design process. The contractor may also be directly involved in completing the design documents (particularly in design-build arrangements). Usually, the construction process occurs in parallel with the design process to reduce project production schedules. At project completion, a variety of testing activities occur to ensure proper operation (the degree of testing and commissioning does vary), and the building is ready for those who will manage, operate, and occupy it.

4. INNOVATION IN THE INDUSTRY

In previous chapters, we have presented a model of the interests, relationships, and worldviews of the multiple actors (bankers, developers, architects and engineers, contractors and users[11]) involved in commercial real estate development markets. Our focus on business-as-usual reveals a conservative industry that is reluctant to change because it works reasonably well from the perspectives of each of the actors. Products and services are produced in a way that provides professional and financial rewards. Buildings are produced that provide a steady stream of income and a reasonably comfortable place for tenants to conduct business.

New practices and new technologies risk disrupting the steady flow of income that is the premise and promise of real estate investments. New technologies demand additional expertise and sometimes unknown contractors, both of which increase uncertainty. Because loan rates are based on the perceived riskiness of a project, and because novel technologies and new actors add risk, innovations potentially increase interest rates and equity requirements for construction loans. Building codes and regulations also work counter to innovation—both reflecting and enforcing established construction procedures and the use of known equipment and materials.

Actors in the commercial buildings market understand its conservative logic and work within it. There would seem to be little reason for any to press for change, and many reasons to resist it. Nonetheless, there *is* change in the industry. When compared with a twenty-year-old office structure, the typical commercial building today incorporates improved materials, more sophisticated control systems, improved information technology infrastructure, and may very well have been constructed by a differently organized construction procedure. We also find some dramatically different "green buildings" that push substantially away from conventional practice in a number of dimensions (e.g., the NMB Bank Headquarters in Amsterdam, 901 Cherry Street Gap Corporate Headquarters in San Francisco, and the 4 Times Square Building in New York City).

In this chapter, then, we consider the basic problem of *innovation* in the building development industry, asking: "What special circumstances converge to make innovation in buildings possible?" and "What can we learn from particular cases of innovation that we might be able to apply to the market more generally?" We first briefly discuss what the literature has to say about innovation in order to provide a conceptual framework for our analysis. We then explore innovation in commercial building development by considering (1) the sources of innovation in market contexts, (2) how innovation takes place within the building development process, and (3) how innovations diffuse across commercial building markets. The innovations we discuss may have little to do with energy efficiency, but the ideas we

[11] The term "user" in this section of the report does not refer to individual users of space (e.g., workers sitting at a desk), but rather to the organizations and firms (and the individuals that represent those firms) that use and occupy commercial office building space.

develop set the context for addressing the prospects for energy efficiency in the building development industry in the next chapter

4.1. What Do We Mean by "Innovation?"

A substantial body of knowledge about innovation aids our study of technological[12] change, slow as it appears to be in the risk-averse development community. Here we briefly highlight some of the social science findings about innovation in order to create an analytic framework for our discussion of innovative commercial buildings. A particularly valuable source is Rogers' (1995) now venerable *The Diffusion of Innovations* (4th edition), which was first published in 1962 and has been regularly updated to include ongoing research. This is the source of much of the discussion in this section. Other key work in this area includes Narayanan (2001) on innovation for competitive advantage, and Utterback (1996) on innovation within the firm and the market-level dynamics of innovation. We also consider how these concepts apply to building markets and the nature and adoption of innovation there.

First, social scientists who study technological change frequently point to the fact that, while many new ideas for products, services or processes are proposed, few are likely to become widely accepted innovations. This is because a technology or practice need not be superior to alternatives, but merely popular among its users. The emergence of any successful technology involves a struggle among alternatives (Bijker 1997), and any number of failed products have been arguably *better* than those that were eventually adopted on a wide scale. A well-known example was the eventual success of the VHS video format over the technically superior Betamax.

The success of an idea or invention depends upon a *social process of adoption*. Successful innovations follow predictable patterns of acceptance known as the "S-curve" where older technologies are eventually supplanted by new ones. The S-curve traces both a process of increasing improvements to a new technology, as well as the process of increasing adoption by users (sometimes called the *bandwagon effect* as actors imitate the behavior of others). Starting slowly, new technologies become widely accepted innovations as the pace of diffusion quickens exponentially.

There are five characteristics of an innovation that seem to influence the process of diffusion. An innovation is likely to diffuse quickly and broadly if:

1. It is perceived to have a *relative advantage* over alternative technologies. The advantage can be related to the performance qualities of the innovation, its price, ease of use, or other attributes,
2. The innovation is *compatible* with the adopter's existing conditions, including such things as perceived needs, values, experiences, lifestyles, work relationships, and organization,

[12] Rogers (1995) defines a technology as "a design for instrumental action that reduces uncertainty in the cause-effect relationships involved in achieving a desired outcome." A technology usually consists of a hardware aspect (the material tool) and a software aspect (the information base for the tool).

3. The *complexity* of the innovation is not overwhelming, and adopters can understand how it is used,
4. The *trialability* of an innovation allows potential adopters to experiment with the product or service before committing to it, and
5. The *observability* of the innovation allows adopters to see the innovation in use and to actually observe the claimed benefits.

Innovations are likely to diffuse if they have an apparent relative advantage, are compatible with current conditions, are simple to understand, and allow for easy assessment of the costs and benefits of adoption. Innovations that allow for a trial period and whose benefits are clearly observable minimize the riskiness of adoption.

Some innovations are only beneficial if an entire community adopts them. For example, it is of little value to own the only telephone or fax machine. Some software such as email programs, and even operating systems, increase in value as the community of adopters increases. Four factors influence whether or not a community is likely to adopt an innovation. If there is *prior technological drag*, that is, an existing technology that is already widely adopted, it becomes costly, at least in the short run, to change technologies even if the new one is superior. If an older technology has *irreversible investments*, such as sunk costs in training, relationships, or hardware, it is more expensive and risky to adopt a new technology. If there is strong *sponsorship* in a new technology, an individual or institution that sets standards, promotes the new technology, and even subsidizes it, then adoption is more likely. Finally, if *expectations* about the new technology are widely positive, then a long honeymoon period will allow the innovation to diffuse and work out difficulties.

The characteristics of innovations and communities that facilitate or impede the adoption of a new piece of hardware or way of doing things often turn on matters of culture, tradition, and personal or institutional support. Innovations should offer a clear benefit, but research shows conclusively that technological superiority is neither necessary nor sufficient to assure adoption and diffusion. Most innovations are not successful. Others do not follow the S-shaped curve of diffusion because a variety of factors may limit the flow of information among members of a social or market system.

Furthermore, we should emphasize that we are not interested solely in technological innovation related to specific building components and sub-systems. We are also interested in innovations in building design and delivery processes that lead to better building outcomes. While these process innovations can involve the use of new tools and technologies, they often focus on changes in practice. The adoption of innovative practices (or software only innovations[13]) can also follow the S-shaped diffusion curve often associated with technology innovation, but they are less well understood. They often have a lower degree of observability and a slower rate of adoption.

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[13] Some innovations have only a software component. Rogers (1995) refers to the *software* aspects of an innovation as consisting of the coded commands, instructions, and other information aspects of a tool (hardware) that allow it to be used to solve certain problems.

Buildings tend to be one-of-a-kind, rather than uniform products. However, building systems and subsystems are applied in uniform ways through accepted development processes. Thus we are interested both in how innovations occur within particular buildings and how those innovations diffuse in the market place and are incorporated into the development process. Social science literature on the adaptive behavior of firms and networks due to uncertainty, coercion (regulation), role models, and normative behaviors adds to our understanding of diffusion of innovation in the building industry (Fligstein 1991, DiMaggio and Powell 1991).

In applying these lessons to the problem of innovation in the commercial building market place, we first observe that whatever can and does occur there takes place within the ideological frameworks and delivery processes presented in our "conservative industry" model. In trying to sort out just how innovation unfolds in the market, we first draw heavily on our detailed studies of particular buildings in each of our four sample markets. The buildings we examine were selected because they are innovative in some regard, allowing us to view the adoption of innovations in particular buildings. Even though these buildings are not representative of the typical office building, they are developed by key building industry players in each market and they largely conform to market requirements. They offer insights on innovations in *buildings* themselves given market contexts. We then consider trends in the *building industry* that may influence innovation and innovation within the *building delivery process*. These observations allow us to develop ideas about the propensity for innovation to occur in building markets. They help us better understand the issues of relative advantage, compatibility, complexity, trialability, and observability in the context of building markets and building development processes. Along with information from key informants, this provides the basis for our discussion of how successful innovations spread across the industry.

4.2. Innovation in Market Contexts

Recall our model: buildings are investments; developers strive to deliver buildings that produce reliable income so they use models that have worked in the past to reduce uncertainty and increase profitability; they take a utilitarian approach to building design that stresses function and flexibility with market place appeal; and they rely on trusted networks of industry professionals with a proven track record for delivering the buildings they want. Within this market context, the prospects for innovation would appear to be limited. Since innovation represents a deviation from approaches that work, it introduces risk, the market may not like it, and it could threaten project income.

> *"At the same time, there's a reason what's being built in the market is being built in the market. It's because it's what the market's buying. And, to the extent that you vary from that and become a pioneer, you may find out that there's a reason no one was building that. Because people don't want it. And there's always a risk in being a pioneer that you've made a value judgment that people want this and you're entirely wrong. They just don't want it. And nobody wants to take that risk and end up with a product that's not wanted. The*

investors look at you askance and say I'm sorry, it's not the model that's worked for me." (Property Developer)

On the other hand, innovation can take place because real and perceived "market requirements" change. Another developer expresses this sentiment in this comment.

> *". . . Do our buildings change? Yeah, they do change. I mean, right now tenants need different things than they did in the past. For example, every tenant that's coming in, they're using up much more power, much more telecommunications than they ever have in the past. And you're seeing buildings that have bigger bay depths because people are going to more open office type plans. You know, all of those things we have to adapt to and we do, but still we have a model that works pretty well."* (Property Developer)

So within the existing development model, change can and does occur in response to new user/tenant "needs." As one industry observer noted, "No building gets built without a user in mind," with innovation occurring in response to non-standard demands. This may be a response to an *expressed need* from a specific tenant, or in response to what *"the market"* (i.e., the population of prospective tenants/users) is believed to want or value. To these two sources of innovation, we add a third: local conditions/constraints (e.g., urban context, site conditions, and regulatory environment). As a result, then, of user and market requirements and local circumstances, non-standard approaches may be required**.** The result may be a one-of-a-kind application of a new approach, process, or technology. Yet, through these incremental changes, the seeds of innovation at the market level are sown in the larger development community. We consider each of these sources of change in greater detail below.

4.2.1. Owner and Occupant Requirements

The owner or occupant of a building project can introduce specific needs or requirements that dictate a non-standard response from the building development team. This situation is most likely to occur for two types of building developments—build-to-suit where the building is constructed for a particular occupant (this may be owner-occupied or leased), or build-to-own where the building developer and partners intend to own the property over the long-term. Special owner or occupant requirements can be products of a particular *vision* for the building, and/or from specific *functional needs* for the space. The following examples illustrate these effects.

Vision. The owner or occupant of a building project may have a particular vision of what the building represents. As a very tangible asset, a building can be a quite visible symbol of the owner's or occupants' status and values. They may want it to fit into the urban context, to stand out as different, or to provide certain community benefits. They may want to focus on creating a space where their employees want to work. In many cases this vision can go beyond bottom-line concerns. The vision provides an overall context for decisions, negotiations, and trade-offs. The design and development team is challenged to come up with innovative solutions that meet the project vision and still conform to the economic requirements for the project. The following case examples illustrate this process.

Headquarters Office Building

A new office building being developed in an urban setting is owned and will be partially occupied by a well-known high-technology firm. The vision for the building is that it be cutting edge and fit into the "wired world" conception of its owner. The owner wants a signature building that creates an image that somehow reflects the firm's vision of itself.

The design team was challenged to develop a set of alternative conceptual designs consistent with the owner's vision. The most expensive alternative was selected—a design that was "somewhat 'out there' by most peoples' standards."

The signature features in this building include the exterior curtain wall elements, the lobby and the integrated building technology elements. A great deal of attention was paid to the exterior envelope of the building, which includes some aluminum cladding, fins, terraced shapes, and a north facing window wall that is curved. The lobby reflects what you would expect to see in a high profile gallery and includes a glass ceiling. An integrated building control system for lighting, HVAC, and security allows for one card access and offers convenience and function for all-hours use of the facility. A unique distribution system for power, telephone, data, and AV has been developed to provide maximum flexibility and function in the space—elements consistent with the "wired world" vision for the project.

When asked about innovation, one of the project architects indicated the whole design was innovative because of the many interrelated and unique elements in the project. "You can design it, but then you have to build it." There was a great deal of collaboration among the whole project development team from the beginning, and a variety of innovative ideas and approaches were used. There was no other choice. As several team members observed, "failure is not an option," particularly on such a visible project. This was also a "fast track" project, with tight timelines and strict budgets. In the end, it was completed within budget and within a few months of the project schedule. Financially, the building has been quite successful. "We've beaten the hell out of our pro-forma." The market and tenants realize that this is the "best building." They are getting the building (architecture and technology), the location, and are sharing the headquarters building of a highly visible firm in the community. So even though this is a signature building, it has been quite successful from the standpoint of the bottom line.

Urban Redevelopment Project

This project is redeveloping five city blocks into an integrated mixed use development consisting of offices, retail, and housing. The developers have a unique vision for the project–they want to activate the streetscape and create an around-the-clock presence in the area. They want to create a neighborhood that extends the edges of downtown and is an attractive destination. The development firm is a member of the Natural Step organization (Natural Step 2000), and has incorporated sustainability into previous projects. Sustainability is also an important part of this project and the project team wants to push the envelope further.

This vision is resulting in innovations in a variety of areas including parking, chilled water systems, lighting and daylighting, and ventilation. The project vision is also consistent with community values, which is important as the developers work with city staff to meet various city design and code regulations and requirements. Fundamentally, the developers believe the vision they have created will result in a successful investment by responding to community values and desires and by concentrating their investments in a specific geographic area.

Functional Requirements. The occupants of a building often have unique needs or requirements for how they will use the building space. In a build-to-suit project, the building is being constructed for a particular occupant. In a more speculative building that will be owned by the developer (build-to-own) or sold by the developer, a target tenant group is identified and the building is designed to meet the needs of that market segment (e.g., high-tech users). In many cases, a major tenant is identified early in the development process and the design may strive to meet that tenant's expressed needs. In either case, a building program grounded in an understanding of how the space will be used shapes its design and the degree of innovation required.

The following example describes the development of an efficient space arrangement for a public facility (build-to-suit) that required some innovative solutions for meeting occupant functional requirements within the project constraints.

A Public Building

This urban public building will house city municipal courts and police administrative functions. The functional needs of these tenants required that court and police spaces be separate for security reasons and to present clear identities for each function to the public. In addition, the courts needed to handle in-custody cases, which require separate and secure elevator access to each courtroom.

The original design created a court space tower on one side of the building, with side-by-side courtrooms on each floor and a secure elevator between them. The police administration function was on the other side of the building. This design was too expensive and was somewhat inefficient in terms of space utilization.[14]

The solution to this problem was to come up with a more innovative approach that allowed for producing a shorter and more efficient building (in terms of space use). The new scheme has separate entrances and separate elevator shafts for police and courts, so the sense of separate buildings is maintained. However, functions are divided by floors instead of separate towers, with the courts having a whole floor and the police the next. The police elevator does not stop on a court floor and vice versa. This results in much more efficient space use. The relaxation

[14] The term "efficiency" is generally used by the building industry to describe effective space utilization.

of one of the design requirements—in-custody access for all the courtrooms—helped make the more efficient design possible.

While the innovative solution to the design challenge in this example is one-of-a-kind, developing efficient space designs is one of the key requirements for developing functional buildings. A building with a low load factor (i.e., that uses space efficiently) can be more functional and flexible, and therefore a better investment. Innovative design approaches can produce this sort of valued result.

Many users have unique functional needs and requirements—these might be courtrooms, as noted in the previous example, security requirements, unique technology needs, or needs for common or public space. These needs and requirements have a significant influence on the shape and form of the building and can require innovative approaches to meet functional requirements while producing a building that meets project financial criteria and is acceptable to the market. In the next subsection we consider requirements that are not unique to a few tenants, but that represent broader market demands and interests.

4.2.2. Market Influence

Broader market trends, as well as beliefs about trends and perceptions of changing client demands, can lead to *anticipatory innovation* from the development community. Effectively responding to broader market developments is crucial to developing properties that will maintain their value and do not become obsolete. When these broader market requirements demand a non-standard approach, the building industry will innovate to attempt to meet them. The most progressive developers will respond more proactively to market trends and innovate to differentiate their product.

In the markets we considered, building development is being fueled by demands from the high-tech sector. This sector has special requirements that differ from conventional commercial office space demands.

> *"I think what is driving the market now are high-tech tenants, and so the space is being geared more towards that type of user, so things aren't quite as traditional as they were during the 80's, when the law firms and accounting firms and all those more conservative type companies were driving the absorption. So, we've seen a little more frivolous type design, a little funkier, not the polished granite and straight-up, conservative type aesthetic."* (Financier)

But meeting the requirements of high-tech users introduces a certain element of risk into a building project. What is "frivolous" or "funky" would ordinarily be viewed as risky by those investing in buildings. The challenge for developers is meeting the unique needs of high-tech tenants while still producing a building that is acceptable to the market. A certain degree of innovation is necessary to produce a product that meets changing market needs. The following example illustrates a new generation of commercial buildings in an urban setting being targeted to high-tech tenants.

Urban High-Rise

This speculative office building was the first new building out of the ground in an urban market that was for many years anticipating a building spurt. The building was targeted to high-tech tenants, as described in the following statement from the project developer. "It's funny... you know, ten years ago there were a lot of start-up companies that are now very large, very successful companies... that now has become our focus... more the high-tech. We sold this as a vertical campus… I mean, we obviously like any tenant, but the high-tech tenant is obviously the future and how are we going to build for those tenants. And this building was a real transition to that, I think, because it... it is a whole different animal."

The developer spent time gathering information on what this market segment required, based on the realization that the segment is different and it demands a different kind of building. A good deal of emphasis was placed on providing a quality work environment that makes it easier for companies to attract and retain employees. So the resulting building has large floor plates, high ceilings, and high performance, clear floor to ceiling windows that create a sense of wide open space and spectacular views to the exterior. Indirect lighting is specified because the developer has had success with it in previous projects due to increased tenant satisfaction with reduced glare.

Provisions have been made for access to multiple telecommunications providers through a large number of risers in the building. Electrical capacity exceeds 12 Watts/square foot to provide for the equipment capacity requirements of these tenants. Electrical system costs were approximately four times what they were five years ago (this is driven both by the high demand for contractors and the extra capacity being provided). There is a large generator, uninterruptable power supply (UPS system), and fuel storage tank to meet the reliability requirements of the tenants. The capacity of the HVAC system was increased to accommodate the increased equipment loads.

It is important to recognize that, rather than being built to meet demands by specific tenants, this is a speculative office building. It was being built at a time when the market had not proven that it would demand this space, although the developer believed the market would respond (and it has much more strongly than many people expected). So the building had tight financial constraints, since no major tenant had been signed when construction started. The goal for the project was to get started quickly, be the first out of the ground, and thus be able to lease the space quickly. But rather than insuring a conservative outcome, as might be expected, these types of market requirements and influences can also lead to innovative approaches. The desire to be first to the market with new space and the very tight time schedule resulted in perhaps the most significant innovation in this project—the structural system and construction approach. This innovation is described by the project manager:

"The other thing we did here, which was a real stretch, was…we needed to build a building really fast. In the past, steel has been the way to do that…you've seen steel buildings. They go up fast. Steel is expensive. It was impossible to get. There was too much construction going on…the steel market was just dried up. We were looking at eight month lead times. Concrete is…on the other hand, is very slow. It's cumbersome. It's a mess. I mean, I can give you all the reasons why not to build a concrete building.

But, what we did is we hired Schilling, Ward, Magnuson, Barkshire, very innovative designers for structures. And they came in and they proposed the concrete core. And the core of this building has two foot thick concrete walls with an 8,000 psi concrete, which we actually changed that design mix because we found a jump form system in Germany that allowed us... it was hydraulic... and we could literally jump that to the next floor in about ten minutes. So, we were able to go on a four-day cycle of pouring back the core of this building. And the steel started quite a ways behind it because the steel moves so quickly that we literally topped out about 30 days, you know, the concrete structure and, then, right behind them, the steel. It might not even have been that long.

So, it was very fast. And what that allowed us to do was... we used a very light steel. You know, where in a steel structure you'll see 30-inch beams. We have... in this building we don't have, you know, any moment system on the perimeter. So, all of our steel is very light coming out. I think, you know, we've got 16-inch, 22-inch beams, which allowed us to gain that height difference. Because one of the things that will kill you on your pro forma is... you know, it's really great to have big high ceilings and all that things, but you have height restrictions, which means you put big high ceilings, you have less floors, you put big high ceilings so you've got more material and you've got…you've got more curtain wall…and your cost per square foot starts skyrocketing. So, you really have to balance that carefully on what works. So, with the... with the structure... because of the core we did,…we were able to get the ceiling height with the lighter weight steel and we were able to build the building very, very quickly." (Project Manager)

So the innovative structural system allowed the project to meet its tight time constraints, but it also supported other important market requirements such as high ceiling heights and large floor plates. It is also important to recognize that the innovation was driven in part by market constraints—the lack of availability of steel.

This building may represent a transition to a new generation of buildings that are shaped to meet new market demands from high-tech tenants. These demands, in turn, are stimulating more traditional tenants to demand similar things. At least some of the incremental improvements and innovations incorporated into this building are quite likely to be incorporated by the developer in future buildings. As described by the project manager for this case example:

> *"So,…in the next buildings we will look at what does the new employee want. I mean, they're not suit and tie kind of guys. You know, they're…they want fresh air, they want open windows, they want to be able to move their cooling from here to over here, so we're looking at raised floor systems which have really come a long way. We're looking at a lot of smart building types of things... how we light our buildings ... the type of curtain wall systems that we use, where before we were more into aesthetics... we want big windows, as big as we can get them and…they want to open them. So, how do we do that? They want higher ceilings…they want big wide open high ceilings, big space, and to be able to control their environment a lot more than what we've ever given anybody any credit for. So, it's going to be interesting seeing how these... how new buildings evolve and what we actually end up building in the next couple years because I think it will be very different than what you see here now."* (Project Manager)

In short, innovations stimulated by evolving market influences may spawn the evolution of new practices and even new types of buildings.

4.2.3. Local Conditions, Requirements and Constraints

Land is a fundamental requirement for a development project—and land use requirements, codes, community needs, site circumstances, political realities, and cultural climates all have a significant influence on how land can be used and what can be built on a particular piece of property. These local conditions and requirements—often in combination with owner/occupant and market factors—may require non-conventional approaches and design solutions.

Here we consider how the location of the building and the circumstances of the site may have a significant influence on the ultimate outcome. We also examine how regulations (such as codes, zoning, and community project review processes) shape outcomes. Innovation may be required to deal with local circumstances and requirements, while still producing a viable building that fits market conditions.

Location. The location of a building and how it takes advantage of its location are critical factors in determining value. The particular circumstances of a site (such as views, vehicle and pedestrian access, surrounding buildings and features, topography and soil conditions, shape and orientation, and existing structures) can have a significant influence on the potential success of a project. In some cases, innovation is required to respond to site circumstances that would otherwise threaten viability. The following example illustrates how orientation constraints were dealt with in an innovative way for a public building project.

A Public Building

The urban site for this public building takes up half of a city block. There is a parking garage on the east portion of the block. The north and south sides of the site are narrow. Access to the site is from the west. Views are also to the west. The primary opportunity to bring light into the space is from the west. The owner also has a desire for the building to appear accessible. All these factors suggest using a significant amount of west-facing glazing. However, west-facing glazing produces significant heat gains and comfort problems.

To deal with this challenge, the designers proposed an engineered thermal buffer wall on the west wall. This wall consists of two layers of glazing separated by an air space. The use of a double wall to solve heat gain and thermal loss problems is a relatively uncommon building element in the United States, but is not unusual in Northern Europe. In the winter, the wall is sealed and the air heats up acting as a thermal buffer. In the summer, the space is vented, allowing the heat gain to be removed. There is also a light shelf along the wall to bring light into the interior of the building. And there is a building corridor directly adjacent to the window wall that acts as a further buffer between the wall and the interior space.

The wall comes at a premium price and it does not pay for itself through energy savings. However, it provides a variety of other benefits, including improved lighting quality, views, and thermal comfort. In addition, it helps the building achieve a LEED (Leadership in Energy and Environmental Design developed by the U.S. Green Building Council) silver rating,[15] which was one of the owner's requirements. The west wall also contributes to the striking appearance of the building. As the architect noted, "In the public sector you need two reasons to do something and one of them can't be aesthetics." The engineered thermal wall meets this criterion and is an innovative design solution to the constraints imposed by the local site.

Regulations. Communities use a variety of regulations to shape and control the nature of building development in ways that are consistent with community politics and values. Codes generally deal with health, safety, and consumer protection issues. National and international organizations usually develop these codes, which are then modified, adopted and enforced by local jurisdictions. In addition, various zoning, land use, and design review requirements exist. Key among these are the type of building use allowed for the site, the maximum allowed density (e.g., the floor to area ratio determines how tall and how many square feet the building can be), and potential environmental mitigation requirements. All of these regulations have a significant influence on what's built and the riskiness of the building process. Innovative approaches or compromises may be necessary to meet regulatory requirements and to ensure that the project is completed in a timely fashion. At the same time, regulations can stifle innovation because it is more difficult to get new ideas through the regulatory process.

Generally the building industry views *building codes* in a positive light. The codes are predictable and represent good building practice. They protect consumers and they level the playing field by not allowing low quality builders to undercut the market place with inferior products that cut corners. However, various *land use requirements* introduce a level of uncertainty and various "shades of gray" that can make developers uncomfortable. Different jurisdictions have different requirements and they can be interpreted in a variety of ways.

> *"You can design to something that's clear, but you can't design to the unclear… the imprecise definitions that can be interpreted in many ways, and those are usually relating to extra building kind of stuff… like stuff that's not within the building itself… I don't like your color, things like that. But as far as the codes go, the UBC, the energy code, the electric code, fire codes and that, those are actually fairly easy to deal with. You can determine what the requirement is and you can follow the requirement. … Codes and regulations that aren't precise… that have a broad range of interpretations… those are the ones that are exceptionally difficult to deal with."* (Developer)

There are many ways that regulations can stifle innovation. They can be written in ways that favor prescriptive and standard approaches. Although one might think that these would be resisted by the industry in favor of more flexible, "performance-based" approaches, the building industry actually favors them. They

[15] For details of the LEED rating system, see U.S. Green Building Council (2000).

make it easier to comply with code requirements, since anything innovative that does not have proven performance and doesn't fit comfortably under the prescriptive requirements must be carefully reviewed by code officials to determine if it is equivalent to the standard requirement. This requires additional work (and time) on the part of the developer to prove equivalency, and requires the regulator to make an interpretation of equivalency. For both, this introduces a great deal of risk into the project.

Headquarters Office Building

One of the unique features of this signature building is a north-facing window wall that curves from near vertical at the ground level to near horizontal at the roof. This introduced a significant structural and curtain wall design challenge. The resulting wall is cantilevered from the side of the building because it extends beyond the original building pad. The design team considered curved glass, but ultimately settled on individual segmented panes that sit on a metal frame. As the upper portion of the wall becomes more horizontal, the window panes have specular dots that gradually go from 5 to 30 percent of the window area.

Because this was a custom wall assembly with an unknown U-value (thermal insulating capability), the project team had to analyze the assembly and demonstrate to code officials that it had the U-value necessary to meet the energy code. Because of the tight project timelines, construction of the building was underway before code approval was obtained for the north window wall. This introduced some risk to the project. Fortunately, they were able to demonstrate the hoped-for U-value. If the demonstration had fallen short, they would have been required to introduce additional efficiency improvements into the building to meet code requirements. This would have been a challenge, since they had already made a number of energy efficiency improvements throughout the building to allow them to construct a building with 59 percent glazing (which significantly exceeds baseline energy code glazing area requirements).

The nature of the regulatory process does not have to be adversarial. There is the potential for forming partnerships with regulators and developers to produce buildings that respond to market as well as community needs. In this sense, innovation can be viewed as a way to form partnerships that use the regulatory process in innovative ways.

Urban Redevelopment Project

Given the very public nature of this project and the significant regulatory issues involved, the development team has been meeting with city regulatory staff on a regular basis. They view this as a "partnering" process to ensure that there are no surprises and that issues are worked out before they get to the formal approval process. This can lead to innovations in the application of regulations.

For example, because of the small size of the city blocks involved, underground parking is difficult because it is expensive and the ramps take up a good deal of space. However, underground parking is desirable from the perspective of the community and the vision for this project—above ground parking is unattractive and detracts from a lively streetscape. Thus to make the underground parking more feasible, they are considering expanding the parking under city streets. This requires an encroachment permit from the city government. The development team is hopeful that this permit will be approved and that it will be easier to do similar things on future projects.

This example illustrates an innovative application of the regulatory process to support a new approach that is beneficial to the community and that is also positive for the project developers.

4.3. Factors Within the Industry that Stimulate Innovation

We next consider the ways in which changes in the *building industry* influence the tendency to innovate. We also consider innovations rooted *in the building delivery process* itself.

4.3.1. Industry Trends and Issues Driving Innovation

The building industry is far from static. It is, in fact, in a continual state of flux and evolutionary change. These conditions influence innovation in commercial buildings in at least three important ways. In terms of the effects of:

- Changes in the organization of the building delivery process,
- Vertical integration and consolidation in the property development and management industry, and
- The use of information management technology to streamline the design and delivery process.

For each of these topics, we examine both how the changes in process support and counteract innovation.

Changing Building Delivery Process. As noted in our discussion of the changing organization of building delivery systems in Chapter 3, there are multiple ways to organize building development and delivery, and these continue to evolve. There is a trend toward hybrid delivery approaches, where developers combine aspects of design-build, construction-manager-at-risk, and traditional design-bid-build approaches to meet their needs. This represents a shift from traditional fragmented and more adversarial approaches towards collaboration. The particular approach used by a developer for a project is shaped by market conditions and developer experience and is intended to balance and reduce risks associated with project cost, delivery time, and product quality (defined in terms of market requirements).

The hybrid building delivery processes being used today bring many members of the design team and contractors into the early stages of the development process. Having early involvement from multiple professional disciplines increases value and reduces risk. This tends to encourage multi-disciplinary interactions that lead to better solutions, and are more likely to support innovation.

> *"We'll bring a contractor on as early as we can…because I like to have the contractor and the architect and the owner working together to come up with a solution to the problem. The architect doesn't know all the answers, the contractor doesn't know all the answers and the owner doesn't know all the answers, but usually amongst that three-legged stool you can find some pretty damn good answers."* (Project Developer)

Building design and development is an *iterative process* in which an initial vision is translated into a building by starting with an idea and continuing to refine it. The hybrid delivery process provides the team interaction that is necessary for the development of innovative approaches to solve problems. Any innovative application will need to be refined throughout the development process using the expertise of many team members. More traditional design-bid arrangements do not as easily allow for this ongoing refinement because design and construction are separated.

It is the case, however, that many of the improvements in the delivery process are primarily aimed toward reducing delivery time (rather than increasing quality). Faster delivery processes in a race to meet market demands can also work counter to innovation. The high-tech industry and "dot.coms" that are fueling demand for commercial buildings in our sample cities demand rapid delivery. In many cases they will only use the design-build approach because this is the only one that can meet their time requirements. Likewise, developers in these "hot markets" are particularly interested in getting their buildings constructed and occupied as quickly as possible. Time is money, and a building project that is completed when demand is cooling off will be less successful.

Tight timelines can, therefore, limit the potential for innovation. The demand for fast delivery may mean that certain innovative options may not be considered because there may not be time to fully develop the idea (or the potential for causing delays is too great). And introducing innovations late in the development process is very difficult under these conditions. But because of persistent needs to innovate to meet market requirements, innovation can occur in projects with tight timelines. In fact, the innovation may result in an approach that leads to faster, more efficient development—e.g., the use of improved project management tools can both speed the delivery process and facilitate innovation.

Design-build delivery approaches (see Chapter 3) are often—but not exclusively—used for projects with tight timelines or for "fast track" projects. Design-build is commonly used at the subcontractor level for mechanical and electrical work, and a traditional design-build approach often works best for simple, standard, or well-defined building projects or building systems. The nature of the design-build strategy may leave little room for innovation. In both design-build and "fast track" projects, significant parts of the design work may occur while construction is underway. This limits the application of innovations that aren't accompanied by predictable outcomes because there is little time to refine and optimize innovative approaches as the design is being implemented as parts of it are being completed. There may also be less interaction between the owner and other team members—much of the development occurs within the design-build firm and is directed by the contractor.

However, innovation can occur within a design-build approach if the owner establishes the vision for innovation at the outset. This is particularly true in hybrid design-build approaches where the owner is an integral part of the project team. Thus, it seems that the trend towards hybrid delivery approaches allows for the interactions that are necessary for innovation—even in projects with tight timelines.

Industry Consolidation. As in many other sectors of the economy, the commercial real estate industry is experiencing mergers and consolidations. Local firms are becoming regional players and are partnering with other regional, national, or international firms to broaden their services, increase their resources, strengthen their presence in particular markets, and make it easier to attract capital. This is leading to a tighter vertical integration of market actors along the supply chain—including the linking of equity partners, project developers and managers, marketing and leasing professionals, property managers, and operations managers into single firms or partnerships (long-term and on a project-by-project basis). These integrated organizations and networks are controlling a growing share of commercial real estate in specific markets. The following example illustrates this situation in Puget Sound and West Coast markets.

Industry Consolidation Example

Equity Office Properties Trust of Chicago (the largest public Real Estate Investment Trust in the country) is the largest landlord of office properties in the Puget Sound market. It has established this position through partnerships, buying out other firms, and strategic purchases. In 1997 it partnered with Wright-Runstad & Company, one of the largest developers and property managers in the region. In a deal expected to close in the second quarter of 2001, Equity acquired Spieker Properties Inc, the top West Coast office building owner. Together, these firms would control about 20 percent of the Eastside market in Puget Sound and 40 percent of Bellevue central business district office space. Likewise, the deal expands Equity's office holdings to 19.5 percent of the San Jose market and gives it significant shares in the Silicon Valley, San Francisco, Los Angeles, and Portland markets. This merger is consistent with the strategy Equity has followed since going public in mid-1997 according to chairman Samuel Zell, a Chicago real estate billionaire and takeover specialist. "We have focused on building critical mass in high job-growth markets with barriers to new supply, the hallmark of Spieker's portfolio." This was reiterated by Spieker's chairman, Ned Spieker, who indicated the deal reflects a changing market by creating a real estate investment trust big enough to attract a broader investment base. "Companies today want property owners with agility, market strength and the ability to provide a range of value-added services that can enhance productivity in an increasingly competitive marketplace. Equity Office has recognized and successfully responded to these trends over the past few years." (Seattle Post-Intelligencer 2001; Bishop 2001)

This has a variety of implications for innovation. It provides the potential opportunity for broader input into decisions from a range of market actors within these firms. It introduces longer-term interests into the development process by including the "far-downstream" actors involved with property management and operations. Since many vertically integrated firms develop, own and operate their own buildings, mechanisms can develop for feeding information across various steps in the development process. Value can be considered in the context of the life-cycle of the building. And, easier access to resources and capital provide more flexibility to respond to market needs in innovative ways.

Office Tower Case

Equity Office Partners provided the capital for this project through its partnership with Wright-Runstad. This allowed Wright-Runstad to beat five competing proposals and complete the first new office tower in Bellevue since the 1980s. Construction on the project was started without a signed tenant. The project was targeted at the high-tech sector and incorporates a variety of features and innovations to meet the requirements of this market segment. The building was fully leased months before project completion. (Nabbefeld, 2000)

Industry consolidation provides the resources that support innovations that might not otherwise have occurred. Access to capital and a strong market position support innovations that further strengthen the position of these firms in the market place. It also provides mechanisms for standardizing innovative approaches across large segments of the market, since these large firms control large amounts of space in particular markets. Mergers and network building are occurring in the context of a (currently) strong building market, where aggressive firms are struggling to establish dominant market positions. These firms can bring new and innovative ideas to the market place. In turn, as they establish their market dominance, one might also expect inertias to emerge, constraining further innovation.

Information Management Technology. Information management technology—including cell phones, palm pilots, laptop computers, web-based management tools and software, and advanced design tools—offer the opportunity to improve the development process and to link functions that have historically been separated across the building's lifecycle. These information management tools support innovation by eliminating inefficiencies in the development process that constrain innovation. They can contribute to improvements in the delivery process, and they can effectively reduce lags and inertia (e.g., resulting from fragmented authority, expertise, and knowledge, and the sequential nature of the delivery process).

A Progressive Construction Firm

In a very short period of time DPR has become one of the most successful construction firms in the Silicon Valley by establishing a record for speed and on-time delivery to high-tech companies that expect nothing less. "One reason DPR is able to meet so many of its deadlines is that its practices emulate those of the computer industry. The company's project superintendents, for instance, carry laptops and wireless hand-held computers to the work site, still a rarity in the construction business. DPR also uses its own internet-collaboration software on projects. As a result, all participants on a job, including subcontractors, architects, and the building owner, can go to a DPR website to access specifications, drawings, photos, and even weather reports" (Carlton, 1999: B12).

This allows for better management of the process and subcontractors in the field, as reflected in this statement by a project manager in the firm. "So management manages, but in the field…they see technology... they see our superintendents use computer-generated, three-week rolling schedules. They see our coordination drawings that are color-coded that are done on CAD, so you're seeing the technicians use the output of technology. … But the people are putting the fittings together and carpenters are still nailing; that's still happening. But I mean we're using the technology."

They use these tools to set expectations and measure expectations. They track and document costs and provide their clients with a matrix of various enhancements they can make to a building and the costs. They believe that the more information they have, the more detailed information they can provide to their customers, thus resulting in more informed decisions and a better product.

The design and development process, and the ongoing refinement of the project vision into a building, is an inherently collaborative business—and information and management tools support and facilitate that collaboration. They allow new ideas to be exchanged and refined in real time, and they provide documentation of changes. This improves the production process by eliminating delays and errors resulting from more fragmented and sequential design/construction strategies. The process is, therefore, more conducive to innovation.

Computer aided design is common design practice, but the recent advent of 3-D modeling capability is a particularly important design aid. 3-D drawings are easier for trades to use and they make it easier to identify conflicts between different systems in tight building spaces (e.g., conflicts between ducts and plumbing in the ceiling space). These drawings can also aid in developing optimum process flow of subcontractors through the building. And 4-D tools add timelines to 3-D drawings for process control, which can result in changes in the delivery process that reduce production time.

Scheduling is obviously a critical aspect of successful project management. However, the process of moving trades through a building smoothly, without delays, is quite complicated. The use of information management tools for scheduling and the monitoring of progress allows for an optimization of building delivery by eliminating lags and gaps in the delivery process.

These tools also provide value over the life cycle of the building, not just during design and construction. Some traditional engineering firms are expanding their service offerings to cover the entire building life cycle, including design, pre-construction planning, construction, commissioning, maintenance, and operations. Likewise, large property management firms and facility operation and maintenance firms are expanding their services or are looking for ways to become more efficient in their service delivery. Primarily this is a question of the management of information over the building lifecycle in support of good decisions and effective facility management. Management information systems document design intent and operation procedures, establish maintenance schedules and the tracking of maintenance history, and allow for the monitoring (and recording) of building performance. Performance benchmarks, diagnostic tools, and other feedback mechanisms can be used to identify problems and optimize performance (Hitchcock, Piette and Selkowitz 1998). These tools also allow for better communications between managers, tenants and service providers. While it may be some time before information management tools are fully utilized and integrated into the development process, these tools are currently being used to improve building delivery and building outcomes. They provide an important source of knowledge to support the adoption of innovative practices.

4.3.2. How Innovation Takes Place within the Development Process

In addition to the factors discussed above, innovation is stimulated and constrained over the course of the development process by changing conditions, events, inter-personal and inter-professional dynamics. We now consider some ways in which these dynamics shape the nature of innovation during project delivery.

Because the building design and development process aims to reduce uncertainty and risk as quickly as possible, major decisions involving those areas with the greatest risk are dealt with first. These early decisions establish the shape and form of the building. This original building form provides the starting point for continued development and refinement. As the process moves along, choices become more constrained and the opportunity for subsequent innovation is limited. However, in this process innovations are often introduced and refined in response to the needs and requirements established in the original project vision.

The *framework for innovation* is established at the beginning of the project, during the creation of the project team and the initial conceptual discussions. The vision established in this initial phase and the openness to new ideas in response to market requirements sets the stage for whatever innovative developments might follow. A project team is formed and a collaborative process begins to design and develop a building that responds to the project vision. How this team is formed—and the ability of team members to buy into the project vision and work effectively together—contributes to whether innovation will occur. The following example of the formation of the project team for a build-to-suit project illustrates the point.

Headquarters Office Building

The project team was formed through a process of conversations, proposals, and negotiations. No formal request for proposals was issued. Instead, the owner and developer handpicked certain firms to make presentations. The selected team members "were just the natural people" to do the project. This was based on their familiarity with the project, their reputations, and their ability to work together. The owner, developer, contractor, and architect formed what the owner described as the "A-Team." This team met on a weekly basis and was able to establish an effective working relationship. The owner was able to establish the sense that "everyone was in this together." According to the project contractor "We had the same goals, the same outcome in mind at the outset. No member of the team could afford to let any other team member fail." This buy in helped the project team to avoid conflicts and come up with creative solutions for producing an innovative building on time and within budget. (Daniels, 2000: 25)

While the *potential* for innovation flows from the initial project vision and the project team formed to deliver the project, the *need* for innovation results from the factors identified in the previous section (owner/occupant requirements, market influence, and local conditions, requirements, and constraints). These factors play into the delivery process to stimulate innovation in response to demands that require actors to go beyond standard approaches.

The ideas for innovation begin to form early in project development. The circumstances of the project shape the form of the innovation and how rapidly it develops. The project team collaborates in gathering information from their own resources and outside experts (specialized consultants are very important in this regard) to deliver the innovation. This is a process of experimentation, negotiation, and compromise. In the end, the option that emerges is often the result of parallel circumstances or decisions that point to a particular solution. In other words, the process of innovation occurs in a dynamic environment that is continuously changing.

Urban Redevelopment

The developers for this large urban redevelopment project, which will include offices, retail, and housing, want to create an integrated mixed use development with an active streetscape. Their vision includes active consideration of opportunities for increasing the sustainability of the project. This includes reuse of some of the buildings on the site, recycling of materials, and incorporating sustainable elements into the development. Although the developer is a member of the Natural Step, this is a speculative development and the developer is clear that the market must accept any sustainable elements. They are not interested in "gee whiz stuff that costs big dollars."

The project team was selected based on their expertise, track record and past working relationships. The developer was looking for a dynamic project team—one that could be flexible and bring new ideas and options to the table in a constantly changing environment. Due to the scale and complexity of this project, the project team consists of 30 or so designers, contractors, and special consultants. The team was formed early in the development process. The developers manage this group and make sure that the project team is "all on the same sheet." The project team is highly interactive, but with a clear division of roles depending on specialty. The core members of the team meet on a weekly basis.

One of the roles the developer played was to challenge the design team to bring new ideas to the table for certain aspects of the project. For example, the developer asked the mechanical design firm to suggest options for the HVAC delivery system for one of the office buildings. The mechanical design firm made an up front presentation on mechanical system options. There were some sustainable design charettes. An energy consultant performed energy calculations on some of the options. A cost-benefit analysis was conducted and decision matrix constructed to narrow their choices. Ultimately, a super-cooled chilled water system was chosen, largely as a result of the availability of super cooled chilled water from a district cooling system.

One of the options they were seriously considering was a low pressure, underfloor distribution system. The developer and mechanical contractor had successfully applied this system in several build-to-suit projects. However, in this speculative development, there were concerns that the market would not accept an underfloor system. Perhaps more importantly, the developer worked out an agreement with a local energy supplier to develop a district cooling system on the site. This system will provide super chilled water at 38 F—a lower temperature than an underfloor system needs. It also is perfect for a super cooled chilled water system (this system provides advantages by allowing the use of smaller ductwork and fans).

So, in this example, the need for innovation flowed from the project vision established by the developer. The project team responded with a set of options in a collaborative fashion. The decision process took place in a dynamic and constantly changing environment. The availability of super-chilled water ultimately led to the innovative HVAC system selected.

4.4. Diffusion of Innovation

Finally, we consider the spread of successful innovations across the industry, asking: "Where does innovation in this market occur?" "Who are the market leaders?" "What market niches support innovation?" "Who are the market actors that serve as agents of market change?"

To begin, we would like to make several observations about the diffusion of innovation in the commercial building development industry. First, the process is incremental. Change occurs one step at a time, with gradual improvements being made to current practices. The result is a process of relatively slow evolution in a risk-averse industry. Second, the process of change is complex—it takes place at multiple levels in the building development process and involves multiple sets of actors. There is a dialogue between the market place (users) and decision-makers in the development process with ideas diffusing up and down a chain of relationships, with different market actors being influenced by a variety of market factors. This somewhat complex diffusion process reflects a building development industry that consists of independent market groups with disparate interests that come together to produce a one-of-a-kind product (a building) in response to demands from a market for commercial space. Third, there are elements in the market that act as market leaders due to their particular interests and motivations and how they perceive risk. These market leaders, and the market actors that respond to their interests, generate the innovations that diffuse into the market place. We consider each of these points in turn.

4.4.1. Innovation is Incremental

Each building tends to be a one-of-a-kind product in response to a particular expressed or perceived market need. To control risk and production costs, the building development industry develops standard practices and approaches that have been successful in the past. This tends to work against "really innovative buildings."

> *"You know, it's back to kind of this theory of evolution. I think the architecture and, more than architecture, construction, is a very slow-moving thing. A simple change in the way a tradesman assembles a component of the building costs a lot of money. You know, the first change… the first little change is a huge order of magnitude, and so you don't see a lot of really innovative buildings, because they're just… frankly, they're just too expensive… both from a design point of view, but mostly from a construction point of view."* (Architect)

But buildings do change. Each new building requires small changes or improvements in practice. These changes 'lift the standard' as described by this industry observer.

> *"But in the end, every time we do something different and it works, it becomes easier to do it again. You lift the standard. So what you're really trying to do is find ways to make small incremental changes, because nobody's really willing to jump all the way across a big chasm in one leap, you know. And the aggregate sum of those incremental changes over a ten-year period makes a difference."* (Building Industry Observer)

Over time, one can observe significant changes in building practices that result from many incremental changes. These range from advances in structural systems that have allowed for taller buildings with larger floorplates, to mechanical air conditioning systems that have allowed for greater environmental control and the ability to accommodate heat generating and temperature sensitive building uses. In some cases, a breakthrough innovation in a specific technology area occurs. But the application of this innovation by the building industry, and its influence on how buildings are constructed, occurs incrementally. This concept of incremental innovation is consistent with the diffusion of innovation characteristics dealing with *complexity*, *trialability*, and *observability*. It is also consistent with how mature industries develop better products through incremental improvements to standard designs and processes.

4.4.2. The Innovation Process is Complex (and Somewhat Convoluted)

Innovation in building development occurs through an active dialogue between users (market place requirements) and developers (or the individual representing owner or investor interests).

> *"I see the developer's dialogue with the end user as very much driving the equation. The catalytic… the point of innovation is that the sponsor… the person who makes the economic decision to spend either their or someone else's funds…they spend most of their time talking to users. … No buildings are built without a user in mind and the user's needs in mind."* (Building Industry Observer)

This dialogue usually isn't a matter of developers talking to a few users. Developers carry on this conversation in a variety of ways, as illustrated by the following comments from three developers about how they learn about new ideas and market requirements.

> *"Constantly talking to… and being involved in the market to, you know, find out what tenants are asking for and what their focus is. It's both the clients directly and the brokers. And the brokers come to us and say I need a space with this criteria. And we hear that from five brokers, the message sinks in, the market is shifting to looking for that or there's a niche in the market developing that's looking for that product."* (Developer A)

> *"No, you get it from your team. I… I think again, you know, our architects aren't just working for us, they're working all over the place all the time. So as you're working with different tenants with different needs, you're always exposed to different concepts. Similarly, the general contractor, you know, they're always looking for an edge, all right? In a sense the general contractors are always out there competing with all of the other generals. How do you get an edge?"* (Developer B)

> *"Well, it's a combination of reading, peer contacts in the industry and our project people that are closest to our tenants, our customers, who say…you know,…there's a high demand for this. We really think this is important* (Developer C)

Out of this dialogue, the developer figures out what the user might demand and produces a product (innovating where necessary) to respond to the market demand. A variety of real estate professionals serve as intermediaries in this dialogue, including brokers, appraisers, property managers, and marketing teams. It is their job to understand what is happening in the market. They represent user and market interests in the development process, but also represent developers and owners in the selling, leasing, and/or managing of buildings. They both bring information up the chain from users to developers, and provide information to users about building value. They deliver and sell new ideas (innovations) to the market place. As users accept these new ideas (or don't), they create demand for the innovations, helping to move them into the category of standard market requirements (e.g., as attributes of "Class A" office space).

The project team that designs and delivers innovations in response to the developer-real estate professional-user dialogue receives new ideas from a peer network of professional relationships and trade organizations, as well as from vendors with new ideas and products to sell. There are incentives for design and contracting firms to incorporate innovative ideas and approaches into their services and capabilities in order to maintain their level of expertise and to insure their competitiveness in a changing world. As firms grow in terms of their expertise, geographic reach, and ability to manage information, they are also relying more on their internal capabilities to generate innovative ideas.

Thus diffusion of innovation is occurring on both the demand and supply side of the building development process. The developer works with the supply side to produce an innovative product in response to new demand side requirements. If the innovation successfully provides a competitive advantage through its market success, the developer incorporates it into the standard model. This relates directly to the concept of *relative advantage* in diffusion theory, with the delivery of these innovations being entirely dependent on their *compatibility* with the adopter's existing conditions and networks. These ideas also relate to the adaptation of firms and networks to changing conditions and uncertainty in the market place. Ultimately the adoption of innovations becomes a way for market actors to respond to and reduce market uncertainty.

A particularly important set of real estate industry actors in regard to diffusion (as well as innovation itself, as discussed above) are the vertically integrated investment, development, and management firms and partnerships. They control a large portion of the commercial building market. They include market actors on both the demand and supply side. They have the internal resources to generate and manage the development of innovative ideas. And they can have a significant influence on the adoption of innovations in the market place.

4.4.3. Innovation Leaders

Some market niches are more prone to innovation, and the market leaders that operate in these niches tend to have motivations and interests that differentiate them from more risk averse segments of the market. The build-to-suit market segment develops buildings for a particular user—either an owner-occupant or an occupant leasing the space for an extended period. The risk for this type of project is somewhat less than more speculative developments because a user with known requirements will be occupying the space and generating the income to pay the investors that provided the capital for the building. Innovation is much more likely to occur in this type of project to meet unique user requirements. These users tend to be larger firms and institutions, including public sector organizations.

> *"The institutional buyers tend to be the leaders in innovation because they can do it for other criteria. It's the right thing to do. It's an interesting thing to do. It provides a better environment for my employees. And it is not their primary economic return to their business. They can look at it more indirectly. So when they demand something different…look at The Money Store building (the building has a very unique shape and appearance). We built that for The Money Store. We wouldn't have done that as a speculative office building. Never in a million years. That is exactly what they wanted, that is exactly what they got. So that's the case of an institutional client saying this is what I want. I'm going to innovate, I'm going to take the risks, I want it. We'll give it to you. But if it were a developer building, they wouldn't come anywhere near it because it's too far out of the model. We wouldn't take the risk to do it."* (Project Developer)

In this case the building user may have specific interests related to the success of their organization that they want reflected in the building. The building represents more than just a real estate investment to them—it is an investment in the success of the organization. In some cases, the innovation may appear to be somewhat esoteric (e.g., building with an odd shape). But the innovative techniques used to create that unique building may have broader applications for more conventional buildings. And, other innovations that contribute to the success of the organization, such as features that improve the quality of the work environment, may have broader application in the market place, once proven in the leading-edge build-to-suit project.

Specific large growing firms that acquire much of their building space in build-to-suit projects may be leaders in their industry. What they demand in their buildings becomes the standard for their competitors when they seek new space. For example, in the Northwest the features that Microsoft requires in their space have spread to the broader high-tech market. High-tech firms are demanding similar power requirements and work environments to be like Microsoft (see Section 5.2.3.2). There is a perception in this sector that to be competitive in terms of technology capability and the ability to recruit employees, it is necessary to meet the "Microsoft standard."

Innovation can also occur in market segments other than build-to-suit. Developers that develop buildings that they will own and operate (build-to-hold) have long-term interests in the buildings. They desire buildings that will maintain their value in the market place, and they are willing to make investments in the building that will provide long term value. This may include new ideas or systems that improve upon standard practice. These developers are often part of larger, integrated real estate firms that have the ability to systematically assess innovations in order to determine whether they should become part of their standard practice. Because these firms manage large blocks of properties, their adoption of an innovation can have a significant influence. In many cases, they have considerable financial resources of their own, reducing the constraints on innovation from risk-averse investors.

Finally, among market leaders, there are design and delivery firms that position themselves to go after projects that are likely to be leading edge, and that, therefore, demand higher levels of design innovation and creativity. Developers select project teams based largely on previous experience and track record. Firms develop reputations and expertise in certain areas, and developers pick certain firms for certain types of projects. Some firms might be best at rehabilitation or redevelopment projects, others at large, complex jobs, and others for green building projects. Leading firms develop skills and capabilities in response to what the market is demanding and the abilities that exist in the firm. These firms position themselves to deliver new ideas or innovations when a developer asks for options to the standard approach in order to meet a particular project requirement. Through the delivery of innovative projects, the firm develops experience and a reputation for being able to deliver difficult projects. These firms are able to market themselves in ways that show they are leading edge firms. They do *not* market "innovation" per se. Instead, they market skills and services (e.g., restoration, sustainability, signature buildings) that actors in the market find intelligible and support.

4.5. Summary

The building development industry exists to produce buildings that generate economic returns for investors. They have developed processes and standard approaches and models that reduce risk and ensure the delivery of successful projects, while providing steady flows of income. Yet buildings do change in response to demands that require non-standard approaches. The market factors that stimulate innovation include specific user needs, broader market trends, and local circumstances and regulatory requirements.

Each new building incorporates small improvements and innovations in response to market place requirements. A risk averse building industry resists dramatic change, but the sum of many incremental improvements does result in significant changes that lift the standard of building practice.

The process of innovation is complex, involving market actors at many levels in the development process on both the demand and supply sides. Innovations result from a dialogue between users and developers, in which real estate professionals (brokers, property managers, leasing agents, etc.) act as intermediaries, both communicating user requirements to developers and selling the developed product to users. Developers work with project teams (designers and contractors) to deliver a building product that meets perceived market needs. The degree to which innovation occurs in the building project flows from the project vision and is established at the beginning of the project during the creation of the project team and the initial conceptualization of the project. The delivery of an innovation is a dynamic process of choices and ongoing refinements by the project team in response to new and changing circumstances. Several building industry trends support innovation in the development process, with new hybrid delivery processes, application of information management technologies, and vertical integration of the real estate industry contributing to collaboration, communication, and better information for decision making.

The build-to-suit market segment is most conducive to innovation because the buildings are being developed for specific users, with large organizations and institutional users being the most important clients. Innovations there can translate into broader market requirements and create new market demands that developers will respond to and incorporate into their standard product. Building delivery firms (designers and contractors) incorporate these now-tested approaches and practices into their service and skill repertoires.

It is important to note, however, that innovations in the building industry may or may not be conducive to building energy efficiency—a topic that we consider in detail in the next chapter.

5. IMPLICATIONS FOR ENERGY EFFICIENCY

Although the industry is conservative, we have seen that innovation does take place and that incremental improvements actually “lift the standard” for the sorts of buildings that markets expect and suppliers produce. We have considered “innovation” as a very broad category of activity, however. Most industry innovations may have little to do with energy efficiency, and some may work counter to it.

So in this chapter, we specifically address the prospects of energy efficiency in this market place. First we consider how the building industry currently deals with and views energy efficiency and whether energy efficiency technologies/designs are, on their own, reasonable candidates for diffusion in this market place. Finding that they tend not to be, we explore a number of emerging market trends that may influence the adoption of energy efficiency in new commercial buildings. These trends may offer opportunities for supporting market change toward more energy efficient practices in the market place.

5.1. The Status of Energy Efficiency in Commercial Building Markets

How energy efficiency is viewed in the market may constrain improvements in the energy efficiency of particular buildings, and certainly influences the diffusion of energy efficiency innovations in the industry and in building markets. In this regard, it is important to understand that in terms of the parameters important to the building industry, buildings *are* energy efficient. Even if there is agreement that buildings could be much more energy efficient, existing building industry perceptions about energy efficiency constrain its ability to develop approaches that lead to buildings in the market place that really use less energy. So we consider both how energy efficiency is viewed in the market place and how existing approaches may be limited in their ability to create the market change we are interested in. This constrains energy efficiency innovation as a diffusion candidate in the market place.

5.1.1. Energy Efficiency Innovation in the Market Place

Our research suggests that the energy efficiency characteristics of an innovation are unlikely to support its successful diffusion in the market place. As described in the previous chapter, innovations must be justified on the basis of value (relative advantage) provided to building investors. Value reflects what the market place is willing to pay as described by this appraiser.

> *“I mean, what we’re supposed to do is simply reflect the market place. I mean, one of the ways I like to explain it is all we are is a mirror. ... If we’re to find market value, you know, even if the market place is doing what we think is a stupid thing, we have to say, this is what the market place is doing and this is how we think the market place is going to react and this is the price that we think the market place will pay.”* (Appraiser)

Thus, even if some interests believe that energy efficiency adds value by reducing operating expenses, if the market does not perceive that value, then the "price that we believe the market place will pay" will not reflect this.

The fact that the market places little value on energy efficiency is illustrated by this banker's comment.

> *"Do we care about energy efficiency? Well, yeah, we do. . . but only from a perspective of are the expenses realistic as the developer is proposing them,…we're going to look at actual historical expenses, and are the tenants willing to pay that. If it's a highly-efficient building, how attractive is that to a tenant…probably fairly, but the tenant…they want to be in a nice-looking building. The most popular building in town, with the highest rents, is the Wells Fargo Tower on Capital Avenue…is it energy-efficient, who knows and who cares."* (Financier)

This sentiment was echoed by many of the market actors we interviewed. What is considered realistic and acceptable is based on historical income, expenses, and leasing rates. While some market actors might consider energy efficiency, it is well down on their list of issues that are important and add value to a building. As a result, energy efficiency seems quite unlikely to stimulate innovation in commercial buildings. It is not part of the ongoing dialogue between users and developers that contributes to innovation as described above.

Note that we are not suggesting that certain energy efficient technologies cannot or will not diffuse into the market place. In fact there is evidence of certain energy efficient technologies enjoying success there. But we are suggesting, based on what we have learned, that those technologies are enjoying success *for reasons other than their energy efficiency.* Perhaps more importantly, we are suggesting that energy efficiency per se has little value in the market place, and that it will not be a driver of innovation in the building industry. While certain energy efficient technologies may enjoy success, energy efficiency is not an important building outcome and, as a result, the innovation process as we understand it is not likely to lead to more energy efficient buildings.

5.1.2. Buildings Are *Already* Energy Efficient

Our research found that the building industry believes they are already producing energy efficient buildings. We found three prevalent views about energy efficiency: that the energy code represents energy efficiency, that "we (the building industry) already do energy efficiency" by incorporating energy efficient technologies into buildings, and that "we have been burned by energy efficiency."

5.1.2.1. Energy Code Represents Energy Efficiency

There is a widespread belief in the building industry that meeting the energy code reflects good building practice. If one meets the code, then the building is energy efficient. The market expects a building that meets the energy code. There is no more reason to go beyond the energy code than there is to go beyond the requirements of other building codes.

> *"The Oregon energy code is pretty strict. If you meet the code you can feel pretty comfortable."* (Architect)

> *"One thing I have noticed is that some people think the code is an optimum design—that they do not need to think about energy efficiency—as long as they meet code they have an efficient building. I find it discouraging to see the energy code viewed this way. It is a minimum standard."* (Code Official)

While those in the energy industry view the energy code as a minimum standard representing the "worst building that can be built without breaking the law," the building industry views the code as standard practice. Conscientious builders tend to favor the energy code because it levels the playing field by forcing builders inclined to cut corners to meet accepted industry standards.

5.1.2.2. We Already "Do" Energy Efficiency

Our interviews also revealed a population of developers that incorporates a variety of features that they believe to be energy efficient into their buildings. For conscientious builders, there is a perception that they all do these "energy efficient type things"—doesn't everyone?

> *"Oh, you know, just normal energy efficient type things. We're…from a standpoint of a developer who's going to operate a building…we don't want huge operating costs. We put, you know, just normal types of things that you would expect most building owners who cared about their costs, their outfitting cost to do."* (Project Developer)

This developer goes on to mention a variety of energy efficient features in the building, suggesting that these are normal components for a developer who is going to own and operate the building. These features include two-tube T-8 fixtures, lighting controls, variable speed fan drives, fan-powered VAV boxes, CO sensors, occupancy sensors, and efficient windows.

There is a perception that if you incorporate these "normal energy efficient type things" you are producing an energy efficient building. Certainly, using energy efficient technologies is one way to reduce building energy use. However, isolated energy efficient features may well not result in a building that uses less energy on an overall basis. In many cases, these features enjoy broad acceptance and represent standard practice. For example, many of the features in the list above are fairly common and in many cases may be necessary to meet the energy code. Again, this contributes to the industry belief that buildings are already energy efficient (because they have the normal energy efficient type things) and certainly does not lead to the innovation and low levels of energy use in buildings that energy efficiency advocates say are possible.

5.1.2.3. We Have Been "Burned" by Energy Efficiency

Also, there is little value to the building industry in making the building more energy efficient if this is risky—and it is often perceived to be. We heard stories from those in the building industry about experiences where they or others they know have been burned by energy efficiency. Whether these are accurate accounts or "urban legends" makes little difference, since they support a widely held perception that the risks of doing energy efficiency are much greater than any potential benefits.

This belief is reflected in the following story told by an architect about the response of a project developer to the building occupants who wanted a variety of "green" components ("stuff") included in the building.

> *"'You can do anything you guys want, however, the major stipulation of this is that once you guys are out of the building I have to be able to rip all of this stuff out and put it on the market.' And everybody's jaw drops. They say 'Don't you see any value in this?' He said, 'No. I lease class A buildings. This is not a class A building. This is a class A building with a lot of junk on it. And this junk is going to make my building less marketable because I cannot create a commodity out of it, right?'"* (Architect)

Clearly, the developer did not see any value in the "green features" of this building, but only saw them detracting from his ability to market it. This view was expressed by others we spoke with - energy efficiency features are risky and are likely not marketable. The perceived riskiness of energy efficiency is supported by a range of stories about failed energy efficiency features—e.g., features that were difficult to operate and maintain, or features that did not live up to claims or expectations. The following example describes a mechanical system efficiency "failure." Even though this particular application really does not involve energy efficiency, the person describing it relates it to energy efficiency.

> *"We have…in the past…I mean, I know where you're headed is, down the road, energy efficiency. We were suckered into a particular type of mechanical system on a project based on representations by electrical rates being more competitive then gas rates, so we had electrical reheat in the building. Well, after the market shifted there was no competitive advantage, that building has a terrible history in operating expenses, and is a pain to lease. Economic disaster. And it's because we were led to believe this particular path was going to be an economic advantage. Not a marketing advantage to the tenants, but an economic advantage for lower operating costs, and it turned out to be exactly the opposite. And just has been a tremendous burden."* (Project Developer*)*

In the following example, a new lighting control technology did not meet expectations.

> *"We metered the branch circuits that had dimmable ballasts—yeah they were dimming but the energy savings were way less than what we were estimating."* (Utility Staff A)

Or in the next example, a unique cooling system was unfamiliar to the operators, which resulted in a variety of problems.

> *"There was a project at a bank that applied evaporative cooling. The operators were not familiar with the system and bypassed it. This caused problems because the remaining system did not have enough capacity. The owners did not know what was going on. These problems caused headaches for the owners and made the designers look bad."* (Utility Staff B)

A developer who participated in the Energy Edge program in the Northwest described the experience in the following way.

> *"It was a failure – a horrible design. Financially we broke even on first cost because of the incentive. But it was a big hassle to replace the failed systems. It caused discomfort for the tenants and really hurt the building. The system design was too big a step."* (Project Developer)

While these negative experiences with energy efficiency may be isolated events, in an industry that relies on relationships and reputations to control risk, they create and reinforce perceptions that are difficult to overcome. Even if successful applications are common, the problems are likely to be more visible. This limits the degree of risk that anyone in the industry is willing to take with energy efficiency, particularly when there is little apparent benefit.

5.1.3. Problems with Conventional Approaches to Improving Energy Efficiency

What does it take to produce new buildings in the market place with higher levels of energy efficiency—buildings that significantly exceed standard practice? Historical new commercial building energy efficiency programs were designed as resource acquisition programs to acquire energy efficiency resources at a cost that was less than the marginal cost of production. The approaches used to achieve building energy efficiency in the market place tend to flow from these energy efficiency programs, and from the building design community's response to those programs. Johnson and Nadel (2000) identify two basic commercial new construction program approaches: (1) The component based approach that promotes the use of specific energy efficient technologies; and (2) The performance based approach that promotes a minimum performance level for the overall building. These approaches have been applied to acquire energy efficiency resources. Yet as described below, these conventional approaches can be limited in their ability to create market change that leads to the production of buildings that use energy more efficiently.

5.1.3.1. Component Based Approaches

Many traditional energy efficiency programs give incentives if a building component meets a certain efficiency standard that exceeds conventional practice. Specific new energy efficient technologies may be targeted by energy efficiency programs for incentives that aim to improve the energy efficiency of particular buildings through the application of more energy efficient components (e.g., lighting controls or CO sensors). The programs also aim to increase the market acceptance and demand for more efficient products. This approach supports the commonly-held perception in the energy efficiency community and the building industry that a building that incorporates some components that are more energy efficient is an energy efficient building.

5.1.3.2. Performance Based Approaches

Performance based approaches strive to achieve or exceed a specified level of building performance. They often provide some level of technical assistance to encourage the selection of an appropriate combination of energy efficiency features. They may use design guidelines or standards representing good energy efficiency practices as tools to provide guidance to designers. These guidelines may be part of an energy efficiency program (e.g., if a building meets the design standard, it achieves a certain "energy rating"). Or design guidelines may be used by various professional groups to encourage better design practices. Performance based approaches can be prescriptive in nature, or they can establish more general performance benchmarks that can be met in a variety of ways. In many cases the use of a building energy simulation program is necessary to demonstrate compliance with the performance benchmark. The perception is that the performance benchmarks represent good energy efficiency practices that result in a more energy efficient building.

5.1.3.3. Evaluating the Approaches

Do these approaches lead to the production of buildings in the market place that use less energy than comparable buildings? Evaluation results show savings from 6 to 20 percent for buildings participating in energy efficiency programs using these approaches. A small number of programs have achieved participation rates of more than 30 percent while the programs were in effect. There is evidence that these programs supported changes in the market place, particularly regarding the application of more efficient lighting technology (Johnson and Nadel 2000).

While these conventional approaches have successfully acquired energy efficiency resources, we must consider whether they lead to market changes that result in the production of more energy efficient buildings in the broader market place. Our research suggests that they do not. The market views of energy efficiency noted above are widespread. Conventional approaches do not address these views and in many cases reinforce them.

Conventional approaches view energy efficiency in an isolated fashion apart from the rest of the development process and broader market interests. They typically focus entirely on the design process. They tacitly over-estimate the importance of energy efficiency to the building industry, and fail to recognize the actual interests and dynamics of the development process.

Approaches that encourage the application of more energy efficient components may result in some components of the building being more efficient, but others may be inefficient, and/or the efficient components may not integrate well with other building system components. One of the most common tradeoffs reported by our informants is the installation of higher levels of energy efficiency in parts of the building to allow the use of glazing areas that are greater than the base energy code level.

Broader, performance-based approaches can overcome some of these limitations, but they introduce more complexity relative to prescriptive approaches. Again, they tend to focus on the design process and may only deal with a small number of opportunities for energy efficiency.

It is important to recognize that energy efficiency is just one of the tradeoffs in the design, development and negotiation process. Greater energy efficiency in one area of the building may be used to achieve some other desired goal in another area of the building that is energy inefficient. Having a building that uses less energy overall is *rarely* the goal for building developers.

Thus, in the course of the development process and the tradeoffs that take place there, energy efficiency is of little concern unless it supports other *more important* goals. Perhaps of greatest significance to would-be market transformers is the fact that the approaches for achieving energy efficiency described above often *flow from energy efficiency industry interests*, rather than requirements or goals important to the building industry.

5.1.4. Energy Efficiency Innovation as a Diffusion Candidate

Because energy efficiency has little value in the market place, "energy efficiency" as a focus of innovation fails most of the tests of a successful diffusion candidate. Considering the five characteristics of an innovation that influence diffusion, we would imagine that the diffusion of energy efficiency on its own would likely be slow. The energy efficiency attributes of a technology offer no *relative advantage* to the building industry, since the market does not value energy efficiency. The industry already believes it is producing energy efficient buildings and there is no advantage in producing a more energy efficient building. Energy efficiency innovations are often not clearly *compatible* with the adopters existing conditions and needs—they do not fit into the existing models and routines used by a risk averse industry to reduce uncertainty. Energy efficiency innovations often introduce new *complexity* into the project because they do not fit the industry model, they may not be fully understood, and the adoption of an energy efficiency innovation can have broad impacts on other building systems. Given the nature of the building industry and the production of one-of-a-kind buildings, energy efficiency innovations offer little potential for *trialability*. And finally, energy efficiency innovations lack visibility and it is usually very difficult to *observe or measure* the claimed benefit.

Likewise, wider adoption of an energy efficiency innovation is clearly limited by *prior technological drag* and *irreversible investment* due to the tendencies of the building industry to standardize on certain products and system types in order to reduce risk. *Sponsorship* of energy efficient technologies within the building industry is limited, and *expectations* about energy efficient products are often not favorable (based on past experience).

Thus, for energy efficiency to diffuse in the market place, we believe that it must be embedded in complementary interests in the building industry. It is these interests that offer relative advantage and compatibility, and that link to existing innovations in the industry that are being tried and tested and enjoy some level of sponsorship and positive expectation. We consider such opportunities for encouraging energy efficiency in the building industry in the remainder of this chapter.

5.2. Macro Market Trends and Industry Movements

In the following discussion we consider some market trends and building industry movements that *are* relevant to energy efficiency, many of which are relevant to building energy efficiency efforts. These include:

- The movement toward more green and sustainable buildings,
- The growing interest in providing quality work environments to attract and retain employees,
- Advances in building technology and controls,
- Changes in the building development and design process,
- The use of regulation to shape building development, and
- Energy price volatility and system reliability.

In the following sections, we consider the ways in which each of these trends and movements might complement or work counter to energy efficiency interests.

5.2.1. Green/Sustainable Buildings

We found growing interest in developing buildings that are more green or sustainable. In the Puget Sound and Portland markets, key players in the market place are embracing or claiming to embrace green or sustainable practices. In the San Francisco Bay Area, there is also evidence of some demand for sustainability in design by particular building owners. While green buildings represent a niche market, we also found signs that green practices are beginning to diffuse into the broader market in these locales. Energy efficiency is one important element of green building practice, although many green design features have little to do with efficient energy use in the building. Both the public and private sectors are providing leadership in this area.

5.2.1.1. Public Sector Leadership

The Cities of Portland and Seattle have formed working groups that include a wide range of players to develop recommendations and action steps for policies that remove barriers to green building practices. The City of Portland has joined the Natural Step, an international movement promoting the routine application of sustainability principles (Natural Step 2000, Nattrass and Altomare 1999). The City also recently established an office to promote and support green buildings in Portland, and a series of program initiatives and services were unveiled in early 2001. The mayor of the City of Seattle recently issued an executive order stating that all new City buildings will achieve a LEED (a sustainable building rating system; see USGBC 2000) "silver" rating. The first City building to fall under this executive order is under development, and recent workshops offered by the City on meeting the LEED standard were well attended. Oregon's governor also recently issued an executive order on sustainability that will promote sustainable practices in state facilities, including the development of new facilities. All of these efforts are consistent with political interests in these jurisdictions that support the environment and that reflect concerns about water quality, salmon survival, growth management, landfills and waste reduction, and quality of life.

5.2.1.2. Private Sector Leadership

The building industry is not interested in creating green buildings for the sake of being green. However, at least some actors there are willing to respond to unusual market demands and to approaches that can lead to bottom line benefits without increasing market risk.

> *"We do really pay attention to being green, as long as it makes financial sense. But, I think you're going to see on the buildings that we move forward with, they're going to be a lot more green. We're going to be taking steps out there to…to kind of be a leader in that role. But, what you're going to find…what we'll find and what's happening in the market place is that the world is kind of changing in that direction so it becomes more financially available, you know,… it's easier to do. From a financial, you can make it pencil."* (Developer)

For example, one common element of a green building project is the reduction of construction waste, and a number of construction firms have been able to significantly reduce their waste disposal costs by adopting practices that reduce construction waste.

> *"In Seattle the infrastructure for recycling is very strong and if you throw metal, wood, cardboard or gypsum board into a dumpster*

you're simply throwing money down the drain because there are people who will take those things for free, sometimes even pay you for them. But if you put them in the dumpster and we get them all to the landfill, you're paying by the ton to get rid of it. So, you see a lot of recycling on the job and contractors are realizing that who cares if it's environmental friendly, I can make money doing this." (Industry Observer)

The bottom line benefits from recycling practices have caused some firms to more broadly explore other green building practices and to subsequently market their green building expertise. As a result, practices that reduce construction waste are becoming more widespread in the industry.

There are a growing number of green buildings in the Seattle and Portland markets that reflect, and in turn promote, increasing market interest. Our research suggests that green building features such as natural ventilation, operable windows, daylighting, non-toxic materials, and more individual control are quite appealing to building consumers. Some large firms and corporations such as Nike and REI are interested in having green buildings that reinforce their corporate image and that create improved indoor environments for their employees and customers. In a tight labor market, these buildings can be seen as mechanisms to attract and retain employees.

The Earth Smart (now Earth Advantage) program sponsored by Portland General Electric has helped to facilitate a number of green building projects in Portland. By the end of next year, there will be more than 50 buildings that have gone through this program. This growing set of green buildings is helping to mainstream green building practices in the market place.

Now, many of the prominent design and construction firms in these markets are positioning themselves to respond to growing market interest in green buildings by developing expertise in green building practices within those firms. For example, the largest architecture firm in Seattle has recently organized a "green group." A prominent engineering firm in Portland has developed marketing materials promoting their sustainable design capabilities. In both the Portland and Seattle markets there is a growing list of firms looking for opportunities to apply and develop green building expertise.

Some developers are interested in greening their image, while many others still believe the market is not ready to pay more for green buildings (i.e., that green features do not translate into building value). A growing number recognize that green practices need to be considered, however. A few developers we interviewed believe that interest in green buildings is growing, particularly among public sector clients. Developers are also recognizing a growing public interest in the environment, and they are beginning to realize that green building practices can contribute to community and regulatory acceptance for building projects in these jurisdictions. Creating buildings that are green and sustainable can counter negative images about developers "raping the land."

On a broader level, there is also the potential for linking more green/sustainable buildings into building industry goals for flexibility, long term value, and enduring market appeal. This must occur in the long run if green practices are to become common. Currently, green building approaches are still viewed as somewhat risky due to concerns about market acceptance and achieving performance goals.

5.2.1.3. Green Buildings and Energy Efficiency

So how is this green buildings movement complementary to energy efficiency interests? Perhaps most important is the fact that the vision and goals for a green building project are likely to be conducive to energy efficiency innovation. Generally energy efficiency is one aspect of a green building project—e.g., an important element of a LEED rating. Consideration of broader environmental issues such as recycling, the embedded energy in construction materials, and transportation impacts can have significant energy benefits. The collaborative and systems approach to design that is common in green building projects also supports designs that better optimize energy performance. And, greater attention is usually given to tracking and monitoring achievement of project goals in a green building project.

However, it is important to recognize that a green building project will not necessarily produce an energy efficient building. Design guidelines such as the LEED standard necessarily offer design flexibility, and this can lead to tradeoffs in the various scoring categories in order to achieve a rating goal. This can result in energy efficiency receiving little attention because it may be easier to score points in other categories. Also the energy efficiency requirements in a green building standard may not be very demanding. For example, to meet the lowest Earth Smart (Advantage) Design standard requires beating the Oregon Energy Code by 20 percent—which some would argue is now close to standard practice.

Even though the project vision for a green building might be conducive to energy efficiency, the project team still needs to deliver good alternative or innovative approaches. For example, poor design of some green (and potentially energy efficient) building features such as daylighting or operable windows can lead to greater energy use by increasing mechanical system loads.

So interest in green buildings creates an *opportunity* for energy efficiency by advancing a building vision that supports low impacts on the environment. By actively taking advantage of this opportunity, energy efficiency can become an important aspect of green buildings. As green building practices become more common in the market, so will energy efficiency.

5.2.2. Work Environment

Tight labor markets, particularly in the high-tech industry, are raising interest in improving the quality of the work environment as a way to attract and retain employees. And the building market is responding by focusing more attention on the work environment.

There is interest among energy efficiency advocates in the "non-energy" benefits of energy efficiency in the work environment—benefits involving such things as improved indoor air quality, occupant comfort, and worker productivity.

Building industry interest in the work environment potentially supports the application of building systems and components that also offer energy efficiency.

In the following statement, a project developer describes what her firm found when they asked prospective users of a new building to be developed about workplace features of most importance to them. They found *attracting and retaining employees* to be more important than the cost of the building.

> *"And, so, we said what do you want? You know, what do your employees want? What do you think you need? Well, their number-one thing is we're not so worried about cost to the building…that's nothing to us. In the realm of the millions we make, our worry is manpower and employees. So, how do I draw employees and what's going to get those employees into my building and make them want to work for my company? So, in order for me to get a Visio or a Microsoft or a…I'm going to have to provide a product that's going to help them get employees. And, if it's a stuffy building with bad air and the windows don't open and they don't have a place to park and they can't ride their bike to work and, you know, whatever…then I'm not going to sell that product to them."* (Developer)

This sentiment about the work environment was expressed in a number of our interviews with brokers and developers. More attention is being placed on creating a quality work environment in new commercial office buildings. However, a "quality work environment" is a somewhat elusive concept that has different meanings to different people. It is often based on perceptions, experience, and cultural beliefs. This is reflected in the following response from a developer when asked: "What do occupants want, what are the trends?"

> *"To summarize, I'm not sure that anybody came up with the answers. I mean, people talk about it, but the reality is you have brand new dot.coms that are moving into 100-year-old buildings in Pioneer Square [an historic district in Seattle] and absolutely loving it, even though the HVAC is somewhat dilapidated. They've got tall ceilings and so on…[it] may not even be sprinklered. It's just fabulous. And on the flip side of that, we have some more staid companies, maybe financial services and so on, but worldwide companies, insurance companies who only use brand-new buildings, which have some of these features, some not. And loving it. I think that the commonality that we're starting to see is not so much whether or not you've got a nine-foot ceiling or a nine and a half foot ceiling . …. I think what we're talking about is environment. Is it a different, interesting environment? And that can mean taller ceilings, maybe with a ceiling grid…it may be…well, it usually means making sure you're close by to amenities and services. I mean, we're all working more hours now and part of that means we make things easier, more efficient for our customer…you know, better, faster. And if we can do*

> *that, that makes their job easier in recruiting and retaining people. That's the biggest challenge today. How do you recruit and retain talented people. It's by providing a great environment. So, (workspace) is becoming a tool, not just a bottom-line expense. So, the commonality, if you will, between 100-year-old Pioneer Square building and a brand-new tech building…same tenants sometimes are going into these things…is that is it a great environment. And that's hard to define, it really is. But it is making sure that when you provide amenities you have the opportunity to be creative and flexible in your space. So, it's not like you absolutely have to have a drop ceiling. And your doors will be eight, six. This provides a little more flexibility… makes the space a little more fun."* (Developer)

So how does the building industry determine what this "great environment" is like? Basically, they rely on their own experience, their trusted staff and peers, and industry informants (such as brokers), and they talk to building users to find out what they prefer.

It is important to recognize that this is not a scientific process. What constitutes a great work environment is based largely on perceptions and cultural expectations. While the building industry does have interest in air quality, ventilation, and lighting, they do not have a direct interest in worker benefits. Beyond overall tenant satisfaction, the building industry does not measure building performance in terms of worker benefits. And *tenant satisfaction* is reflected by whether a building is fully leased and whether complaints are received that it is too hot or too cold. So feedback from tenants is sketchy and reflects whatever tenant experiences and perceptions about the space happen to be expressed—rather than representing any systematic measurements or formal post-occupancy evaluations.

Efforts to identify and measure worker benefits (such as productivity) that might result from better air quality, lighting, and ventilation in association with more efficient systems and design (i.e., "non-energy benefits") are gaining some momentum among utilities and other energy efficiency advocates. However, our research found *no evidence* that the building industry conducts any surveys or measurements related to energy efficiency, non-energy benefits and the work environment.

User demand seems to focus on building amenities and features, rather than building performance. This is what the building industry markets—access to parking and transportation, a location near other business and public spaces, common area attributes, information technology features, and space efficiency. These are the sorts of things tenants and employees can see and relate to their working conditions—things that make busy lives more convenient and easier.

So what are the implications for energy efficiency due to interest in the work environment? For one thing, an exclusive focus on building features and amenities—the building industry approach to marketing buildings—can run counter to lower building energy use. While there is an interest in a "great work environment," this seems to relate to the characteristics of the space rather than energy-linked considerations such as air quality, thermal comfort or lighting.

However, air quality, thermal comfort and lighting *do contribute* to a great work environment. They just don't easily fit into marketing approaches and they are not easily appreciated and specified by prospective tenants and users. While building users are likely to have an interest in these issues, the challenge is to incorporate them into market perceptions of the "good workplace."

5.2.3. Technology

The building industry is applying a variety of new building technologies to improve the performance of buildings. The application of much of this technology is in response to market demand for "smart buildings" and the requirements being placed on the building infrastructure from high-tech tenants. Our intent in this section is not to review all of the advanced technologies in the field, but to instead discuss the trend in "smart buildings" and to identify particular technology applications that illustrate complementary opportunities for energy efficiency. In particular, we consider building management and control systems and emerging HVAC technologies that are consistent with user demands. We conclude this discussion of technology by considering the trend of equipping buildings with much greater electrical and HVAC capacities to accommodate large computing and communications equipment loads.

Technology has become an increasingly important factor in determining real estate value. Smart buildings (those with the latest technology) are more desirable.

> *"Where comparisons between properties are heavily dependent on location and quality, a new category of technology capability has become equally important."* (*Business Journal*, Biethan, 2000: 40)

The characteristics of a smart building are valuable for the functional requirements of high-tech users, but they also offer other benefits to a wide range of users.

> *"A high level of connectivity, proficient monitoring systems and efficient environmental controls are only some of the characteristics that make up a smart building. This collection of services allows companies to control operating costs, raise productivity and provide greater physical comfort in the office."* (*Business Journal,* Berry, 1999: 39)

Other smart building features include fiber-optic capability, redundant power sources, multiple communication access points, HVAC systems controlled through the latest technology, integrated high-speed network connectivity, built-in Internet access wiring, and multimedia networking/videoconferencing capability. High-tech users are driving the growing demand for many of these features in the market, but it is important to recognize that this is not purely a case of new technologies becoming available. Instead, it reflects broader trends in how business is conducted and the changing nature of work.

"Technology is changing the way we do business, and accommodating it into the office of the future will be an ongoing process. But it is still a "people business" and understanding not only where people work, but also how they work, will be the key to successfully anticipating and meeting work space requirements." (Developer, cited in Gervais, 2000*)*

Market interest in smart buildings, and the application of new technologies in buildings to meet the needs of high-tech users, has implications for building energy efficiency. It can present opportunities for energy efficient technologies that are complementary to market requirements, but it can also create new demands for energy consumption.

5.2.3.1. Complementary Energy Efficient Technologies

Building control systems that manage lighting, mechanical systems, and security are common in most new buildings. Also, the movement to develop smart buildings for high-tech users demands the use of more sophisticated control systems. Advances in control technologies offer opportunities for greater individual control of the work environment (related to the growing interest in creating quality work spaces). And, advances in control system capabilities allow for more sophisticated control, monitoring, and management techniques across multiple buildings. In addition, standard communication protocols are making it easier to integrate the control systems for various building components. These control system technology trends contribute to important building industry interests related to reliability, flexibility, and greater user control.

Opportunities exist for taking advantage of the increasing presence of sophisticated control systems in buildings to better optimize building energy efficiency. The presence of these control systems meet the demands of the market and they can be used as a tool to provide feedback to building managers and the building development community on building performance (e.g., see Hitchcock, Piette and Selkowitz 1998). This feedback can be used to optimize the performance of existing buildings as well as to improve the design of new buildings. Thus control systems can be used as an information management tool to help institutionalize higher levels of building energy efficiency.

Applications of technologies such as under-floor or raised-floor ventilation systems provide another example of how a new technology can respond to important market needs and provide complementary energy efficiency benefits. This is expressed by a broker responding to a question about innovations in new commercial buildings.

I think one of the, probably the most dramatic ones is this idea of raised floors. You know, it used to be just reserved to computer rooms and things of that nature, but now there's the Fisher Properties Group in Seattle put their entire building on a raised floor system. Hines Development is about to build a large building in downtown Bellevue that they're going to be putting their entire building on a *raised floor... which you can bring your ducting, you can bring your cable, you can bring a whole…sort of things which adds more costs …certainly more expensive, but [it's] a great value for flexibility to the tenant."* (Broker)

There is growing interest in under-floor ventilation systems and applications of this technology are beginning to appear in the market. This is occurring because the technology offers some important values to building owners and tenants, particularly flexibility, individual control, and the potential for improved comfort. These are the factors (or *relative advantages*) that are helping this technology to begin to diffuse into the market place. These systems have the potential to be more energy efficient, but energy efficiency is a secondary or complementary benefit.

Other new technologies or innovations complementary to energy efficiency that were identified by our interviewees include indirect lighting and advanced windows. For high-tech users, lower levels of indirect lighting are preferred to reduce glare on computer screens. Advanced window systems that appear completely transparent, but reduce solar gains and have good insulating properties, are being adopted more widely in new buildings because of the views to the exterior that they offer.

5.2.3.2. Competing Technology Demands

At the same time, the trend toward equipping buildings for dramatically increased loads associated with information technology equipment, computers, and internet communications has the potential to *swamp* incremental efficiency gains. We must not ignore this trend by basing future office equipment loads on historical applications and use of this equipment. There can be a tendency to believe that these building loads are overblown and not real. But a project developer describes in the following statement how she became a believer in the significance of the load capacities demanded by high-tech tenants.

"And this building was a real transition to that, I think, because it [is] a whole different animal. ... I've been doing this for 20 years and I will sit at a table and argue with somebody all day long on how many tons of cooling they need and which power they need. And, you know, Microsoft came along and ... boom…there was this Microsoft standard that everybody thought they needed that Microsoft standard, which was not true. You know, it's a huge power consumption. We don't really use that power. There's different factors, diversity factors, that you use in calculating those loads for cooling and power. And Microsoft was the first one to really step out there and say we need all this stuff. And, so, everybody kind of took the lead ... well, we want to be like Microsoft, so we need it, too, which just increased the power requirements for the building, the cooling, and it was unnecessary. …. We really fought that battle.

Now, you know, 'xxxxx' [a large dot.com company] comes into this building…I started working with them…and they're saying, you *know, we need 200 tons of cooling. We need 100 tons of cooling. You do not. Well, they do and so this has really been enlightening for me because, you know, I feel like the old person that kind of needs to get out there and re-learn what's going on because these companies really…it'll just…it would blow your socks off to see, you know, really what they're putting in there and what their requirements are and what their needs are."* (Project Developer)

While one can argue about what this means in terms of the magnitude of greater energy use, the electrical *capacity* is being installed and the money is being spent to provide this capacity. The high-tech users are demanding this capacity, as well as high levels of reliability. And it is clear that energy use will increase in these settings.

This trend has the potential of *countering efficiency gain*s in other areas. But it also presents a potential opportunity through the heightening of user interest in energy costs and energy reliability. This could ultimately provide some support for more optimized design. Currently there is little thought or interest in optimization of these systems. The application of computing technology for data center type applications in this manner is a relatively new phenomenon. Basically, it appears that as much computing power as possible is put into a small space and building infrastructure capacity is added in whatever quantity might be needed to support the power demands of servers, disk arrays, lighting, security, and very large cooling loads. The goal is to get data facilities (whether in office buildings or stand-alone sites) operating quickly, with reliability being the primary energy-related concern. There is, however, an opportunity for optimization—both by supporting the development of more efficient computing equipment, and by better integrating and optimizing the building infrastructure.

5.2.4. Changes in the Development and Design Process

A number of development process innovations that may have efficiency implications (both positive and negative) include increased supply chain integration (vertical and horizontal integration of firms), web-based information management tools, and building commissioning. Several of these were also considered in our discussions of innovation and industry change above.

Fundamentally, these changes offer the possibility of improving the production process by eliminating fragmented knowledge and authority, information gaps, and poor communication and coordination that lead to sub-optimal design and delivery. This provides the potential for more effectively addressing energy efficiency in the development process.

5.2.4.1. Supply Chain Integration.

The vertical integration and consolidation that is occurring in the property development and management industry is a process trend that we identified earlier (see Section 4.3.1). The vertical integration of firms allows a broader range of interests to be represented in the development process early on, which allows for more widely shared knowledge, recognition of new market requirements, the generation of new ideas in response to those requirements, the support of better decisions, and reduced risk. It also leads to longer term operating interests being represented in the development process, allowing for the possibility of feedback and optimization. By appealing to these broader interests and understanding the relationship between energy efficiency and market requirements, there is an opportunity to raise the status of energy efficiency in the development process. In addition, the number of diffusion channels for bringing new ideas into a project are increased. This has implications for targeting efforts for encouraging energy efficiency to larger, integrated property management firms (discussed more fully in the concluding chapter on market intervention).

Likewise, we found that horizontal integration of firms is occurring through partnerships, consolidations and business expansion across regional, national, and international markets. This expands the resources and expertise that a particular firm can bring to a particular project. It also expands the range of ideas that might be considered for particular design challenges. For example, the prominent Seattle architecture firm that designed the thermal engineered buffer wall for the public building described in Section 4.2.3 has a branch office in Europe (as well as in Tokyo and Taipei). This system is an uncommon building element in the United States, but is not unusual in Northern Europe. Thus, a firm with a presence in European markets might apply energy efficiency techniques common in Europe to a project in the United States where the technique is unusual. This provides a new mechanism for the diffusion of new ideas.

5.2.4.2. Application of Advanced Information Management Tools.

The use of information management technology for optimizing the design and delivery process is another process trend identified earlier. The application of web-based information management tools allows the production process to be improved, which increases the potential for consideration of energy efficiency. These tools make it easier to track information throughout the development process, thus helping to ensure that information and knowledge are available within and across projects. What was learned in current or previous projects is documented for future work. This provides the potential to better optimize tradeoffs between performance and cost, and to streamline and standardize the delivery process. For energy efficiency, this facilitates the collaboration necessary for design optimization. Perhaps most importantly, it reduces the risk associated with energy efficiency by assuring that all relevant information is available during the development process.

5.2.4.3. Building Commissioning.

Building commissioning[16] is being adopted by many large engineering and contractor firms as a service that offers additional value to their clients. More and

[16] Building commissioning is a process intended to ensure that building systems perform in accordance with design intent and occupant operational needs. It involves documenting, testing, and verifying the performance of building systems.

more building owners and developers are demanding commissioning of their buildings because it adds value by ensuring the building "works well."

> *"Yeah, we do [building commissioning]. We usually have an outside commissioning agent that we also bring on early in the process so that they have input in the specs. The contractor knows what's to be expected of them and, you know, when this project's finished you have to consult with us out on the job site, going through the whole commissioning process. And we feel when we're done, we have a building where we know how it's performing, they know how it's performing and it just works well."* (Project Developer)

The Seattle energy code requires commissioning for building mechanical systems and lighting controls, and it is being considered for the energy codes in Washington and California. Various peer organizations in the HVAC industry have developed commissioning standards and commissioning training for their members. And a peer organization has emerged (the Building Commissioning Association) for commissioning providers.

Commissioning feeds into the process improvements noted in this section by creating a means to document actual building performance. This can support better designs in the future, when the feedback loops are in place. Most importantly, through documentation and testing, building commissioning helps to ensure that buildings function as they were intended—which is likely the most energy efficient way to meet user requirements.

In short, emerging changes in the design and development process are critical for producing buildings that use less energy. It strikes us that the simple adoption of innovative technologies is less important than the development of processes that support consideration of energy efficiency as a tool to meet market needs. The emerging process innovations described in this section contribute to the development of buildings that are not only easier to manage and operate, but that also use less energy.

5.2.5. Regulation

Energy codes have been a traditional approach for achieving minimum levels of building energy efficiency. Earlier we described how the building industry views the energy code as representing good industry practice for energy efficiency. We noted how the energy code is often used as a baseline for determining the higher levels of energy efficiency required to produce a more energy efficient building. Energy codes are an important mechanism for raising the overall energy efficiency in buildings. However, energy codes do have limited ability to continually raise the standard of energy efficiency practices. Our findings suggest that other regulatory mechanisms that could offer incentives for higher levels of energy efficiency need to be considered as well.

5.2.5.1. Energy Codes

Energy codes only offer a minimum standard—generally codifying building practices that are well on their way to becoming standard practice. In some cases they can help move the market toward the use of more energy efficient technologies, when those technologies are available in the market place and have achieved a certain level of effectiveness. For example, tighter lighting power density requirements pushed the market toward the use of T-8 fluorescent tubes and electronic ballasts. Most progressive building developers and engineers support the energy code because it levels the playing field, and clearly the energy code plays an important role in standardizing industry practice.

> *"Title 24 has probably been the single best thing that's happened to energy efficiency, bar none. As much as it's abused, as much as it's ignored, as much as…people, you know, toss it around like it was, you know, not important. What it has done is changed the conversation. Now there isn't a single developer or builder who does not consider Title 24 when they are doing their building… Regulations…they change what people consider as a normal thing."* (Architect)

So the energy code sets a standard—defining what is normal and ensuring that energy efficiency is considered. However, the energy code has limited ability to greatly improve energy efficiency beyond standard practice because it is a minimum standard. As we've mentioned, the old saw in the industry is that code represents the worst building that can be built without breaking the law. Perhaps, most important, it is difficult to regulate good design. Prescriptive requirements do not necessarily lead to a more efficient building, and, in fact, an argument can be made that an aggressive energy code actually stifles innovation.

As energy codes mature in these markets, they are updated to reflect improvements in building practice. In California and Washington, incorporation of new requirements (e.g., building commissioning, lower lighting energy intensity) are being considered by regulators, in a process through which codes are improved and the standard is raised. However, the process of updating the energy code is a political one, and there is a considerable lag in new building practices being reflected in the code, making it a somewhat clumsy regulatory tool. But the energy code does set a minimum standard, it does raise the level of performance of developers that would otherwise lag industry standard practice, and many other initiatives to encourage energy efficiency in buildings would be less effective if the energy code did not exist.

5.2.5.2. Other Regulatory Approaches

It is important to recognize that there are a variety of other codes and regulations in addition to the energy code (e.g., related to zoning, transportation, density, the environment, and livability) that have the potential for affecting energy efficient design and innovation as well. These codes and regulations have not historically included consideration of energy efficiency or related sustainability issues.

These other regulations and the methods that they employ offer some interesting possibilities for taking a more progressive approach to encouraging energy efficiency by offering incentives for improved energy efficient practices. Many of these regulations are intended to require or encourage certain types of developments that a community has identified as desirable. In some cases, they offer incentives such as allowing the building to be taller if it includes affordable housing. These types of incentives could also be used to encourage energy efficiency—e.g., by allowing higher building densities if the building meets a certain energy efficiency standard. In this case, the larger building might use less energy than a smaller, less efficient building. In urban settings, this could also provide transportation benefits by increasing urban density, which supports alternative transit options.

We believe that progressive jurisdictions like Seattle and Portland might be inclined to support regulations that give incentives for higher levels of energy efficiency or sustainability as part of their sustainable building efforts. These jurisdictions are also more likely to form partnerships with private developers during the design review and approval process that support the application of innovative ideas that might not otherwise be possible if the City did not have policies supporting sustainable building practices.

Hook up fees are another mechanism that utilities can use to encourage energy efficient practices. This seems particularly relevant for addressing the large power loads for new buildings. One developer we spoke with indicated they paid thousands of dollars for the extra power capacity they required for their new building.

5.2.6. Energy Prices, System Reliability and Price Volatility

Finally, there are a variety of forces and trends related to *energy deregulation* and *instability* in energy prices that may heighten user interest in energy and thus provide an opening for energy efficiency. These directly (and increasingly) impact upon building industry concerns about risk—in this case, risks involving energy supply and prices.

5.2.6.1. Market Uncertainties.

The advancing deregulation of parts of the electricity grid and related (and unrelated) price spikes and uncertainties about both short and long-term electricity and natural gas prices has caused building owners and managers to think seriously about their energy supply.

> *"Up until several years ago, managing real estate was pretty straight 'over tackle', and then some things have started happening that are really requiring more and more time of building owners and managers and more and more expertise. I think the first example, and good example is just the ADA… dealing with the requirements…that was a big learning curve and hurdle for owners and managers to deal with. The next wave that's kind of complicated things is just with*

telecommunications. You got all these rooftop people that want on your rooftops, you get fiber providers that want in through your fiber, you get the local telephone companies that were spun off from who ever that still operate like they're the monopoly. And then you've got the lobbyists in DC that are trying to basically say that any communications company can come into your building at any time and you just have to open the door and say, hey, yeah, come on in, trash my house. And that's a whole 'nother bag of information and expertise that we as owners and managers have to deal with. I think, the next big bucket of information is the energy deregulation. How do we deal with it? What's right? What's wrong? What's really going to benefit us? What's really going to hurt us? Who can you trust? Who can't you trust? So, that's going to be a whole 'nother layer of information and expertise that I would say 99 out of 100 owners across the country don't have the staff, don't have the expertise, so it will be another big, big, you know, bucket of information to wade through. And it will take years." (Property Manager)

The lack of knowledge and expertise in the area of deregulation poses a significant risk to industry actors. It may expose them to price increases, or their competitors may get better energy deals, giving the latter an advantage in competitive markets. This has the potential of raising the profile of energy in the building industry, and enhancing the prospects of energy service providers who offer services that mitigate the risk associated with unstable energy markets.

One way that developers and owners are dealing with this risk is to pass energy costs to building tenants. The trend in industry leasing seems to be away from gross leases and toward net leases, where the tenant pays the energy bill. This could cause tenants to pay more attention to the energy efficiency features of the buildings they lease, and might cause them to look for ways to control their energy usage. As we have indicated, in current building markets energy efficiency is not something prospective tenants are concerned with. However, the sorts of sharp increases in energy bills that are now being experienced across the U.S. could rather quickly move energy efficiency onto their radar screens. Opportunities are likely to exist to help organizations more effectively manage their energy use. However, this reduces the incentive for building developers to invest in energy efficiency, since it does not directly affect building income.

5.2.6.2. Growing Demand for Reliable Energy

Building users are demanding more reliable energy to run sensitive electronic equipment, which is often the lifeblood of the company. High-tech companies will go to great lengths and expense to ensure the reliable operation of this equipment. The cost of even a minor power surge can be significant, as this example shows.

"One of the things…is the purity or clarity or cleanliness of the power…power surges are bad news…I had a power surge over in Seattle and I'll bet it cost me 30 grand in the equipment it destroyed.

And I lost an elevator for a week, and so…that's bad." (Property Manager)

The costs to building owners, managers and tenants of power reliability problems can be huge—often much greater than any potential energy efficiency improvements. This can be a disincentive for energy efficiency, particularly if there is a perception that reliability might be compromised. On the other hand, it raises the importance of reliable energy supply and increases the level of attention it receives. This creates opportunities for more optimal solutions that may include energy efficiency and other approaches for reducing energy use and increasing reliability.

Unstable and changing energy markets have the potential for causing building owners, managers and tenants to have a *much greater* interest in energy supply, reliability and price. They offer the opportunity for energy efficiency to be used as a tool for managing reliability and price. They present opportunities for suppliers of energy to develop innovative solutions to meet new customer demands.

5.3. Summary

In this section we have considered how energy efficiency is not an outcome that is valued by the building industry and is thus an unlikely candidate for broad diffusion into industry practices. Current industry views about energy efficiency constrain the ability to produce buildings that are more energy efficient. Approaches for encouraging the development of more energy efficient buildings have failed to link their messages and activities with issues of real importance to the building industry. In order to raise the level of awareness and interest in energy efficiency, it must be better connected to complementary interests in the building industry. In other words, energy efficiency must be viewed as a tool for achieving valued industry goals and for reducing uncertainty in the development process. We have identified a number of market trends and industry movements that we believe are particularly relevant to energy efficiency in buildings. These trends and movements seem to offer opportunities for energy efficiency advocates who would take advantage of complementary building interests.

In the following chapter, we consider how to apply some of these opportunities to move building practices towards higher levels of energy efficiency. The methods have more to do with standardization of approaches and the use of better management and feedback methods than with the introduction of particular innovative building technologies. They relate more to making energy efficiency relevant to the existing development process, and to creating market demand for energy efficiency as a tool to meet perceived market needs.

6. DEVELOPMENT OF A MARKET THEORY FOR CHANGE

This final chapter considers, in light of our findings, the prospects for significant improvements in the energy-using characteristics of new office buildings. We were charged by our sponsors with developing a market model and a market transformation (MT) theory that could capture the dynamics of the markets of interest, and to present a market transformation strategy that identifies particular market actors, processes and/or subsystems as potential targets for market transformation intervention. We address these topics here, and we identify some directions for further research and policy/program discussions in support of such initiatives.

6.1. Model of a Conservative Market

The primary objective of our research has been to model the office building construction market, providing a realistic abstraction of the structure and dynamics of this industry. Chapters 2-5 presented our market model in detail—showing how various actors are related, how innovation takes place in the industry and how energy efficiency is (and isn't) taken into account in the development and design of office buildings.

Our purpose has not been prescriptive or programmatic. Rather, it has been to provide a social scientific foundation upon which prescriptions and programs could better be built. Our model of the industry provides such a basis for those who would attempt to design programs to secure greater energy efficiency in office buildings.

We have found the industry to be a complex multi-dimensional system whose building products are primarily conservative investments. This fact structures and constrains how buildings are seen, evaluated, designed, and operated. Real estate development requires the coordination of users, capital and land, with the resulting products strongly shaped by the availability of these elements and the requirements and constraints they impose.

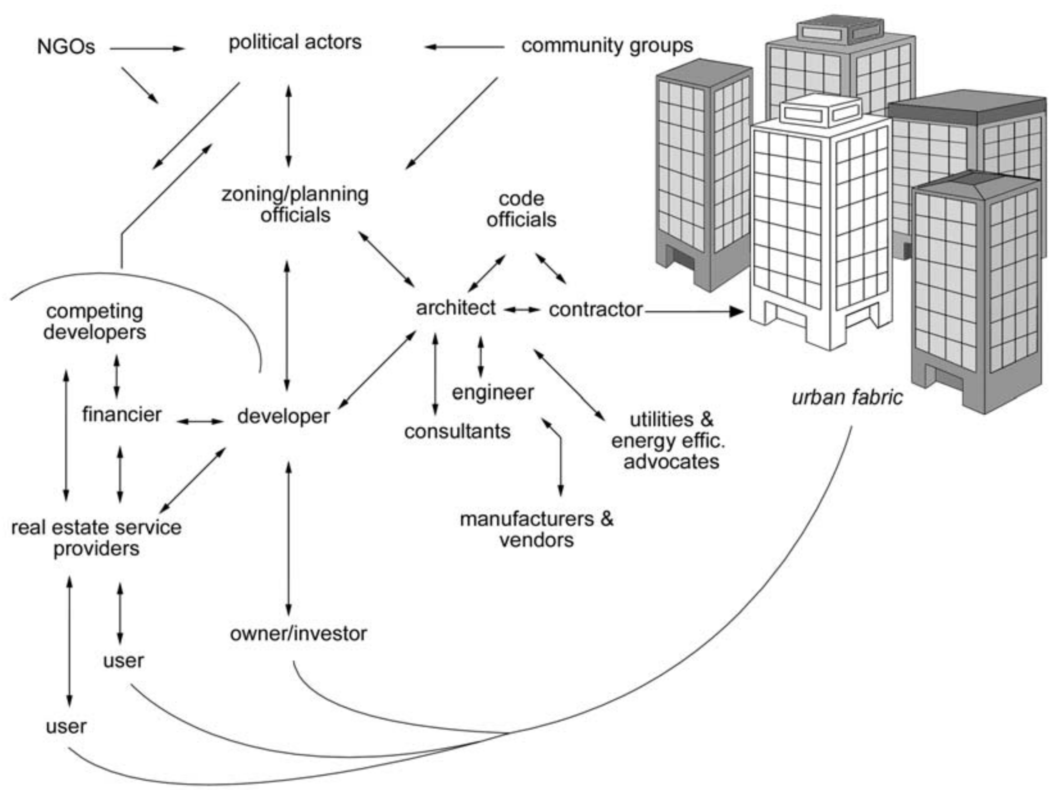
The commercial building "industry" is in fact a series of linked industries arrayed along a "value chain" or "value stream" in which each loosely-coupled link contributes value to the building in process. Each link, while aware of the others, is a somewhat separate social world with its own logic, language, actors, interests, and regulatory demands.

The building development process organizes the various industry groups and actors to produce a building, with different *delivery systems* organizing these actors in somewhat different ways. For the most part, the actions of "upstream" actors constrain the choices of "downstream" actors—and the process as a whole works to limit radical innovation. Yet innovation in building processes (and in buildings themselves) does take place under a combination of supply-side, demand-side, and regulatory influences. And commercial buildings markets are dynamic, with incremental change resulting in an evolving conventional building "product."

As a result, market transformers, energy industry executives and regulators should consider each step—and each cluster of actors—in the production process as possible points for programmatic attention. Energy efficiencies in the market place can theoretically be induced at "upstream" (e.g., development and finance), "midstream" (e.g., design and construction), and "downstream" (e.g., building management and leasing) points of the process. The more limited industry sketches presented in Figures 2 and 3 are elaborated into a more complete model in Figure 4. Here a larger array of actors are found within the contexts of the urban fabric and competing interests. Strong ties are shown as solid lines and weaker forms of influence are shown as dashed lines with arrows. The figure is not intended to be a complete summary of the model, but a device that attempts to depict the industry's complexity and network character.

In particular, note how the developer is at the center of the system. Investor interests are represented by owners and financiers. Users typically act through real estate service providers. Community interests are represented by zoning, planning, and code officials. The developer directs the design and delivery team (architects, engineers, consultants, and contractors) to produce a building that responds to these interests. Real estate service providers then manage these buildings for users and investors.

Figure 4. Improved Market Model: A Complexity of Actors



6.2. Market Transformation Theory

In this section we first briefly recapitulate what we have learned about the dynamics of innovation and change in this complex and multi-layered industry. We then consider some of the larger systems in which the markets of interest are embedded—environmental, economic, energy, and political systems over which local market actors have little control. We also introduce several social science perspectives on adaptive change in organizations that are useful in considering how these markets might be targeted for the purposes of energy efficiency market transformation.

We have noted that innovation in the building industry is incremental, with the combination of many small improvements lifting the standard. However, the process of innovation is neither straightforward nor particularly far-sighted. With many different market actors involved at many levels in the development process on both the demand and supply sides, innovation (and subsequently, longer-term change) is situational and punctuated.

We have argued that innovations result from an ongoing dialogue between users and developers in which changing tenant/user requirements, beliefs about market trends, and local conditions and constraints lead to innovative solutions to problems encountered in the building development process. We identified changes in industry structure, the organization of the delivery process, and information technologies that seem to be favorable to innovation in the markets of interest. We've also isolated some trends in green building, workplace environment, building controls, energy prices, and regulation that are potentially complementary to energy efficiency agendas.

Later in this chapter we suggest some ways in which MT interventions might make use of these developments and trends. But first it is necessary to identify four macro systems whose dynamics have a powerful effect on what can (and cannot) be accomplished in local/regional commercial buildings markets. Any workable market transformation theory must take into account not only the dynamics of the market itself, but also forces external to that market.

6.2.1. Significant Macro Systems

Our markets of interest are embedded in a number of larger systems, and the dynamics of those systems are difficult for local market actors to predict. As change takes place in these macro systems, market actors and firms are forced to adapt in order to survive and prosper.

Social scientists who study firms and organizational networks have been interested in how they adapt to changing conditions—although common failures to adapt are also considered in the literature (e.g., Hannan and Freeman 1989). The fates of buggy whip makers, corner grocers and typewriter manufacturers come to mind.

The office building development and construction industry is continually faced with pressures to adapt in a changing urban, environmental, economic, and socio-cultural scene. Office buildings themselves, and the organization of their development and delivery, affect the systems in which they are embedded—and are, in turn, shaped by those systems. For the present discussion, the most salient of these larger systems are: ecosystems, macro-economic systems, energy systems, and political-regulatory systems. We briefly sketch the changing conditions of each.

First, the *environmental* impacts of commercial buildings, while rarely the subject of public and policy debates, are significant in terms of their energy and resource requirements and their return of wastes to the biosphere. The indoor air quality impacts that designers presently address are accompanied by outdoor environmental air quality impacts—from the buildings themselves, as well as from the electric power plants that serve them.

Particularly in the Northwest, impacts to river flows, salmon and other wildlife from electricity generation are severe and represent a mounting social and political problem. The threat of designation of a number of salmon runs under the U.S. Endangered Species Act is a very real concern to regional power planners and political actors, since reduced power production from the Bonneville Power Administration system would likely be required.

And in terms of global environmental change, the impacts of CO_2 and other greenhouse gases emitted by buildings and power plants (and commutes to urban office workplaces from sprawling suburbs) are large and growing. In sum, the interactions of the built environment with natural ecosystems are significant and of growing social and political importance.

Second, the development of office buildings depends upon robust local *economic activity*, which in most instances also depends upon growth in national and international economies. As a result, the real estate development business is quite sensitive to fluctuations in the macro business cycle, as well as to local business cycles. These, in turn, spawn cycles of expansion in real estate development activity, with chronic over-building and space glut followed by increasing competition for a dwindling number of likely tenants, retrenchment, etc.

Much of the uncertainty in commercial real estate development is related to economic cycles and their well-known "boom/bust" effects upon regional/local real estate markets. Recent "hot" markets in our study areas and elsewhere in the U.S. have been dependent to a significant degree on national and international economic activity related to computer hardware and software, telecommunications and the internet, e-commerce, and global trade (the current downturn in these industries has cooled building markets). Regional tenants and office building owners—who are also often global economic actors—do not control the forces of the larger economy that ultimately determine their health, wealth and space needs. Just how changing national and global business conditions will shape future demands for office space (and particular types of office space) is—and will continue to be—quite unclear. Significant profits are made in timing these cycles correctly—i.e., buying into markets before they boom and reaping the benefits of growth; building on the upswing and acquiring distressed properties on the downturn. In all of this, the costs of energy and the profits from efficiency tend to be seen as "noise" in the fluctuations of the investment cycle. This may be changing, however.

Energy system problems have historically produced dramatic changes in public concern and policy action (Rosa et al. 1988). Although thought to be plentiful and cheap for most of the last two decades, during the past year energy has, once again, become a matter of serious concern, reaching "crisis" proportions in our study area. Growing global demands for energy now bump up against increasingly scarce (and more costly) energy resources, limits in energy production capacity (e.g., petroleum refining and electricity generation), and limits in energy transport capacity (pipelines and transmission lines). This means that even small supply disruptions (e.g., refinery explosions or power plant outages) or fluctuations in demand (e.g., unusually hot or cold weather) can severely tax the system. Supply and demand in California and the Pacific Northwest are so closely balanced that unfavorable weather conditions can result in rapid price increases and threats of system failure.

The utility deregulation movement has exacerbated the problem. Particularly in California, deregulation has had dramatic consequences for prices and power availability—with rolling blackouts now a part of everyday reality. In the Northwest, regional energy market instability, economic growth, limited transmission capacities and generation growth, and real problems with the Columbia River system (e.g., endangered species, competition for water, extreme weather and stream-flow fluctuations), mean that a region that once enjoyed cheap hydro power in abundance is now also facing volatile energy markets, rapidly rising prices and potential energy shortages. Across the nation, gasoline, electricity and natural gas prices are rising, and in some cases fairly dramatically. New sources of energy supply can and will be brought on line in the coming decade, but usually with environmental costs and with social and political resistance (e.g., to new pipelines and power plants). The commercial real estate sector cannot escape these energy system changes, which will likely have important impacts on both building owners and tenants, and in some cases will significantly affect the profits of both. At this writing, efforts are underway across the region by utilities, governments and building owners to upgrade building control capacity and reduce commercial energy use during times of peak system load.

Finally, because of changes in these three macro systems, citizens, non-government organizations (NGOs), political actors, and governments are *increasingly attentive to the industry*. Office buildings serve various social "needs"—for workspace, for economic growth and tax benefits, and for the benefits of their products and services. As social assets, they are suitable objects of policy attention. While governments have historically supported business expansion and real estate development (Logan and Molotch 1987), public problems that have resulted from both dense and dispersed forms of development have led to a wide range of planning, zoning and design restrictions on developers. In the future, concerns for "livability," "community" and "sustainability" are likely to grow, along with public interest in developers' plans and government efforts to control their activities. While we have seen that developers are generally willing to "work with" regulators and public officials, the industry also resists regulation. It is routinely stymied by citizen protests, lengthy regulatory reviews, community inputs, and lawsuits by anti-development groups and environmental NGOs. And the industry isn't likely to gain greater control over these influences in the future—particularly in the politically active cities of the U.S. West Coast.

In sum, the environmental, economic, energy, and political systems within which the real estate development industry is embedded will exert significant, and to some degree unpredictable, influences upon that industry. These influences will interact with the trends we've identified, as well with any initiatives launched by MT efficiency advocates.

6.2.2. Adaptation in the Face of Change?

The social science literature has considered how firms and networks adapt under these sorts of changing conditions. We don't offer a detailed review of that literature here, but we do point to some important findings that bear upon the prospects of industry change and market transformation in this sector.

For example, Fligstein (1991), in his studies of change across the nation's largest firms over the Twentieth Century, identifies *key actors* in firms/networks and the presence of *role models* (e.g., exemplary figures and firms) as significant influences upon processes of adaptation. He finds that when industries are faced with uncertainty and changing conditions, adaptations first occur within particular focal firms and then spread to competitors and trade allies.

DiMaggio and Powell (1991) expand upon these observations, considering in more detail the ways in which firms in particular industrial sectors have come to resemble one another so closely in form and function. Although using similar technologies, firms can, in principle, be organized along quite different lines (e.g., consider the vast differences between Japanese and U.S. forms of automobile production in the 1970s-80s). However, they often converge on a common form. DiMaggio and Powell identify three significant influences that encourage homogeneity (or "isomorphism") in organizational sectors. They call these *coercive*, *mimetic*, and *normative* influences upon adaptation.

Coercive adaptation comes from both official regulatory influences (e.g., requirements that firms adhere to affirmative action policies or report toxic releases), and socio-cultural and market sources (e.g., consumer expectations of certain product features, or supplier and trade ally performance expectations). Mimetic change involves the imitating or role modeling of other firms. This might come from shareholder expectations that the firm adopt organizational forms and "business models" similar to those of its competitors. Or it might come from managers who see in a competitor successful adaptive strategies that can be emulated. Normative sources of change have to do with the influence of social norms and standards on organizational actors. For example, these might come from the recruiting of managers and professionals from the same educational institutions (e.g., "top fifty" business schools where new organizational approaches are studied and advocated, or leading architectural colleges where the latest design trends are embraced). Normative influences also come from the professional and trade associations to which executives and employees of firms and their competitors jointly belong, and through which they interact with one another (e.g., societies of accountants, personnel managers, purchasing officers, the American Institute of Architects, the Urban Land Institute, the American Society of Heating, Refrigeration and Air-conditioning Engineers).

We introduce these theoretical insights to our discussion of commercial building markets at this point because they identify some important processes at work in business networks (e.g., involving key actors, coercive and normative pressures, imitation and modeling). We assume that these processes will be at work in our markets of interest, where firms and networks will attempt to adapt to changing industry trends within the contexts of changing environmental, economic, energy, and socio-political conditions. It is within this system of global change and local response that customary practices will be tested, altered and/or abandoned by market actors. And whether rapidly as a result of unforeseen crisis, or incrementally in response to more gradually changing conditions within and outside of the industry, adaptive change will take place—drawing upon existing firm/network competencies, and organized by the processes identified by Fligstein, DiMaggio, Powell, and others. Market transformation efforts can use knowledge of these processes to encourage and shape change—or their success can be limited because they lack this knowledge.

6.3. Market Transformation Model

Our market transformation model builds upon these perspectives and offers a set of strategies that target some of the most promising points of intervention in the industry-system. We believe, for example, that upstream points in the building development process are particularly important. As we have described at length in this report, for upstream actors in the industry, buildings are primarily investment vehicles, and it is this status as a financial asset that drives critical decisions about siting, materials, size, HVAC and lighting technologies, etc.

Traditional energy efficiency program interventions have often aimed at modifying buildings by encouraging the adoption of better technologies or improved design. Sometimes owners and users have been program targets (generally through incentive offers), but quite often the architects and engineers responsible for building design have been the focus of intervention efforts. The presumption has been that if these professionals were aware of alternative technologies and appropriate design principles, and were comfortable with their performance, they would promote their use. Their frequent failure to do so has not, with a few notable exceptions (e.g., Janda 1998), been examined very closely.

Our research suggests that while architects and engineers are important actors in the construction process, it is critical to understand that a building is the outcome of a complex social dynamic involving a variety of other actors—particularly the developers who pay the architects and engineers, and who largely control their decision making latitude.

Our research also suggests that the organization of the industry and its processes are the major determinants of construction outcomes. Improved technologies, while certainly worthwhile, are neither necessary nor sufficient to improve the overall energy efficiency of the built environment. Indeed, our interviewees suggested time and again that abstractly superior technologies are quite available to industry actors who know about them, yet who fail to seriously consider their adoption. Interestingly, a good deal of technology-focused research and development continues to refine the efficiency of devices and systems in the absence of a credible understanding of the social worlds in which they must be adopted.[17]

We are not convinced that successful market *transformation* by efficiency advocates is likely in office buildings markets—particularly when pursued largely through these "hardware" and "design" strategies. But because change has and will continue to take place in those markets, practices there can be prodded in more, rather than less, socially and environmentally desirable directions. Past success in achieving energy efficiency in this sector should be recognized, and not all past efforts and approaches should necessarily be abandoned in a market transformation context. We believe, however, that effective efficiency interventions in such complex, multi-actor, multi-interest systems cannot be simplistic. We have found no conceptual or programmatic "magic bullet" that can reduce this complexity. As a result, MT efforts will need to attack the problem on multiple levels, and in concert with a variety of market and non-market allies.

Three critical problems confronted by efficiency advocates in this system are (1) a general lack of awareness, appreciation and interest in energy or energy efficiency, (2) low levels of demand for better performing buildings, and (3) resistance to significant innovation in the development/design/delivery process. Any serious MT intervention in these markets must target each of these problem areas.

The following discussion offers some suggestions for making energy efficiency *relevant* to system actors, building *impetus* for efficiency on the demand side of the market, and *incorporating* energy efficiency more fully in the development process. Such efforts cannot be independent of one another, since the success of each is linked to the success of the others. Each initiative also requires different approaches, and confusing them may lead to ineffective interventions. Also, ignoring any of these levels is likely to lead to a poor result—e.g., encouraging demand without supply or supply without demand.

6.3.1. Establishing Relevance: Linking Energy Efficiency to Industry Interests and Trends

The macro-system pressures discussed above are all encouraging greater attention to the impacts of the real estate and construction sectors on environment, energy and society. But these pressures are locally interpreted and acted upon, and the status that energy efficiency now "enjoys" as a practical problem can quickly recede with falling prices and increased energy supplies (both predicted for the not-too-distant future).

In order to make energy efficiency in the long term relevant to market actors, MT efforts should link efficiency to *industry interests and complementary trends*, with the idea of incorporating energy efficiency into mechanisms for meeting routine industry goals. Because energy costs are ordinarily not an important consideration for builders or occupants, it makes little sense to promote energy efficiency per se to them. There are, however, a number of other factors such as *comfort* and *flexibility* in

[17] For example, the U.S. Department of Energy's Office of Building Technology, State and Community Programs R&D efforts and the California Energy Commission's similar Public Interest Energy Research programs.

which they are interested. These categories have meaning to market actors and are more likely to command attention in efforts to "sell" efficient designs and technologies such as daylighting and raised floor systems.

However, efficiency packaged in this way must also offer real market value—as the market defines value—while not increasing risk. Where innovations readily diffuse in the market is where they reduce uncertainty. We have seen that innovation is most likely when developers respond to challenges, and particularly when working with institutional and corporate clients on build-to-suit projects. The learning from these projects can lead, in turn, to a somewhat broader vision of what a "good building" is. But these experiences are not the norm.

In looking for ways to make links between quality/efficient buildings and issues of interest to market actors, the value of improved work environments, building function and profitability might be stressed. Some important efforts to measure these effects have been reported (e.g., Heerwagen 2000, Heschong et al. 2000, Okura et al. 2000), and utilities and others have attempted to promote these benefits in some markets. A fundamental problem remains, however, in the label "non-energy benefits," and the mischief that it causes by obscuring the nature of the industry's understanding of what is and isn't a "benefit." [18]

It is also important to link efficiency arguments and initiatives with complementary industry trends. We have already noted possible connections between energy efficiency and growing environmental concern and interest in green/sustainable buildings, energy deregulation and problems of price, reliability and uncertainty, and increasing technology-driven demands for workplace energy (and resulting demands for significant new building infrastructure investments).

But our research suggests that, despite these obvious connections and benefits, the general level of awareness of energy efficiency remains low in the development community—and trust levels would likely be low even if industry actors were better-informed. So more than just marketing (i.e., advertising, training, promoting, educating) will be required to increase awareness and secure greater legitimacy for energy efficiency in these markets. It is necessary to begin to consciously undertake efforts to use the normative, mimetic and coercive tendencies in industry networks to increase that awareness and secure that legitimacy.

More thorough documentation of "benefits"—of both the energy and non-energy sorts—is required. Also, a better selection of messengers is likely needed. If documentation existed, then real estate brokers and other intermediaries might be induced to help spread the message. That documentation should come from trusted sources such as industry-sponsored university-based real estate research centers.

As our earlier analysis suggests, large institutional users and large integrated property development and management firms might be targeted as sites where new ideas, paradigms and business models diffuse more rapidly than in a fragmented market place. The importance of these firms as exemplars is obvious, as is their

[18] A clear "benefit" to a building owner might be the ability to resell the property readily because of its "class A" characteristics, including a large atrium space, marble wainscoting and a high ratio of leaseable to common area space. "Benefits" to occupants which may be quite apparent to efficiency advocates are quite likely not to even appear on the owner's radar screen.

influence on the professional norms of the industry. As actors who "set the standard," product vendors might be important allies in these efforts as well.

While a good deal more effort on a variety of fronts will be necessary to secure the relevance of energy efficiency for commercial buildings markets, several current efforts merit mention. They can serve as sources of insight and potential allies in coordinated MT initiatives. These include the Northwest Energy Efficiency Alliance's (NEEA) "Better Bricks" program—a marketing campaign aimed at increasing demand for energy efficient buildings by raising user/tenant awareness of the productivity benefits of "better" (more efficient) buildings. The premise behind the program is that demand for non-energy benefits of energy efficiency can increase the demand for more energy efficient buildings (see NW Alliance 2000). A recent evaluation of the Alliance's Efficient Buildings Practices Initiative provides some important lessons learned for the "Better Bricks" effort (Dethman and Peters 2001). The Institute of Market Transformation is working with actors in the appraisal subsystem to demonstrate that reduced operating costs from energy efficiency can increase building value (see IMT 2000). And the U.S. Environmental Protection Agency's (EPA) Energy Star Buildings program has developed analytic tools that allow real estate investors and property managers to more fully incorporate energy operating costs and efficiency effects in their assessments of return on investment (see EPA 2000).

The optimistic premise of these and similar efforts is that increased awareness of energy costs and the non-energy benefits of energy efficiency can lead to demands by owners, managers and tenants for more efficient buildings. These efforts undoubtedly do contribute to the salience of energy efficiency within the development community. However, they are not enough on their own to motivate significant shifts in demand or changes in the delivery system. These must be addressed by other efforts.

6.3.2. Building Demand and Institutionalizing Energy Efficiency

"Demands" are not abstract urges or wishes that can be easily shaped by information. They are concrete expressions of willingness to act in particular ways by concrete actors on the ground. Therefore, demand is best encouraged and facilitated by efforts directed at specific actors in real markets. A key problem for market transformers, then, is creating an *impetus for change* in the market that leads to demands by owners, occupants, and investors for more efficient buildings. The goal here is to amplify the normative and coercive pressures upon the development community to pursue efficiency as the course of least resistance. At the same time, the support of exemplary firms and buildings offer proven role models that reduce the risk of efficiency innovation for other firms and projects.

While we don't offer detailed prescriptions, our research has identified arenas in which energy efficiency activity has and is taking place, and where MT initiatives might be effectively focused. These include: progressive markets, build-to-suit projects, large institutional users, vertically integrated property developers and managers, institutional investors, and policy and regulatory contexts. Again, the mechanisms of change at work across these arenas include key actors, role models/imitation, and both normative and coercive forms of demand-side pressure.

Progressive Markets — These are markets that support progressive building development with political leadership that offers a consistent public vision and incentives to move toward that vision. Generally this vision encourages development that contributes to a "livable city" and includes ideas related to green building and sustainability. Progressive policies and codes that allow for public-private partnerships in support of community and developer goals are conducive to innovations that lead to better, more efficient buildings.

Build-to-Suit Projects — Buildings developed for particular users are more likely to include innovative ideas because there is less market risk (a user already exists). These users are less driven by short-term bottom line issues, and are able to consider some of the trends complementary to energy efficiency as a way to increase the value of the building to their organization.

Large, Institutional Users — Large institutions that consume large amounts of property can have a significant influence on the nature of property development, particularly if they are viewed as leaders in their industry (e.g., the Microsoft standard). Some of these institutions (particularly in the public sector) are likely to have values that are complementary to energy efficiency. They can be better informed consumers of space and may be more likely to relate work environment to productivity.

Vertically Integrated and Multi-Market Property Developers and Managers— These large real estate firms develop and manage large segments of the commercial building market. They are more likely to pursue a "portfolio" approach to investing, in which risk is managed as much by diversity of holdings as by conservative choice on a project-by-project basis. They have the ability to consider a wider range of issues related to both supply and demand, and to manage information in ways that could be complementary to energy efficiency.

Institutional Investors — We believe that Real Estate Investment Trusts (REITs), pension plans, and mutual funds could have a critical role to play in shaping construction standards. Although many (or most) pass energy costs along to their tenants, their long-term outlook and institutional values may lend themselves to a favorable view of energy efficiency. In the past, for example, large California pension funds such as Cal PERS and UCRS have withdrawn funds from industries that are not considered healthy or environmentally friendly. Cal PERS, in particular, has been notable for its activism in influencing business decisions—e.g., deciding in October 2000 to divest tobacco stocks. We can imagine, for example, that socially conscious institutional investors might have a powerful effect on the industry by refusing to invest in REITs and development projects that do not uphold environmental (including energy efficiency) standards.[19]

The efficacy of this approach would depend on the concentration of investment in real estate, the availability of a standard against which buildings can be compared, and public consciousness of the issue of "dirty buildings." The EPA's Energy Star Buildings program might offer such a standard, since it certifies the best-

[19] In this, they may quite likely be supported by the insurance and risk management communities whose own long-term views and concerns (e.g., related to occupational health claims and global warming-related severe weather events) are increasingly favorable to energy efficiency innovation.

performing buildings and has been adopted as a reasonable benchmark by a number of large property development/management firms (Janda and Brodsky 2000).

Policy and Regulatory Approaches — A number of more progressive policies and regulatory approaches that offer incentives for greener and more energy efficient buildings can be imagined, and there is evidence of some public sector leadership in this area. A coordinated MT effort would look for opportunities to link up with more progressive political actors and policy makers in order to incorporate policies encouraging more sustainable building practices—e.g., by building new incentives into zoning, building codes and land use requirements. Some notable policy innovations along these lines have included the adoption of the LEED standard by the City of Seattle, and the institutionalizing of energy efficiency in Portland's new Office of Sustainable Development. Also, work with professional associations and standards groups (e.g., AIA and code bodies) can yield code improvements that could work in concert with planning policies to enhance energy and resource efficiency—while preserving profits and insuring flexibility/functionality in buildings constructed under those conditions.

This is a fairly eclectic menu of demand-side intervention prospects. But all are potentially important, and significant energy efficiency work is already underway in most of these areas. The main point, however, is that efforts to encourage demand and more thoroughly institutionalize energy efficiency need to mobilize key resources and change agents in the market place. However, these efforts to encourage demand are not sufficient to actually *transform* the market in the absence of mechanisms to delivery energy efficiency in the building development process.

6.3.3. Standardization within the Development/Design Process

Conventional approaches to energy efficiency have often involved efforts to encourage innovation in the building delivery process and adoption of new technologies and design tools—often in isolation from other design goals, and ignoring both problems with efficiency fixes and the non-energy aspects of efficiency solutions.

The loosely-linked process that brings together different actors and technologies to produce a building requires that many activities become routinized and standardized in order to reduce complexity and costs. We heard time and again that doing things even a little differently is costly and avoided wherever possible. So we suggest that the routines themselves be examined for ways in which they can be modified to enhance the energy efficiency of buildings. And, rather than trying to get the industry to accept "innovative" ideas, the tendencies in the industry to *standardize* ought to be exploited in order to "build-in" efficiency choices. In this way, the power of professional norms (via "best practice," generally accepted standards, design guidelines, financial pro forma, etc.) are invoked to legitimize energy efficiency and assure that it is integral throughout the development process.

For example, emerging trends in building delivery that involve more early stage multi-actor decisions in the design process can allow energy efficiency interests a "seat at the table." To take this seat, we found readily identifiable and trusted efficiency and sustainability consultants with strong credentials and considerable experience in all of our study markets. If market demands and uncertainties (e.g., regarding energy prices and government expectations) warranted it, early stage consideration of efficiency beyond code requirements would be possible. And there are precedents for the routinization of efficiency. Code requirements and government/utility incentives have already made some efficiency features that were once considered "exotic" and "risky" into standard items.

The increasing adoption of information technologies to tighten coordination might also work to integrate energy efficiency into building development—e.g., insuring on-time and correctly installed equipment, plan adaptations that don't subvert energy efficiency goals, and the survival of efficiency measures in the face of late-process "value engineering."

These process innovations have the potential of providing better information for decision making during building development and later in building operations. Building commissioning as a quality assurance process for development and design is being more widely adopted in these markets (although its use is far from universal). As we've noted, commissioning involves the documenting, testing, and verifying of building performance—insuring that buildings operate as efficiently as possible (and at least as efficiently as designed). If commissioning becomes more routine, commissioning agents may well be brought into the design process at earlier stages, where their experience in how buildings actually operate can be of considerable value to the design team.

In selecting particular *program targets* for MT initiatives that might move these markets toward integration of energy efficiency as a more routine element of the development process, we point to several likely prospects. Again, large vertically integrated property development and management firms are likely to be good partners in this enterprise. As noted, they have a longer-term view, are already applying some of these approaches, and are highly visible exemplars. Also, we've identified a number of progressive design and contracting firms that are developing a portfolio of services to be delivered over the life of the building. The efforts of these firms might be strategically supported, with an eye toward their emergence also as role models for the market. A caveat is necessary here. It would be a mistake to conceive of any of these development or design firms as intrinsically "innovative." They innovate, of course. But their primary product is not "innovation," and, in fact, all are quite capable of very conventional development in the absence of appropriate market and policy pressures.

We think that land use and design review requirements—which significantly shape the form of buildings—could be used to offer specific, easily incorporated incentives for energy efficiency early in the development process. We have found evidence of state tax credits for energy efficiency being treated by developers as serious inducements. Interviewees, who see codes as a strong regularizing force in the process, have mentioned a number of possible improvements to energy and building codes. Work by the New Buildings Institute (NBI 2000) and others on codes as a market transformation tool contribute to this effort.

Appraising the value of a construction project is a critical step in determining its economic viability and current appraisal standards give short shrift to the lower operating costs of efficient buildings. In fact, novel energy efficient technologies may be deducted from the value of a building assuming that unproved technologies might need to be replaced (e.g., by a traditional HVAC system).

Because the appraisal industry is professionally organized and holds members to standard practices, it may be a promising target for intervention in defining new standards that take into account the reduced costs of operating, leasing, and even building an energy-efficient office building. Similarly, other professionals, including architects, engineers, and real estate professionals, may also be influenced to adopt new standards of practice through licensing requirements, peer review processes, professional education curricula, and continuing education requirements—again, the *normative* sources of organizational change. In all of these cases, universities play an important role in training industry professionals, developing new analytic approaches and certifying state-of-the-art professional practice.

Designers and developers need tools and benchmarks to develop and sell green buildings. Several ongoing efforts by utilities, university and industry groups, and environmental NGOs are aimed at producing design guidelines and metrics for green construction (e.g., the U.S. Green Building Council's LEED rating system, see USGBC 2000). A long-time sponsor of energy efficiency technology R&D, the U.S. Department of Energy (DOE) continues to fund national laboratory efforts to produce improved building performance metrics and measurement systems, as does the California Energy Commission (e.g., Hitchcock, Piette and Selkowitz 1998, CEC 2000). DOE also has developed, with industry input, a "Technology Roadmap" that identifies an R&D agenda for DOE and the National Laboratories, as well as some market-based intervention approaches. The support of industry and trade press representatives for the roadmap (e.g., see DOE 2000) suggests some interest at the national level—interest that might be reproduced at the local level if the material coming out of the R&D pipeline can be incorporated in standard practice.

Finally, some traditional DSM-based approaches for encouraging energy efficiency still have a place in a portfolio of MT measures, but they need to be integrated with broader approaches that reflect market interests. These include traditional incentive, design assistance, and education programs, some of which are now institutional features of the development landscape (e.g., the Seattle Lighting Design Lab, the PG&E Energy Center, the Portland AIA Energy+Architecture Program, SCE and SMUD design assistance). Because they have become institutionalized, their support of newer efficiency efforts lends credibility to the latter.

A final caveat: we must remember that all of these efforts to make energy efficiency "routine" in the development process have limited prospects for success unless energy efficiency is relevant, valued and in demand in the market place.

6.4. Research Needs and Program Development

In concluding, we briefly point to the need for *targeted research* that explores in greater detail the dynamics of subsectors of the markets of interest and their potentials for the sort of multi-dimensional MT initiatives identified above. We close with some thoughts on policy and program development discussions that also ought to be undertaken in support of MT efforts in commercial buildings markets.

6.4.1. Research Needs

In order to better understand particular elements of these markets, focused research is needed in the following areas.

- The implications of the development cycles (e.g., building, overbuilding and absorption) for energy efficiency and sustainability efforts need to be better understood. While contributing to the riskiness of real estate development, the existence of these cycles suggests that there may be strategic times for intervention, and times to avoid efforts to intervene in the market. Research in this area might also reveal different motives, interests and actors as likely targets at different phases of the cycle. For example, efficiency might be a better selling point in down phases, compared to times when all space is in high demand.

- The terms "tenants" and "users" are widely used in the industry and refer to a variety of market actors who have not been carefully studied in our research. In order to employ MT strategies that increase the relevance and value of energy efficiency, we must better understand the "users" that occupy building space, as well as the various market actors that represent them.

- In this regard, we would particularly like to know more about the professional activities, culture and careers of commercial real estate brokers—actors who are key links between users and developers.

- It would be useful to better understand the nuances of appraisal practice and the potentials of the appraisal/valuation subsystem to advance energy efficiency and sustainability goals. What makes a building "valuable" to appraisers influences what financiers will lend, and ultimately, what is built.

- The standard specifications used by large institutional property owners (e.g., Federal and state governments, large private firms such as AT&T, Intel, etc.) establish the ground rules for design. So too do engineering standards related to comfort, health, fire safety, etc. These two quite different types of rules are the results of struggles and negotiations between interested parties—decisions that are ordinarily made in highly technical and virtually secret proceedings. A better understanding of how energy efficiency is framed, debated and dealt with in the production of technical/design standards and product specifications would offer insights into some important, but presently obscure, dynamics of the system.

- We have suggested large institutional users and vertically integrated property firms as likely MT allies. We need to know more, however, about their goals and operations, for example, their procurement practices and acquisition strategies. Determining just how realistic partnerships of this sort might be developed involves better understanding of how they behave in the market place and how they are viewed by smaller and more local market actors.

- If energy use is to become important to a wider range of actors in the system, it has to become more visible. For example, the energy consumption requirements of spaces might be estimated for lessees, much the way federal agencies estimate miles per gallon for vehicles or energy costs for appliances. In addition, rate structures might be changed to promote energy efficiency—particularly at peak demand times. Current rate structures do little to make energy use salient to most commercial office occupants. Applied research that explored ways of communicating facts about energy use to system actors, and research that produced models of alternative patterns of use and/or rate structure effects, would advance the relevance/visibility agenda.

- Beyond office building markets, a host of related commercial/institutional building markets warrant more detailed investigation. Specific studies might focus on the processes involved in the development, design and construction of hospitals, schools, industrial facilities, and so on.

- Also, in addition to new buildings markets, a considerable amount of important work remains to be done in the study of markets for *existing* office buildings, their management, trading, retrofits, etc.

- Re-interviewing key informants regarding impacts of escalating natural gas and electricity prices, as well as the problems of system reliability, blackouts, etc., would shed light on the degree to which their perspectives on energy efficiency and its value in their operations may have changed under "crisis" conditions.

- A better understanding of the *interactions and linkages* between new office buildings markets, markets for other sorts of commercial buildings, the development of government/institutional buildings, and markets for existing buildings, would allow better grounded planning for MT activities across these markets.

While, to the best of our knowledge, our research represents perhaps the most extensive study of this market yet, the long list of remaining research questions suggests that we've only scratched the surface. It is our intention that the models of market organization and market transformation presented here offer a fairly solid starting point for those studies, however.

6.4.2. Policy and Program Discussions

Finally, how might our findings and suggestions be put into action? We suggest a series of *policy and program discussions* to consider the prospects for effective MT intervention in the specific markets of interest. Our report might serve as a starting point for those discussions, but of greatest importance is the involvement of a wide range of relevant actors. Those who make the investments, develop the properties, design the buildings, regulate the land use, supply the technology, watch-dog the industry, and train its professionals need to be involved in order for MT interventions to be both legitimate and potentially effective. Both "ownership" of problems and ideas, as well as contribution of insights and resources, are required in order to leverage scarce MT resources in the most effective possible ways. At a minimum, participants in these discussions should include:

Key market transformation agencies and energy efficiency advocates — sponsors of a variety of current initiatives directed toward commercial buildings markets (e.g., the EPA, CEC, NW Alliance, CEE, utilities, DOE and the national laboratories)

The industry — developers, owners, managers, bankers, brokers, architects, engineers, builders, and consultants.

Political actors — local and state officials (and their staffs) who are charged with planning, development, energy, and environmental policy responsibilities.

Regulatory agencies — planning, zoning, redevelopment, and building codes officials, including persons involved in code-making and participants in standards-promulgating bodies.

Universities — under-utilized actors with many resources of value to MT and other sustainability efforts; significant owners and developers of property in their own right, as well as the primary source of training for all of the professions involved in these markets; have extensive alumni networks, continuing professional education programs, centers of leading-edge research, and trusted sources of information.

Government and institutional property owners — these control a good deal of real estate, routinely commission new projects, have interests in efficiency, productivity, working conditions, sustainability and the environment that are congenial with MT and energy efficiency goals. Their buildings are often test-beds for energy efficiency and other sorts of innovation.

Movement actors — representatives of both community-based groups and larger NGOs with interests in the built environment.

The goal of these discussions would be to secure lasting commitments to clear, realizable MT goals which could be pursued by coordinated action in the market place. We've noted a good deal of pro-environmental and pro-efficiency activity already taking place there, as well as supporting trends at the both the global/national and regional/local levels. However, in order to realize significant changes in development practice and building performance, a good deal more activity is required.

To an important degree, just what the most appropriate actions might consist of in any given city will depend upon the local culture and networks available to support coordinated MT efforts there. Therefore, it is crucial that key actors from those networks be responsible for shaping discussions about their own problems, and for devising locally appropriate solutions. At the same time, locales can learn a good deal from the experiments taking place elsewhere. State, regional and national MT organizations can play an important role in facilitating the exchange of information among locales, as well as in fostering change as specific opportunities arise.

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