

**Joint Center for Housing Studies  
Harvard University**

**Market Data for Housing Innovation:  
A Policy Agenda and Plan  
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## **Introduction**

In 1994, the U.S. White House convened various stakeholders to establish a set of “National Construction Goals” recognizing that the residential building industry is one of the largest and most important sectors of the U.S. economy. According to the U.S. Department of Commerce, the construction industry comprises the second largest contributor to national GDP (over 8%, behind only healthcare) with the residential market comprising more than half of the construction industry as a whole. Therefore, it is critical that the barriers to adoption of new innovations in the residential sector be understood to speed up this diffusion of new technology to the marketplace.

With this challenge in mind, the Partnership for Advancing Technology in Housing (PATH)<sup>1</sup> was launched in 1998. PATH examines the issues and barriers related to technology development in the housing industry and strives for viable cost-effective solutions. It is dedicated to accelerating the development and use of technologies that fundamentally improve the quality, durability, energy efficiency, environmental performance, and affordability of housing in the U.S. As a result, study has been done in identifying the barriers to the use of these technologies and the outlining of the supply and demand chain for new innovation. The next critical step is to take the existing and acquired knowledge and identify research data needs and projects that move beyond understanding barriers – to understand the behaviors and motivations to push through these barriers and accelerate the adoption of innovation in homes. Leaders in the industry have met to begin addressing many of these issues.<sup>2</sup>

Despite the importance of the housing industry to the American economy and its products’ great market value, there has not been much investment in both innovative residential technologies and market analyses for those innovations when compared to other industries. This is especially true of the single-family homes that comprise most of America's housing stock.

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<sup>1</sup> PATH is a voluntary partnership between leaders of the homebuilding, product manufacturing, insurance, and financial industries and representatives of Federal agencies concerned with housing (U.S. Department of Housing and Urban Development [coordinator], U.S. Department of Energy, U.S. Department of Commerce, U.S. Environmental Protection Agency, U.S. Department of Agriculture, Federal Emergency Management Agency, National Science Foundation). Working together, PATH partners improve new and existing homes and strengthen the technology infrastructure of the United States.

<sup>2</sup> McGraw-Hill Construction and PATH sponsored a day-long Symposium on Market Data for Housing Innovation (Symposium) in order to (1) overview current knowledge and available information about the drivers and influence of major players on the diffusion of innovation and new technology in housing and (2) discuss research gaps, behavioral characteristics, decision motives, and primary player practices. For more information, please go to [www.pathnet.org/sp.asp?mc=about\\_projects](http://www.pathnet.org/sp.asp?mc=about_projects).

The importance of this lower level of innovation cannot be underestimated; advances in innovative technology are widely regarded as major sources of improvement in the competitive position of firms and industries and major factors for increased national economic growth and standards of living.

There has been recent work to identify the barriers to innovation, but one of these challenges remains – to identify and then acquire market data and analyses that shed light on behaviors and motives around technology. The lack of sufficient knowledge about market drivers for demand of new technologies is creating a barrier to advancing innovation in the housing industry. Historically, firms have not been proficient in creating or adopting innovations because either the market for an innovative product was not clear or methods to understand market behavior were wanting. Filling market knowledge and behavior gaps, then, is one method of spurring both innovations in particular, and the industry's growth as a whole.

This report, in conjunction with parallel reports titled “Symposium Summary” and “An Industry Agenda and Plan,” reviews the problem associated with firms not fully comprehending the *behaviors* and *motivations* behind driving through the barriers to fundamental technology innovation and offers some research solutions to answering some of the most critical market questions. This report focuses on the public sector role in furthering this market research agenda and specifies actions and timeframes for that implementation. It also suggests other pressing policy issues that can be assisted with and by accurate and comprehensive market research.

## **Background**

As reported in the “Symposium Summary,” housing researchers are faced with scant data and data collection vehicles in their attempts to understand production in general, let alone how existing production shapes housing innovation. This lack is particularly acute when examining participant behaviors, motives, and perceptions. Likewise, there is currently a lack of information, literature, and market data for PATH and others in government and as well as in industry to truly understand housing innovation adoption or change. This information, though, is critical when trying to change a complex industry that includes a wide mix of players, low profit margins, and labor shortages.

The information that does exist is often proprietary in nature, though there are significant fundamental data collections and analyses provided by the public sector upon which much of the

industry information is generated. From the ubiquitous U.S. Census — which includes the Census-HUD American Housing Survey (AHS) — to the Residential Energy Consumption Survey (RECS), public data sets and analyses provide much insight into consumer and commercial practices, and thereby spur improved commercial practices and increased consumption. Along with the AHS and RECS, a variety of studies done by Energy Star<sup>®</sup>, its multiple partners, and State or regional utilities and energy offices shed light on home consumers (owners and buyers). The Census Bureau's Survey of Construction, Survey of Manufacture, and — jointly with the National Science Foundation (NSF) — the Survey of Industrial Research and Development, as well as the NSF's Science and Engineering Statistics all reveal information about the production side (from manufacturers to builders and remodelers).

Nonprofit industry related organizations provide complementary and, oftentimes more comprehensive, information and analysis on housing production and practices compared to their public counterparts. Organizations performing such work include, but are not limited to, Harvard University's Joint Center for Housing Studies and Virginia Polytechnic Institute's Housing Research Center among academic sources. Trade associations with thorough and ongoing market research include, but are not limited to, the National Association of Home Builders (NAHB), the National Association of Realtors, and the American Institute of Architects. Lastly, numerous private sector survey instruments and data collection services exist that usually execute the market research for industry, but who offer some level of publicly accessible information. Leading among these are products from McGraw-Hill Construction's Dodge data and analytic information; the NAHB Research Center's Builder Practice and Consumer Surveys; Frost & Sullivan; R.S. Means cost data; housing customer satisfaction studies by J. D. Power and Associates; trade journal surveys in McGraw-Hill Construction, Reed Publishing, Scripps, and Hanley-Wood publications; and a volume of private trade association and/or individual manufacturer market research studies (though this is not a comprehensive list).

Despite this somewhat extensive listing, two points should be noted. First, the level of detail needed to understand obstacles and drivers to innovation adoption is insufficient (particularly when looking at some physical conditions of homes and home production practices). Second many of these are not ongoing or have decreased resources to perform their work. As such, Symposium participants recommend not only expanding the kinds of data they specified as needed, but also ensuring continuation of core, more generalized data sources.

So, which additional activities should be taken on by the public sector? And how can this be done? The first step is to look at pressing policy needs that require market research assistance. The second involves looking at the long-term data infrastructure and market agendas that can be shared between industry and policymakers.

### **Themes**

In the Housing Innovation Market Research Symposium held by PATH and McGraw Hill Construction in February 2006 (described in the accompanying report “Symposium Summary”), three primary homebuilding participants were described as the primary focus of all market research: consumers (both homeowners and homebuyers); builders (including remodelers); and building product manufacturers. Critical to furthering knowledge of the industry as a whole is acquisition of data, analysis, and all information focused on these groups.

In contrast, the plan for acting on the Symposium’s recommendations within industry further specified the three key users of market research within the industry, or ‘actors.’ These actors included builders, manufacturers, and housing intermediaries (including the participants interacting between manufacturers and builders (e.g., suppliers and dealers), those between manufacturers and consumers (such as retailers and the press), and those between builders and consumers (such as appraisers, realtors, lenders, and insurers)). In unique ways, each of these three groups use market research on the previous three groups.

When discussing government’s role in market intelligence, however, we are confronted with both the public sector’s role as a user of data and analysis for policy formulation, and its role as a generator of data and analysis either through funding, coordinating, and/or executing that market research work. Because of these multiple activities, it is critical to revisit the context within which housing statistics in general — and housing technology and industrial practice statistics in particular — are generated. Then, a review of the primary themes for data collection presented in the Symposium can be viewed with regard to public sector involvement.

### **Context & Justification for Public Intervention**

The level and pace of innovation in the home building industry is generally considered to be disappointing. One reason may be that accrued knowledge of industry participants is not fully used by policy makers in developing innovation strategies. An enhanced understanding of the

evolving home building industry can lead to greater levels of overall innovation and have significant beneficial results for the residential construction industry, homeowners and renters, as well as for the overall U.S. economy.

Therefore, to understand the innovation process within the industry, as well as to leverage even more innovation, there is a need for better market information on home building practices. This information could dramatically improve the potential for greater levels of innovation – and diffusion of these innovations – in the industry moving forward.

Despite the numerous reasons for the apparently disappointing performance of the home building industry with respect to innovation, there have been several industry developments in recent years that, taken together, have the potential to alter this record. These developments include changes in the structure of the industry and its near-term outlook, labor shortages, current rebuilding efforts following natural disasters, challenges to industry competitiveness, and cutbacks in research support for innovation in home building.

### ***1. The home building industry is at a crossroads.***

The past several years have been some of the best years for home building in U.S. history. Since 2000, the industry has averaged over 1.8 million housing starts a year. Single-family construction in particular has enjoyed a stellar performance, averaging nearly 1.5 million starts a year over this period, reaching record levels in 2005.

However, there are two important trends that should encourage increased levels of innovation in the industry. The first is the concern over an impending slowdown in the housing market. After years of strong growth in home building facilitated by the lowest mortgage interest rates in a generation, many analysts feel that home building activity is likely to slow in the years ahead. With slower growth, home building companies will face pressure to maintain profit levels through more efficient operations.

Research conducted through the Harvard Distribution Study (Joint Center, 2006) concluded that over the past five years, operating efficiencies (e.g. per square foot construction costs, construction cycle time) have increased the most among builders operating in more competitive markets. As home building slows and competition increases, we can expect builders to look favorably toward innovation to increase their efficiency and therefore profitability.

The second concern centers on the industry itself — namely, the level of consolidation that has risen in the past decade. Like many other U.S. industries, we have seen growing consolidation among home builders in recent years. The share of all new homes sold by the top 10 builders in the country is approaching 25% according to *Builder Magazine*, more than double what it was a decade ago.

With consolidation, builders are finding that they need to pursue greater technological sophistication in their operations to ensure smooth operations among their larger organizations. Additionally, innovating faster than their competition to create greater efficiencies is likely to be a popular strategy moving forward since their smaller competitors likely have a lower cost structure. Additionally, consolidation is threatening the traditional power structure within the industry. With a small number of builders accounting for a significant share of activity, power is no longer concentrated in the hand of manufacturers.

## ***2. Labor shortages and immigration issues are shaping the homebuilding industry.***

Labor shortages are commonly considered to be one of the most important issues facing the residential construction industry. With productivity levels in the industry reputedly quite low and stagnant, recent growth in activity has put strains on an already thin labor pool. Immigrants, often undocumented, have helped meet the growing labor needs of the home building industry. Recent analysis by the Pew Hispanic Center (Passell, 2006) concludes that almost a fifth of all short-term unauthorized workers work in construction and extractive industries. However, as the debate continues on immigration reform, labor shortages again loom as a major industry concern. Looking for labor saving investments is likely to be a major priority for home builders over the next few years.

## ***3. The building and rebuilding of homes comes to the forefront of social concerns during natural disasters.***

The difficulties faced by the federal, state, and local governments in providing housing to citizens displaced by natural disasters were highlighted in the recent response to hurricanes Katrina and Rita. While there were many issues involved in the ability of government and the housing industry to respond quickly to these disasters, unimaginative building technologies and inflexible building codes often were identified as key impediments. While these examples are still fresh in

the mind of policy-makers, coupled with the recent 100<sup>th</sup> anniversary of the great San Francisco earthquake reminding the population that the potential for other natural disasters remains great, public support for a more innovative residential construction industry remains strong.

#### ***4. The competitiveness of American home building is increasingly challenged.***

Due to the fact that home building remains a site-specific activity, it has not faced much in the way of global competition to date. However, the industry is not insulated from globalization. As larger shares of homebuilding activity are manufactured and preassembled offsite, international competition becomes a more significant risk. With home building and home improvement activity now accounting for 6% of our national economy, successful innovation to keep this industry competitive is essential to maintaining U.S. economic health.

#### ***5. There are shrinking public resources for fundamental research on housing, let alone for housing innovation.***

In addition to broader issues that offer challenges and opportunities for the industry, funding for direct support to innovation research is under pressure. Traditional nongovernmental funding sources for basic and applied research that might be directed toward innovation in home building – philanthropic foundations, university endowments, and other nonprofits – have been under financial pressure recently. Much of this is due to the poor performance of equity markets in recent years, where most of the assets of these institutions are invested. Government funding for basic research through agencies such as the National Science Foundation, the National Institutes of Health, and the National Institutional Institutes of Mental Health are likewise becoming more restrictive on funding given the recent pressures on federal budgets.

Recent pressures on the Federal budget have forced government statistical agencies to consider scaling back several ongoing data collection efforts that are critical to measuring the level of innovation in the home building industry. Two data sources that are of particular importance to understanding the longer-term impact of innovation in home building operations are the American Housing Survey and the Residential Energy Consumption Survey.

The American Housing Survey is conducted biannually at the national level, with studies of major metropolitan areas conducted annually on a rotating basis. It is principally funded by the U.S. Department of Housing and Urban Development (HUD), was initiated over three

decades ago, and tracks a large panel of homes nationally. With its focus on housing conditions, it is an important and useful database for helping to evaluate the impact of home building innovations on longer-term housing conditions, durability, necessary improvement and repairs, affordability, and so forth.

The Residential Energy Consumption Survey is a national survey conducted every three years across a panel of homes and funded by the U.S. Energy Information Agency. With its focus on energy consumption, it is also an important and useful database to track the impact of energy investments and conservation measures on home energy consumption.

Additionally, there are several other government sponsored data efforts that can help with the understanding of the innovation process in homebuilding. The 5-year Construction Census undertaken by the U.S. Census Bureau provide useful information on the structure of the residential sector in terms of the distribution of the size of establishments, and the revenue generated per employee, which is a rough estimate of the productivity of these employees. The quarterly survey of expenditures for residential improvements and repairs undertaken by the U.S. Census Bureau tracks home improvement activity to owner-occupied as well as rental housing units, activities that generally are overlooked from their innovation potential.

Finally, monthly data on manufactured housing activity undertaken by the U.S. Census Bureau and HUD track activity in this important sector. Given the factory environment for the production of manufactured homes, there are numerous opportunities for innovation in production techniques. Comparable information in modular home production (homes built off-site but shipped to their site without a chassis like manufactured housing) would also be potentially helpful in understanding industry innovation.

Some data sources that held promise for understanding innovation in the industry already have been suspended. Until early 2006, the U.S. Census Bureau collected information on home improvement permits by permit issuing places, which facilitated the analysis of retrofit activity within small areas. However, the Census Bureau suspended this activity earlier this year in large part due to funding pressures.

## **Market Research Themes**

Each of these changing social, economic, and cultural phenomena justifies policy interventions in and of its own right. Together, they resoundingly demand action. For these

reasons, the next few years provide a unique opportunity to make significant inroads in increasing innovation in the home building sector by promoting research that builds off of the knowledge of the home building industry.

This policy paper provides suggestions for increasing innovation in the home building industry through public involvement and policies by leveraging industry's knowledge. Innovation can be increased through policies and initiatives that demonstrate a greater sensitivity to the structure, organization, and incentives of homebuilders and residential remodeling contractors. The five target initiatives to leverage information and knowledge from the home building community are presented below, with special attention on how the public sector plays a role in their development as both a generator and user of market research. These are presented in descending order of importance to the public interest.

### ***1. Performance Measures***

Probably no greater problem exists in trying to understand how innovation has affected residential construction than the near impossibility to measure definitively the impact of these innovations on industry performance. Conflicting estimates exist on the direction of trends in productivity in the construction sector, given that the Bureau of Labor Statistics does not compute productivity in this large and important sector of the economy. Productivity measures the relationship between labor inputs and output, and in the case of construction, both sides of this computation presents challenges. However, the lack of precise measurement certainly inhibits innovation, since it is nearly impossible to assess the overall impact of innovations without knowing how productivity is changing.

A commonly held perception is that productivity gains in construction have been low (or nonexistent) over the past several decades. Serious efforts to measure productivity trends in construction have not generated a consensus. (See for example Allmon, et al., 2000, and Teicholz, 2001.) The lack of a consensus of productivity in the industry almost certainly colors the perceptions of innovation in home building. Construction productivity studies have proven problematic in part because they have utilized aggregate data that often contains serious measurement flaws. An example is the measured amount of home improvement activity in the U.S. Two government surveys – the quarterly survey of residential improvements and repairs and the biennial American Housing Survey – generate estimates of homeowner improvement

activity that were recently estimated by the U.S. Census Bureau to be about \$40 billion or 48% different. While some of the difference was due to varying definitions, much of it could not be explained (Rappaport and Cole, 2003). The magnitude of these differences in output makes any effort to measure home improvement productivity suspect.

The development of such a database would allow the calculation of overall productivity in the residential sector, facilitate the analysis of trends at different stages in the business cycle, as well as permit comparisons across key housing segments (e.g., production housing construction, custom housing construction, high-rise multifamily construction, improvements to existing housing). Such measures would give industry leaders as well as policy makers better insight into the direction of the industry and whether innovations, in aggregate, are producing desired results.

Developing reliable information on productivity in residential construction is a significant undertaking. However, while detailed information on labor productivity in all phases of construction is the ultimate goal of this initiative, any reliable information on productivity levels for any type or facet of construction is an important start. The federal government could begin this effort in its own procurement process by requiring contractors of federal building projects to collect information on labor resources used as part of the construction process. If a blanket mandate covering all federal projects is deemed impossible, partial measures would still be helpful. Examples include bonus points in the selection process for bidders agreeing to collect the necessary productivity data or selected demonstration programs where such information is gathered.

By establishing performance metrics, the homebuilding industry would be able to set a standard and create a level playing field – the result being information relevant across stakeholder groups. The kinds of metrics in question, though, is expansive; these might run the spectrum from the physical and engineering performance of building systems and whole houses, to operational performance of homebuilding firms, to the research and development activities of manufacturers. For example, a set of best practices regarding improved business operations would allow for an evaluation of how home building product manufacturers and home builders are doing compared to competitors and other industries. The creation of an industry performance measure can outline the advantages and added value of innovation to builders' and manufacturers' bottom lines. Though there are a number of challenges involved, establishment

of new measures will help make the business case for new technology development and the advantages transparent to the market.

Yet, for many reasons described in other PATH documentation and in the literature on construction innovation, the industry has not been able to create performance metrics. This is likely due to two causes. The first is that there are no incentives for any one firm to take on such metrics and, as such, public intervention is required to provide for the common good. The second is the fact that extreme competition in the industry prohibits virtually all collaborations — particularly with regard to manufacturers' operations (though deterrents to proprietary exchange appear to be minimal). A neutral, non-regulatory third party such as public research and incentive programs fill in these gaps nicely.

While the public interest is served by both spurring market intelligence that might increase industrial R&D as well as evaluate other governmental programs, the need for government to produce such investigations also stems from its role as a common arbiter. Reliable, unbiased, and easily available information on home performance and industry productivity can only be provided by the public sector — though with significant industrial assistance.

## ***2. Value and Valuation of Housing Technology and Innovation***

Understanding the perceived value of housing technology and innovation is necessary to overcome existing barriers to innovation. Specifically, there are three types of perceived value worth investigating: consumer valuation, builder interpretation of value to projects, and builder perception on consumer valuation. While these are further explained in both of this project's complementary papers, the public interest in this theme requires some explanation.

The value to the public in how consumers and builders place value on technological change stems directly from its interests in both improving the condition of American housing (through incentives rather than regulation, to the greatest extent possible) and from decreasing the costs of housing in order to increase the number of households in actual housing. Knowing whether changes in production and products can alter the cost structure and, in turn, demonstrate improvements in the quality and/or increases in the quantity of homes is critical to all of the governmental programs that have either of these as a goal. Moreover, the simple measurement of that valuation is critical for creating industrial incentives — thereby spurring further cost considerations without additional public resources. Valuation of total homes and individual

building technologies in new and remodeled homes, then, requires significant — though not solely — governmental intervention. As a result, the case for tracking and analyzing the costs and values of housing innovation is readily made.

For whole homes, this project is almost self-explanatory. For individual technologies, this case is slightly more difficult. One reason that the home building industry and consumers are reluctant to embrace innovation is that there is little public objective information that documents the full benefits of an innovation. Little is known about how well construction products or processes perform over the lifecycle of a home. While the first cost of an innovation often can be estimated, the final cost of an innovation – to help determine its full benefit – often is missing. One reason for the success of the government’s Energy Star<sup>®</sup> program is that it gives consumers clear information on the ongoing energy consumption of products.

Databases, particularly longitudinal data bases, that provide information on housing quality and characteristics, energy consumption and efficiency, and modifications to the housing stock that affect their performance and cost of operation, are critical resources for the development of these performance metrics. The richest and most reliable databases traditionally have been publicly funded (e.g., the American Housing Survey, the Residential Energy Consumption Survey). However, industry data sources also are available that have not been fully utilized to evaluate the longer-term impact of home building innovations, and have the potential to supplement government efforts.

A clear goal of such individual product valuation comes in the basic provision of information; if builders or consumers are aware of the full costs and benefits of an innovation, they can make informed choices to meet their needs. With better information, they will implement the innovations that meet their objectives. Lack of this information adds risk to the decision and generally leads to more conservative, time-tested results that often are neither in their own best interests nor the best interests of the larger community.

Developing an effective monitoring system for assessing the impact of innovations is a three-step process. The first step is a systematic review of publicly available data sources to identify data items that can help to assess the long-term impact of innovation in home building.

The second step is to identify and review private data sources that can supplement public data sources in this effort. Typically, historical data derived from private data collection efforts is viewed as having less value than recently collected information, so data providers may be

willing to put it into the public domain at more modest costs. Because private sector historical data may be perceived as having less value than recently collected data, providers may be willing to put it in the domain at a more modest price. The willingness and costs of accessing private sector historical data sources needs to be assessed to combine with public domain data.

The third step is to identify the gaps in required information from the first two sources and creating a strategy for filling these gaps. Adding a few data items to existing surveys often can fill an existing data need. In other cases, a new data collection effort will need to be considered.

Supplemental information may be needed to develop these performance metrics, such as having product manufacturers document the performance of a product over its life cycle or having an outside testing and documentation agent assemble the information over the life-cycle of the home (through initial testing after installation, the documentation of builder call-backs and customer complaints, and periodic on-site assessments), in effect creating sort of a “Consumer Reports” for the home building industry. Since home builders may have little incentive to document the performance of a construction process, government agencies may need to provide incentives for this effort.

### ***3. Role and Interests of Other Players or Intermediaries***

Other parties are having or can have profound impacts on influencing housing innovation. The primary intermediary groups needing understanding fall into five major categories: technological (subcontractors, installers), distribution (dealers, suppliers), informational (media, retailers), financial (realtors, appraisers, lenders, and insurers), and regulatory (code officials). In order to add to the arsenal of knowledge to create additional demand and gain additional ‘influence agents,’ study is needed on the direct role these intermediaries play in influencing key players (consumers, builders and manufacturers) as well as the intermediaries’ own perceptions and valuation of innovation. Understanding these players’ motivations and roles can create further mechanisms for leveraging increased technology diffusion.

Insight into the role of these intermediaries directly shapes manufacturers’ and homebuilders’ ability to predict costs and sales — and, therefore, the ultimate costs of producing and purchasing homes. Yet again, because of the industry-wide nature of the research that would result from this insight, Symposium participants were not aware of individual firms doing this work. Collaborative work among industry firms — with the public sector as convener — could

be a good solution. It could also spur changes in those intermediaries' practices in the same ways that studies on homebuilder productivity and manufacturing efficiency improve those as well. Such changes could include:

- Improvements in subcontractor and installer training
- Expedited dealer and supplier transactions that lead to improved market choices
- More extensive media and retailers providers for builders and consumers
- Corresponding restructuring and reductions of mortgages and insurance premiums based on technological improvements
- Reduced regulatory barriers to innovations in code adoption and enforcement

One example of a current production change that requires public analysis is the increased use of installation services. More and more builders are using installation services from their distributor and manufacturer suppliers. Research from the Harvard Distribution Study (Joint Center, 2006) has determined that, although it varies considerably by product line, somewhere between a third and two-thirds of products purchased by larger builders (those that build 500 homes a year or more) are generally purchased installed, meaning that the product and installation are purchased together.

As common as this practice is becoming among certain types of builders and in certain areas of the country, little is known about the implications of this growing practice on construction cycle time and quality, competitiveness, labor needs, construction costs, supply chain integration, liability issues, and more generally the risks and rewards of having suppliers more involved in on-site construction. It may, in fact, be a subtle change where suppliers are absorbing subcontractor management responsibilities, or it may be the beginning of a more significant change in liability assignment and industry structure.

While it appears that supplier installation for home building and potentially even home remodeling is the wave of the future, little is known about the implications of this shift in the production process. An industry/government partnership could significantly enhance the diffusion of this process. However, the costs and benefits of supplier installation to the industry and to the economy are not well known. More focused analysis of this activity would inform decision-makers on its broader implications.

An evaluation of the benefits and costs of supplier installation programs for a range of different construction products is best undertaken with a field research study. Product manufacturers, distributors, and builders and contractors should all be involved in the study. A comparison of supplier installation with traditional builder crew/subcontractor installation would cover issues such as the following: efficiency of on-site installation (e.g., installation time frame, labor hours required for installation, total costs of installation); efficiency of supply chain integration (e.g., required inventory levels, communication and ordering issues, supply chain efficiencies); warranties and product liability issues; and life-cycle costing issues for products that are supplier installed.

Another example of housing practices with broader policy implications comes in the American building regulatory system. In recent years, there has been a growing interest in looking at government regulations to assess their impact on the level and cost of construction activity. (See for example PriceWaterHouseCoopers, 2005.) However, this research generally has not directly focused on the impact of these regulations on industry innovation. The residential permitting process, the development of building codes, and the implementation of land-use regulations all have the potential to encourage or hinder greater innovation in home building. To the extent that innovations may delay any of these processes, they become large risks and, therefore, a disincentive for the home builder. Often these are unintended consequences of the government agency charged with their implementation.

By explicitly measuring the potential impact of the permitting process, building codes, and land-use restrictions on innovation, there will be a better knowledge base on the ways these processes can encourage or discourage innovations. This will help to more directly consider the impact on the innovation process so that changes can be made to encourage even more innovation, or to mitigate unintended negative effects.

The building permit process, building codes, and land-use regulations can all vary significantly from jurisdiction to jurisdiction. The first step in this research is to review the breadth and depth of local variation. The second step is a thorough analysis of the range of permitting processes, building codes, and land-use regulations with an eye toward their impact on home building innovations. This effort would be used to identify those provisions and procedures that are particularly conducive to or discouraging of innovations. Before a more analytical research effort is undertaken, local officials, as well as representatives of the local

building industry, can provide useful insight as to the probable impacts of these local regulations on innovation.

Through these two examples alone, it is apparent that changes in all intermediary groups have significant public implications. As such, their analysis becomes a de facto need for public intervention.

#### ***4. Information and Knowledge Transfer***

Beyond barriers, it is critical to understand how information is *transferred* to those who will adopt the new technologies. Though study has been done on identifying barriers to innovation, there remains a critical knowledge gap in understanding how users actually get information. Getting insight into the behaviors, motives, and actions of consumers, in particular, is essential for governmental programs involved in market transformation. Once achieved, this knowledge is passed on to industry forces attempting the same.

The issues surrounding content and quality of information is a particular concern, and one in which government can play an active role. These include the level of information detail that is needed for a decision-maker to be able to pass judgment, as well as the manner in which it is delivered (i.e., in the form of marketing or sales information versus unbiased technical delivery). As stated in Eric Belsky's discussion within the NAS 2000 PATH Evaluation:

“Information asymmetries result when buyers and sellers in market transactions have different information. PATH could develop impartial, credible information that rates the quality and value of new technologies. PATH could support existing product evaluation programs and ongoing efforts to develop product evaluation methods. PATH could also assist in the development of programs to increase public awareness and to make information about housing technologies available to builders and consumers.”

In numerous focus groups for PATH's ToolBase information resource, builders and remodelers (as well as many architects, homeowners, and other homebuilding participants) have demonstrated that they have very specific needs and questions about innovations. Generally, smaller-scale innovators do not develop adequate materials for these decision-makers. Having unbiased, clear, and readily accessible information is not only critical but absolutely necessary for a technology to be introduced to decision-makers, to be considered, and to be decided upon.

Government has a clear role in producing comprehensive, accessible, non-commercial information on technologies.

### ***5. Data Collection Methods***

Data collection methods should be standardized to allow for data comparisons and easier analysis of known information. In order to make research and data collection most useful, consistent standards of study need to be identified and developed. Consistent data collection and new analysis methods will allow for more efficient data collection, comparison, analysis, and results. While this theme is not of direct public interest, the only venue for achieving accurate results in the other themes is to develop it. Improvements in data collection are critical for all sectors and often are demonstrated only by scholarly efforts funded with public monies.

### ***Summary***

All five of these themes require necessary public interventions in the current context described — due to the competitive nature of private sector research results, which are not usually shared in the public domain. Despite housing's importance in individual lives and family outcomes, it is a social phenomenon. More than almost any other industry, it deserves efficient public interventions that neither change regulations nor require ongoing public funds. Funding of preliminary market intelligence is one such intervention.

## **Plan and Schedule**

The following agendas and schedules are mirrored in the “Industry Agenda and Plan.” and allocate specific responsibilities between industrial and public parties for each of the five research themes.

### ***1. Performance Measures***

#### **Project A: Industry Performance Data**

<b>Research Strategy: Acquire Industry Performance and Market Segmentation Data</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
1.1 Create a Stakeholder Consortium	Medium	Public-Private					
<ul style="list-style-type: none"> <li>• Invite appropriate experts</li> <li>• Use group to identify data gaps</li> </ul>							
1.2 Aggregate Existing Information	High	Public					
<ul style="list-style-type: none"> <li>• Collect, categorize, and organize existing information</li> <li>• Leverage off existing data such as Departments of Commerce and Labor</li> <li>• Analyze existing data</li> </ul>							
1.3 Map Market	High	Public					
<ul style="list-style-type: none"> <li>• Use Consortium or other group to take existing results and map out market</li> </ul>							
1.4 Acquire Needed Data	High	Public-Private					
<ul style="list-style-type: none"> <li>• Identify data gaps</li> <li>• Acquire additional data using appropriate survey mechanisms and partnering</li> </ul>							

#### **Project B: Firm Performance Data**

<b>Research Strategy: Create Product and Process Performance Measures</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
2.1 Review current evaluation programs on diffusion and adoption processes	High	Public-Private					
<ul style="list-style-type: none"> <li>• Analyze current programs</li> <li>• Develop alternative models</li> </ul>							
2.2 Document private data sources	Medium	Public-Private					
2.3 Establish alternative research methods	High	Public					
<ul style="list-style-type: none"> <li>• Outline limitations of surveys</li> <li>• Create methods for research and data collection aligned with goals</li> </ul>							
2.4 Create independent information broker for results	Low	Public					

## Project C: Firm Performance Case Studies

<b>Research Strategy: Develop Business Process Best Practices (Including Success and Failure Information) In Homebuilding Product Manufacturing Sector Applications</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
7.1 Convene a consortium of homebuilding product manufacturers	Medium	Public					
7.2 Establish collaboration with business schools	Low	Public-Private					
<ul style="list-style-type: none"> <li>• Gather business information</li> <li>• Document data collection</li> </ul>							
7.3 Collaborate with research groups	Medium	Public					
<ul style="list-style-type: none"> <li>• Analyze results</li> <li>• Prepare final outcome for third-party credibility</li> </ul>							
7.4 Create case studies	Medium	Public					

## 2. Value and Valuation of Housing Technology and Innovation

### Project A: Valuation of Technologies

<b>Research Strategy: Research the Effects of New Technologies on Asset Performance</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
3.1 Determine focus group/area	Medium	Public					
<ul style="list-style-type: none"> <li>• Analyze current housing programs that include new technologies</li> <li>• Set a representative sample for investigation</li> </ul>							
3.2 Acquire baseline data	Medium	Public					
<ul style="list-style-type: none"> <li>• Gather safety and operating data of sample</li> </ul>							
3.3 Conduct market research tracking increases in innovative home value	Medium	Public-Private					
<ul style="list-style-type: none"> <li>• Track resale value of sample</li> </ul>							
3.4 Conduct studies of customer satisfaction	High	Private (lead)					
<ul style="list-style-type: none"> <li>• Gather market data on real estate agents' preferences and satisfaction with new technologies</li> <li>• Use customer satisfaction studies</li> </ul>							

## Project B: Consumer Valuation Models

<b>Research Strategy: Conduct Market Research on Consumers: Characteristics, Decision-Making Process, and Motives for Adopting New Technologies</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
5.1 Create public/private partnership group <ul style="list-style-type: none"> <li>Gather existing consumer demographic and preference data</li> <li>Determine data gaps</li> </ul>	Medium	Public					
5.2 Set study sample and research methodology	Medium	Public					
5.3 Conduct market research, examining the following areas <ul style="list-style-type: none"> <li>Knowledge of housing technologies</li> <li>Behavior drivers</li> <li>Interaction with technology</li> <li>Sources for information</li> </ul>	Medium	Public					
5.4 Analyze results and disseminate widely	Medium	Public					

### 3. Role and Interests of Other Players or Intermediaries

## Project A: Intermediary Surveys, Modeling, and Simulation

<b>Research Strategy: Conduct Market Research Studies to Understand How Intermediaries Drive Innovation</b>							
<b>Proposed Action</b>	<b>Recommended Priority</b>	<b>Recommended Funding Source</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
4.1 Document existing information <ul style="list-style-type: none"> <li>Aggregate existing research on suppliers (as first group for study, can be expanded to other intermediaries based on funding, etc.)</li> <li>Analyze results and identify data gap areas</li> </ul>	High	Public					
4.2 Set study sample <ul style="list-style-type: none"> <li>Establish study group and research methodology</li> </ul>	High	Public					
4.3 Conduct market research determining supplier preferences, communication methods with manufacturers and builders, information exchange, etc. <ul style="list-style-type: none"> <li>Analyze results</li> </ul>	High	Public-Private					
4.4 Determine supplier impact on profitability	High	Private (lead)					

#### 4. Information and Knowledge Transfer

##### Project A: Intermediary Surveys, Modeling, and Simulation

Research Strategy: Conduct Studies on the Acquisition and Knowledge Transfer of Innovation Information							
Proposed Action	Recommended Priority	Recommended Funding Source	2006	2007	2008	2009	2010
6.1 Aggregate existing information	High	Public					
6.2 Conduct multi-stage study	High	Public-Private					
<ul style="list-style-type: none"> <li>• Establish research methodology</li> <li>• Identify and model the transfer of knowledge about new products</li> <li>• Identify best practices</li> </ul>							
6.3 Document sources of data	Medium	Public					
<ul style="list-style-type: none"> <li>• Identify data sources for technology measures</li> <li>• Identify methods for generating information</li> </ul>							
6.4 Create case studies	High	Public					

#### 5. Data Collection Methods

There are no specific projects offered relating to government at this time because this theme is not of direct public interest. However, the only venue for achieving accurate results in the other themes is to develop it. Improvements in data collection are critical for all sectors and often are demonstrated only by scholarly efforts funded with public monies.

#### Next Steps

Applying the market research strategies and answering the questions above will develop a better, and necessary, understanding of the challenges that lie ahead in increasing development and use of new housing technology. The challenge described in this paper lies in the ability of public sector participants to agree both to joint research agendas, and then ensuring that private sector projects are timed with those commitments. With a full analysis of the private sector aspects of this work being described in a separate paper authored by McGraw-Hill Construction, such coordination will be more feasible.

While the need for intervention to improve housing innovation is argued and supported by most of the literature, it is still not clear why government should play a role in that intervention. Just as importantly, we need to know who in government should play the role.

Also, it is unclear how that should happen given both precedents for government's involvement in industrial and economic growth and the unique structure of the homebuilding industry.

Understanding whether government should have a role in industrial innovation is a fundamental concern. Historically, the Federal government has been involved in a wide variety of housing-related activities, including “making homes more affordable to build, safer to live in, and less costly to maintain and operate.” Part of these policies has included sponsoring research in housing design, construction, and maintenance, and in setting standards for the same. The government has also been concerned with barriers that impede further housing development and homeownership. When it comes to looking at barriers to innovation, then, current public sector debates about this issue follow a long tradition on both fronts.

If we assume that public goods are not diminished by any one individual's use despite being made available to all, information on housing performance and quality is one such public good. It is in the public interest that all manufacturers producing building materials and systems subscribe to similar standards, and because private producers will be unable to recoup the costs of creating standards, it is appropriate for the government to establish the standards for building materials and systems.

Collaboration is needed. Manufacturers, builders, and homeowners need incentive to bear the full cost and risk of investing in this type of market research. Market research assistance — including coordinating shared investments, educating and disseminating housing participants, and reducing local barriers such as building codes — could help with new product market penetration. Additionally, many builders and homeowners make decisions and purchases with different levels of information. The need for non-commercial, impartial information on innovation and the markets for innovation is critical to overcome these asymmetries.

The case for governmental intervention in R&D has been made in numerous historical instances in the past century — particularly in those instances when industry cannot reap the profits from such endeavors. As has been repeatedly demonstrated, accelerating the adoption of new technology into housing is an ongoing challenge, one that is complex and dynamic. To overcome that challenge, both industry and government need clarity and understanding of the R&D and market adoption process, interaction and influences of different industry players, and their patterns of behavior. However, that understanding comes only from sound market research data collection.

Market intelligence allows government and the public sector to successfully influence innovation adoption, and it presents the private sector with an unbiased assessment of the market opportunity and competitive advantages of innovation. Through collaborative studies, such as those suggested in this project, housing producers and analysts of all kinds will be better equipped to meet that challenge.