Building Better Homes At Lower Costs

The Industry Implementation Plan for the Residential National Construction Goals

Prepared for

U.S. Department of Housing and Urban Development
451 Seventh Street, SW
Washington, DC 20401

by

NAHB Research Center, Inc.
400 Prince George's Boulevard
Upper Marlboro, MD 20774

January 13, 1998

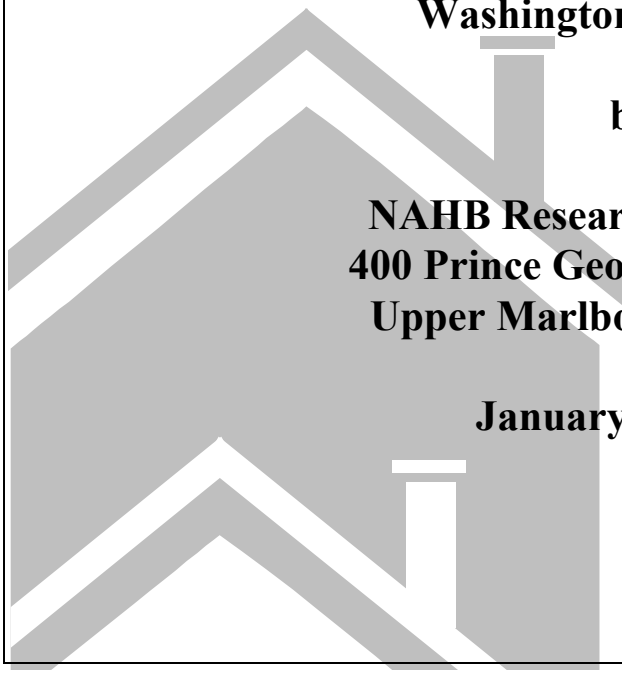


TABLE OF CONTENTS

Acknowledgements

The U.S. Department of Housing and Urban Development and the NAHB Research Center, Inc. would like to thank the following individuals for their participation:

Hank Adler (builder), Kathleen Almand (Civil Engineering Research Foundation), Andy Anderson (Anderson Construction Services), Gary Bachula (U.S. Department of Commerce), Tom Bee (Office of the Secretary of Defense), Richard Belle (Civil Engineering Research Foundation), Mark Bernstein (Office of Science and Technology Policy, White House), Peter Billing (Insurance Institute for Property Loss Reduction), Walt Bilinski (GE Plastics), Liza Bowles (NAHB Research Center), Pat Bridges (Bridges & Associates), Brian Burrows (USG), Nelson Carbonell (U.S. Department of HUD), Gerald Carlisle (International Union of Bricklayers and Allied Craftsmen), Dan Cautley (NAHB Research Center), Bill Connolly (New Jersey chief code official), Mari C∗t■ (NCSBCS), Jay Crandell (NAHB Research Center), David Dacquisto (NAHB Research Center), Bill Duncan (The Enterprise Foundation), David Engel (U.S. Department of HUD), Charles Field (NAHB), Andy Fowell (National Institute of Standards and Technology), Bob Fowler (City of Pasadena), William Freeborne (U.S. Department of HUD), Tom Frost (BOCA International), Angela Garcia (Housing Subcommittee), Wesley Giles (HBA of Greenville, SC), Bill Gilmartin (The Jefferson Group), Burton Goldberg (NAHB Research Center), Rose Geier Grant (State Farm Insurance), Miles Haber (builder), Pat Hamill (Oakwood Homes), Bob Hanbury (House of Hanbury Builders), Dave Harris (National Institute of Building Sciences), Dick Hauer (Andersen Corporation), Paul Heilstedt (BOCA), George James (U.S. Department of Energy), Larry Kaetzel (National Institute of Standards and Technology), Richard Karney (U.S. Department of Energy), Earle Kennett (National Institute of Building Sciences), Will Kirksey (Civil Engineering Research Foundation), Ray Kothe (Kothe & Hart), Dick Kuchnicki (Council of American Building Officials), Nancy Libson (Housing Subcommittee), John Martin (National Institute of Standards and Technology), Dan Mandelker (AICP), John Mervine (Nanticoke Homes), Melvin Myers (NIOSH), Mike Myers (U.S. Department of Energy), Tom Newton (CertainTeed Corp.), Chuck Nichols (Civil Engineering Research Foundation), Cliff Oliver (FEMA), Kent Reed (National Institute of Standards and Technology), Tom Rutherford (Office of the Secretary of Defense), Brian Sherry (GE Appliances), Robin Snyder (U.S. EPA), John Talbott (U.S. Department of Energy), Robert Wible (NCSBCS), David Wismer (City of Philadelphia), Jim Work (Armstrong World Industries), Richard Wright (National Institute of Standards and Technology), Larry Zarker (NAHB Research Center), and Joel Zingeser (National Institute of Standards and Technology).

Executive Summary

Economists and other housing experts have long recognized the link between homeownership rates and the overall health of the U.S. economy in both the domestic and international arenas. A decline in homeownership rates typically signals a mismatch between housing prices and the income of potential homebuyers; moreover, it produces ripple effects felt throughout all sectors of the economy. The most immediate result of the housing price/income mismatch is that entry-level buyers are eliminated from the market and construction activity slows. Ramifications extend not only to societal impacts associated with quality of life but also to the Gross Domestic Product GDP and the unemployment rate. According to Harvard University's Joint Center for Housing Studies, residential construction and investment combined with housing consumption and related expenditures accounts for 20 percent of Gross Domestic Product annually.

In recognition of the role of housing in the U.S. economy and the housing cost/housing price relationship, the White House in 1994 convened representatives from all segments of the nation's construction industry to consider a broad set of National Construction Goals. As a result of that meeting, the residential segments of the construction industry assigned highest priority to the two following goals:

- To reduce production costs through improved technology.
- To improve product durability.

Inextricably linked to the role of technology, both goals address the direct connection between the material and process inputs to housing and the performance of the structure as related to the home's cost-effectiveness and efficiency and its impact on the natural environment. The application of advanced technologies to home building can reduce or bring in line housing costs such that the greatest number of entry-level households can enjoy access to the housing market even as the construction and operation of the unit preserve, protect, and even enhance the quality of the natural environment. Already, several important technological advances have demonstrated their operational, functional, and environmental benefits.

To address the above goals, the residential segment of the construction industry—as represented by home builders, code officials, product manufacturers, and other interested parties—developed a plan for implementing the National Construction Goals in the context of a supporting research agenda. In particular, the residential segment representatives specified the following seven strategic approaches, listed in priority order, for achieving their high-priority goals:

STRATEGIC APPROACH #1

✔ Establish and maintain an information infrastructure responsive to the needs of builders, designers, subcontractors, manufacturers, code officials, and consumers.

STATEGIC APPROACH #2

✔ Develop and implement improved methods for assessing and increasing the durability of specific types of building products.

STRATEGIC APPROACH 3

- ✔ Improve the efficiency of the housing production process.

STRATEGIC APPROACH #4

- ✔ Improve the efficiency of the regulatory and new product approval processes.

STRATEGIC APPROACH #5

- ✔ Develop an improved understanding of the performance of conventionally built light-frame structures.

STRATEGIC APPROACH #6

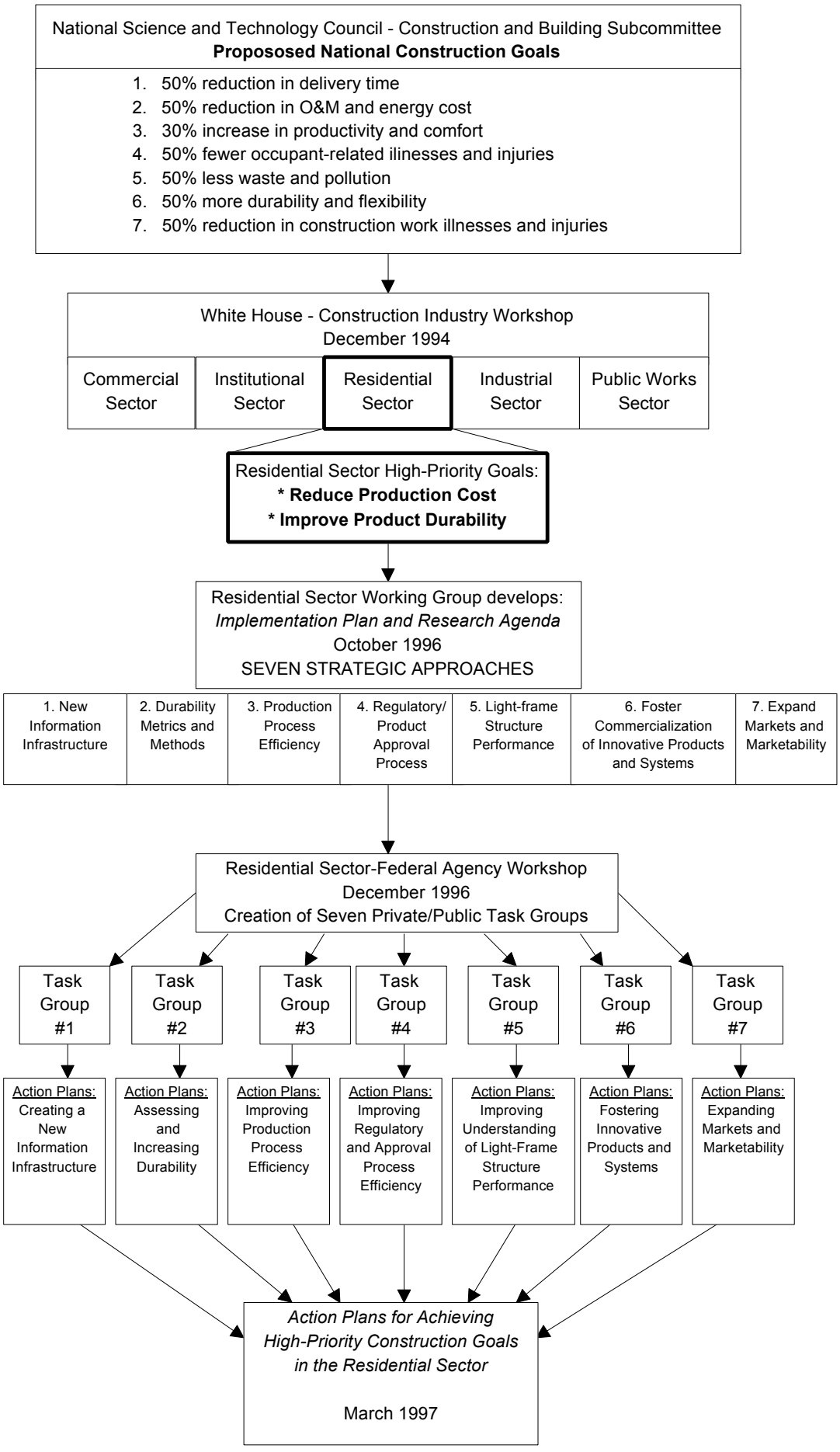
- ✔ Foster the development and commercialization of innovative products and systems based on input from the building community.

STRATEGIC APPROACH #7

- ✔ Expand markets and marketability for products and systems that reduce costs or improve durability.

The representatives recognized, however, that merely developing a plan and research agenda was insufficient to achieving the two high-priority goals. Instead, the plan had to account for the several barriers to innovation that have historically plagued the residential construction industry and have branded the industry as less inclined to innovate than other industries. Commonly cited barriers include but are not limited to fragmented industry structure, liability exposure, the building industry's cyclical nature, and the lack of access to information,

Most recently, a Residential Sector/Federal Agency Workshop met to take the next steps in addressing the two high-priority goals. Participants confirmed the priority already assigned to the seven strategic approaches and formed seven task groups to address each of the strategic approaches. This document sets forth the plans and action agendas developed by the task groups.


National Science and Technology Council - Construction and Building Subcommittee
Proposed National Construction Goals
1. 50% reduction in delivery time
2. 50% reduction in O&M and energy cost
3. 30% increase in productivity and comfort
4. 50% fewer occupant-related ilinesses and injuries
5. 50% less waste and pollution
6. 50% more durability and flexibility
7. 50% reduction in construction work illnesses and injuries
White House - Construction Industry Workshop
December 1994
Commercial Sector
Institutional Sector
Residential Sector
Industrial Sector
Public Works Sector
Residential Sector High-Priority Goals:
* Reduce Production Cost
* Improve Product Durability
Residential Sector Working Group develops:
Implementation Plan and Research Agenda
October 1996
SEVEN STRATEGIC APPROACHES
1. New Information Infrastructure
2. Durability Metrics and Methods
3. Production Process Efficiency
4. Regulatory/ Product Approval Process
5. Light-frame Structure Performance
6. Foster Commercialization of Innovative Products and Systems
7. Expand Markets and Marketability
Residential Sector-Federal Agency Workshop
December 1996
Creation of Seven Private/Public Task Groups
Task Group #1
Task Group #2
Task Group #3
Task Group #4
Task Group #5
Task Group #6
Task Group #7
Action Plans: Creating a New Information Infrastructure
Action Plans: Assessing and Increasing Durability
Action Plans: Improving Production Process Efficiency
Action Plans: Improving Regulatory and Approval Process Efficiency
Action Plans: Improving Understanding of Light-Frame Structure Performance
Action Plans: Fostering Innovative Products and Systems
Action Plans: Expanding Markets and Marketability
Action Plans for Achieving High-Priority Construction Goals in the Residential Sector
March 1997

BUILDING BETTER HOMES AT LOWER COST

The Industry Implementation Plan for the Residential National Construction Goals

Growth in housing production is the hallmark of a strong national economy. A healthy, efficient, and technologically advanced home building industry can help foster a strong role in international trade and a vigorous domestic market. In recognition of the central role played by housing and other construction activities in the U.S. economy, the federal government set forth a set of seven National Construction Goals in early 1994. The seven goals were the product of lengthy deliberations between the construction industry and the Construction and Building Subcommittee of the National Science and Technology Council. The council is a Cabinet-level group charged with setting federal technology policy, including coordination of R&D strategies across a broad cross-section of public and private interests. The Construction and Building Subcommittee established a target date of 2003 by which time the technologies necessary to achieve the goals would be developed and available for use by the construction industry.

The White House convened a Construction Industry Workshop in December 1994 involving representatives of various segments of the construction industry and the federal agencies whose mission relates to housing. The purpose of the workshop was to obtain feedback on the National Construction Goals. The participants reached general agreement on the importance of setting the goals and using them to guide public and private building technology research. The group also recognized that the federal government assigned relatively low priority to construction industry research and concluded that the process of reaching consensus on goals could help elevate research to a higher-priority position.

The Original Seven National Construction Goals

- 50 percent reduction in project delivery times;
- 50 percent reduction in operations, maintenance, and energy costs;
- 30 percent increase in occupant productivity and comfort;
- 50 percent fewer facility-related illnesses and injuries;
- 50 percent less waste and pollution;
- 50 percent greater durability and flexibility; and
- 50 percent reduction in construction illnesses and injuries.

In addition, the participants agreed that construction was too large and diverse an industry to be treated as a single economic sector. Therefore, separate groups formed to represent the residential, commercial, institutional, industrial, and public works segments of the construction industry. The groups reviewed the National Construction Goals, established priorities for their respective industry segments, and developed research agendas and action plans for achieving the highest-priority goals designated by the groups. The NAHB Research Center served as secretariat for the group representing the residential segment of the construction industry. Other participants in the residential component of the workshop included home builders and remodelers, product manufacturers, code officials, and federal agency representatives.

The residential group reviewed the National Construction Goals from the perspective of its specific segment of the construction industry. While it affirmed that all seven goals are significant to the construction industry and the economy, it identified the following two goals as highest priority for immediate action:

❶ To reduce production costs through improved technology and shortened production cycle time,

❷ To improve product durability.

In endorsing these two high-priority goals, the residential sector working group emphasized the importance of reducing barriers to the development and acceptance of new technologies as one of the most significant methods for achieving these goals.

The group also emphasized the importance of recognizing the structure of the industry in the design of implementation strategies. The home building industry is characterized by many relatively small firms that operate over limited geographic areas and rely heavily on subcontractors to perform most on-site work. Indeed, the profile of the industry is unlikely to change because of the ease of entry into the industry, the number of workers with a background in construction who wish to start their own businesses, the cyclical nature of production, and the difficulties in achieving economies of scale in an industry where each local market is distinguished by unique characteristics, land development and building regulations, and zoning rules. It is particularly difficult to conduct large-

Overview of Residential Construction Research

In a recent report to Congress, total 1992 expenditures on housing technology research in the United States were estimated at $359 million, approximately 85 percent of which was funded by the private sector, 8 percent by the federal government, and 7 percent by other sources such as state and local government, universities, and nonprofits. This represented about 0.2 percent of the total value of new housing construction for that year. Nearly all of the private sector research ($287 million) was conducted by material and product manufacturers while nearly half of the federally sponsored research was funded by the Department of Energy ($14 million). Home building firms were estimated to spend a total of less than $10 million per year on R&D. Comparative data indicated that expenditures on housing technology research were significantly higher as a percent of sales and on a per capita basis in Canada and Japan than in the United States.

A 1993 report estimated total U.S. funding for all construction-related R&D at $2.1 billion in 1992, or about 0.5 percent of the value of all construction put in place during the year. Of that total, $1.3 billion was funded by the federal government, with the Department of Energy as the single largest sponsor ($553 million). That report also cites a 1986 study that estimated total construction R&D as 0.38 percent of annual sales.

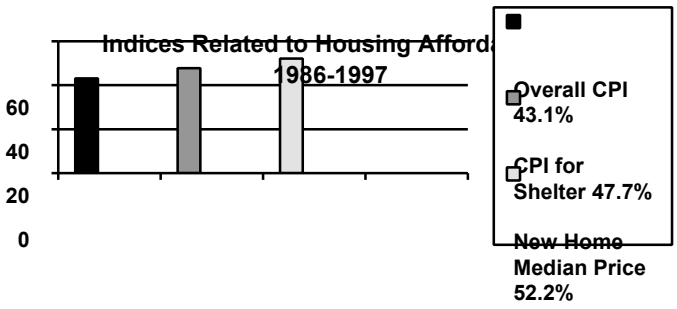
A third source is the "R&D Scoreboard" published in *Business Week*. The 1992 composite level of R&D for "all industry" was 3.7 percent of sales compared to an estimated 4.5 percent of sales for foreign corporations. Within U.S. industry, areas with relatively higher R&D outlays as a percentage of sales included aerospace (4.4 percent), automotive (4.0 percent), electrical and electronics (6.0 percent), health care (9.7 percent), and office equipment (8.4 percent). In that survey, R&D in the "housing" group was estimated at 1.8 percent of sales based on total sales of $27 billion. The survey was limited to publicly traded firms with at least $58 million in annual sales and at least $1 million in annual research expenditures. Obviously, it excluded the vast majority of residential construction, but the results still indicate that R&D activities in other industries are substantially higher than R&D among the largest producers of materials and products used in housing.

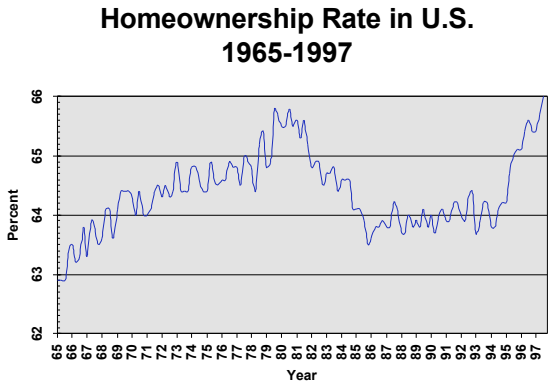
All of these studies are limited by a lack of data from many sources on their R&D activities and difficulty in disaggregating or attributing broadly defined R&D to specific ends. Yet, a general consistency in the conclusion points out that the R&D activity in the United States focused on construction in general, and residential construction in particular is relatively low as a percentage of sales compared to other industries and in comparison to other industrialized countries.

scale operations where land is not available in large parcels and where home building has traditionally occurred on individual customer lots.

Goal #1 Reduce production costs through improved technology and shortened production cycle time

The cost of producing homes has always been a concern to home builders. Higher costs lead to higher selling prices, which in turn limit demand and marketability. The link between higher costs and higher selling prices is especially problematic under the prevailing mortgage system in that both the cash downpayment and monthly mortgage payment required to buy a home increase with selling price. A potential buyer who cannot accumulate the required downpayment and closing costs or whose income is insufficient to cover mortgage payments based on standard qualifying ratios is automatically excluded from the housing market. As shown in the accompanying graph, trends in home prices have been unfavorable to buyers for many years. Over the past decade, the price of a new home as measured by various indices in the graph has increased faster than the overall rate of inflation. Fortunately for the homebuyer, these price increases have been offset by low interest rates.





Source: U.S. Bureau of the Census, Series H-111

The residential construction group recognized the importance of delivery time as a factor in reducing costs but also acknowledged that other important factors affect housing costs. Thus, the group kept reduction in delivery time as an important part of Goal #1 but also broadened the goal to include technology innovations in all areas related to production costs.

Several variables contribute to the cost of producing housing, including land, site development, construction labor, materials, utility hook-ups, impact fees, permits, and all the overhead costs of equipping and operating a building company. Many direct costs are driven by the choice of products, systems, and construction techniques and can be reduced through improved technologies. As identified in the original National Construction Goals, other costs relate to the length of time or cycle time that is required to build a project. Therefore, reducing production costs increases the pool of eligible buyers. Particularly in the starter home market, an expanding pool of buyers makes move-up homes more affordable by freeing up lower-priced houses for resale to entry-level buyers.

The National Home Ownership Strategy:
Partners in the American Dream

Between 1940 and 1980, the rate of homeownership in the United States increased from 43.6 percent of all households to 65.6 percent; however, ownership rates began to decline in the early 1980s. Under a directive from President Clinton, the U.S. Department of Housing and Urban Development issued a new national goal of 67.5 percent homeowership by the end of 2000 as part of the National Home Ownership Strategy. A 1995 report, *The National Home Ownership Strategy: Partners in the American Dream*, lists 100 action items that can help expand homeownership opportunities. Specifically, many are designed to reduce or contain construction costs. The action items are closely related to the strategies developed to meet the National Construction Goals.

Selected Action Items Related to the National Construction Goals

- Assess regulatory impacts on affordable homeownership.
- Initiate affordable home design and construction awards.
- Improve the evaluation process for home-building products.
- Initiate an affordable home technology program.
- Create a fast-track administrative review system for starter homes.
- Provide information, training, and technical assistance for innovative technologies.
- Expand technical evaluation of home-building products.
- Conduct research on technical innovation for affordable homes.

Goal #2 Improving product durability

Houses are expected to be highly durable goods so long as owners provide reasonable maintenance. Examples abound of homes that have remained in service for 100 years or longer. Yet every year, for a variety of reasons, houses are removed from the housing stock. Some removals result from economic obsolescence when a homesite becomes more valuable for other than residential uses. Other times, removals are necessitated by major damage from catastrophic events such as high winds, earthquakes, fires, or explosions. Many other homes experience progressive deterioration from causes such as water damage or wood-destroying insects that ultimately render the structures unserviceable and economically infeasible for rehabilitation. Preventing these types of damage or deterioration can extend the life of existing housing stock and increase the overall supply of housing.

Another important set of product durability issues involves the performance of components or systems that may need repair or replacement during the life of the house. Such components include siding, roofing, flooring, equipment, appliances, and finishes. Where replacement cost is high, premature failure has serious implications for the owner or occupant

During the last decade, a growing number of products failed to meet durability expectations. Examples include FRT

Life Expectancy of Typical Home Features

Asphalt roof shingles	**15-30 years**
Vinyl siding	**50 years**
Electric water heater	**14 years**
Interior wall paint	**5-10 years**
Window glazing	**20 years**
Wooden deck	**15 years**

Source: NAHB, *"Housing Facts Figures and Trends, 1997."*

plywood, some types of siding, and selected sidewall vents for furnaces. While there is no question that the failures occurred, the result has been controversy and litigation over whether particular failures are due to deficiencies in design, manufacture, installation, or maintenance. Avoiding premature failure is an important part of improving durability. Nonetheless, not every product can or should be designed for an indefinite service life. For some items such as carpeting or inexpensive floor coverings, styles or preferences change such that periodic replacement may be acceptable. Even so, it is important to achieve reasonable predictability of service life.

Though not mutually exclusive, production costs and product durability often demand a tradeoff. Yet, expanding the opportunities for improvement in both directions will allow consumer preferences, market forces, and the regulatory environment to influence the ultimate degree to which today's technical innovations become tomorrow's common practice.

DECEMBER 1994 WORKSHOP PARTICIPANTS

In December 1994, the White House-Construction Industry Workshop on National Construction Goals was held in Washington, DC. Approximately 60 construction industry leaders participated in the workshop. Following are participants of the residential sector group:

Brian Sherry (GE Appliances), Paul Heilstedt (BOCA), Gerald Carlisle (International Union of Bricklayers and Allied Craftsmen), Robert Wible (NCSBCS), Bill Connolly (New Jersey chief code official), David Engel (HUD), Dan Mandelker (AICP), Burton Goldberg (NAHB Research Center), Miles Haber (builder), David Dacquisto (NAHB Research Center), Liza Bowles (NAHB Research Center), Melvin Myers (NIOSH), Hank Adler (builder), Walt Bilinski (GE Plastics), and Brian Burrows (U.S. Gypsum).

Industry Response: Implementing the Residential Goals

After the residential construction group established the goals of reducing costs and improving durability, a cross-section of home builders, code officials, product manufacturers, and other interested parties participated in a series of meetings and discussions to prepare a plan for implementing the goals and to develop an accompanying research agenda. The group identified and assigned priority to **Seven Strategies** for achieving the two high-priority goals within the residential construction segment of the construction sector.

The Seven Strategies

PRIORITY #1

- ✔ Establish and maintain an information infrastructure responsive to the needs of builders, designers, subcontractors, manufacturers, code officials, and consumers.

PRIORITY #2

- ✔ Develop and implement improved methods for assessing and increasing the durability of specific types of building products.

PRIORITY #3

- ✔ Improve the efficiency of the housing production process.

PRIORITY #4

- ✔ Improve the efficiency of the regulatory and new product approval processes.

PRIORITY #5

- ✔ Develop an improved understanding of the performance of conventionally built light-frame structures.

PRIORITY #6

- ✔ Foster the development and commercialization of innovative products and systems based on input from the building community.

PRIORITY #7

- ✔ Expand markets and marketability for products and systems that reduce costs or improve durability.

As part of its effort to develop the seven strategies, the residential construction group recognized that housing is influenced by many variables that extend from planning, zoning, and land development to the actual construction of the home. The group ultimately placed its emphasis on technology and innovation as related to housing design, products, systems, materials, management, and regulation of the construction process. The group did not specifically include zoning, land use planning, and environmental regulation in the scope of its report but did recognize that these issues influence housing costs and durability.

Successfully achieving the two highest-priority goals for the residential construction industry will yield results that in turn will help government and the other sectors of the construction industry achieve the remaining National Construction Goals. For example, the successful creation of an information infrastructure will provide a vehicle for gathering and disseminating information necessary to achieve all seven National Construction Goals. Likewise, durability improvements in housing can result in reduced operation, maintenance, and energy costs in the residential and other segments of the construction industry.

BARRIERS TO INNOVATION

During its series of meetings, the residential construction group identified research, development, and demonstration activities needed to implement each strategy. At the same time, the participants recognized the importance of understanding the barriers to implementing the strategies before undertaking specific activities can be undertaken. For example, in the home building field as in others, barriers to innovation have hampered the widespread use of many currently available innovative building products and methods. In all likelihood, other useful innovations have not been developed because of the perception that the industry will respond slowly, if at all, to their availability.

Reducing barriers to innovation and expanding and improving R&D can stimulate technology advances. In turn, barrier reduction helps spur demand while R&D helps expand supply. Even barriers that cannot be mitigated should be understood because they contribute to the environment of innovation. To gain a better understanding of the issues surrounding the seven strategies and their implementation, the residential construction group included a section in its report on barriers that must be understood and addressed.

Eight widely recognized barriers to innovation in home building are listed below. In several instances, paths to mitigation, where they exist, are described briefly as part of the discussion of the barrier. Other barriers are directly addressed by the strategies and action items that are described in detail in the following section.

Barrier 1: Fragmented Industry Structure

The home building industry is complex and fragmented. The chain of production extends from raw material suppliers and product manufacturers through distributors, wholesalers, or retailers to home building companies and trade contractors. In addition to supplying builders, manufacturers sell products to commercial contractors, remodelers, and do-it-yourselfers.

Most homebuilding firms and trade contractors are too small to invest in R&D. While manufacturers command the resources to perform R&D, their ability to understand and meet the needs of home builders is diminished by inadequate communications links. In addition, most manufacturers and suppliers specialize in a small number of products or materials which restricts opportunities for systems-related research.

In this environment, there is no clear process for defining needs. Better communications extensively addressed in the discussion of Priority #1 made possible by establishing an information infrastructure in concert with the accompanying program recommendations can make a substantial contribution to overcoming the barrier posed by industry fragmentation.

Barrier 2: Exposure to Liability

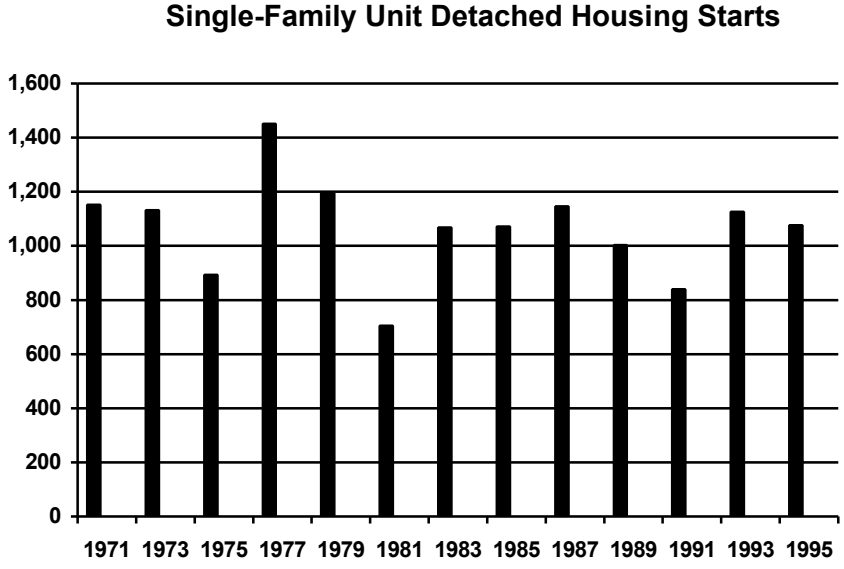
Fear of litigation and the potential expense of call-backs for repair or replacement of defective products discourage manufacturers from introducing new products, discourage builders from using them, and discourage regulators from approving them. Litigation involving building products has become more widespread and has driven some products off the market. Manufacturers find it difficult or impossible to obtain product liability insurance for either a limited period following introduction or on an ongoing basis.

Portions of Priority #2 relating to product durability address the barrier posed by liability exposure. Product failure can be reduced through more comprehensive testing of innovations before their introduction, particularly field testing under conditions where installation quality and interactions with other products and systems can be assessed. Warranty protection and strong manufacturer support can help overcome builder reluctance to adopt innovations.

Manufacturers and builders would benefit from improved and continuing feedback on user experiences with products. All parties would benefit from tort reform that would clarify potential liabilities and limit the rule of joint and several liability for damages.

Barrier 3: Cyclical Nature of Construction

The number of housing starts varies widely over the course of the business cycle. While many factors are involved, one major contributor is the impact of interest rates on the cost of home financing. Shifts in short-term interest rates to speed up or slow down the economy can influence long-term rates and thereby home buying.



Source: Bureau of the Census, *Current Construction Reports, Series C-20, Monthly.*

The business cycle adversely affects the capability of the home building industry to conduct R&D. While product manufacturers may take a longer-term view, they must consider the possibility that sales of new products, already subject to hazards of potentially slow acceptance, may be further jeopardized by the unpredictability of economic downturns and their impact on home building.

The barrier posed by the cyclical nature of construction involves economic forces and trends beyond the control of the building community but constitutes part of the environment of innovation.

Barrier 4: Lack of Access to Information

Building products are increasingly marketed through wholesalers and mass merchandising outlets rather than directly by manufacturers' representatives. This arrangement has reduced builder access to technical information and support. Builders who might be interested in using a new product must search for information in an environment in which time means money. Not surprisingly, many builders prefer to stay with familiar products and methods. The barrier posed by insufficient access to information is addressed in action items under Priority #1 relating to communications.

Barrier 5: Need for Education and Training

The several members of the homebuilding team—architects, designers, home builders, workers, trade contractors, installers, plan reviewers, and inspectors—need to know the characteristics of products and materials, proper installation techniques, and correct methods for operation and maintenance. Learning "on the job," which is the main method of education and training in home building, is not conducive to technological change. Programs of more formal education and training can help reduce resistance to the introduction of innovative products and help ensure that such products are used successfully.

Barrier 6: Building Code and Product Approval Systems

Product developers may find it difficult to determine the performance criteria that new products must meet. They may be discouraged by the prospect of working in local jurisdictions that require regulatory acceptance. For innovative products and systems to enter home building, they must gain the approval of local code authorities. Local codes are generally based on the three major model U.S. codes and/or the Council of American Building Officials *One- and Two-Family Dwelling Code*. However, requirements can differ for reasons that include use of different code editions, local amendments or locally developed variants, or inconsistent interpretations.

Each of the model code groups operates a product evaluation system that is intended to facilitate new product introduction and promote uniformity. However, the evaluation is limited to compliance with the model code offering the service, and the results are advisory only.

U.S. Building Codes: A Changing Environment

Even as the National Construction Goals were undergoing development, changes were occurring in the system that has historically governed U.S. building codes. Over the last few years, the model building code groups have formed the International Code Council. They are currently developing the International Building Code and the International Residential Code, which are eventually expected to replace the three regional building codes and the Council of American Building Officials *One- and Two-Family Dwelling Code.*

The barrier posed by the building code and product approval system is directly addressed by Priority #4, relating to improving the efficiency of the regulatory and new product approval processes.

Barrier 7: Limited Funding for Nonproprietary Research

Privately funded research in the building industry is almost exclusively proprietary; that is, private companies undertake the research and enjoy exclusive rights to the profits through patents and copyrights. The system creates an incentive for product and system innovation, but the incentive does not extend to innovations that cannot be protected. Types of innovation that are unlikely to emerge from this environment include methods for improving design, scheduling, coordination of trades, waste management, and management practices that produce quality improvement. Public funding and public/private collaboration are required to promote non-proprietary innovation. This issue is addressed in the discussion of Priority #6 relating to the development of innovative products and systems.

Barrier 8: Market Resistance

A significant factor in the success of many new products and systems is the reaction of homebuyers. Buyers are likely to react to innovations with doubt or distrust, especially if visible products or systems differ in appearance from traditional products or systems. Therefore, builders may prefer to avoid the potential risk of consumer rejection by using familiar materials and methods.

Manufacturers can take steps to address market resistance as they design new products and associated marketing campaigns. Builders should be fully versed in the benefits and advantages of new products, and should be prepared to explain them to buyers. Well-publicized demonstration homes that prominently display innovative products and systems can help promote buyer acceptance.

IMPLEMENTING THE STRATEGIES

ACTION PLANS DEVELOPED BY THE TASK GROUPS

With agreement on the seven strategies, the residential industry group faced the task of developing implementation approaches and delineating necessary actions. In December 1996, more than 30 representatives of federal agencies and private sector organizations met at a Residential Sector/Federal Agency Workshop to take the next steps. The group established seven task groups to develop action plans for implementing the seven strategies and assigned each group a single strategy for further development. The following sections set forth the implementation plans and action agendas developed by the task groups. The reports are presented in their order of priority to the residential segment of the construction industry.

Each task group report begins with a rationale that describes the relationship of the strategy to the two goals of reducing production costs and improving product durability. Each task group's recommendations for implementation then follow. The report describes each action item, specifies the approximate time frame required to carry it out, indicates related work known to the task group, cites available sources of expertise, provides cost estimates, suggests potential sources of support, notes impediments to carrying out the agenda item, and indicates the next steps for launching and carrying out the work.

The task group that worked on Priority #1, *Establishing and Maintaining an Information Infrastructure*, prepared an integrated report that addressed several related activities. A summary of that report is included in this chapter. The other groups prepared a list of necessary action items accompanied by a one-page summary for each item. The Appendix includes a detailed description of each action item. As with the **Seven Strategies**, the action items are listed in priority order, with the exception of the comprehensive report for Priority #1 which was considered integral to the overall achievment of all strategies, and deserving of separate treatment.

Residential Sector/Federal Agency Workshop Representatives

- Andy Anderson, Anderson Construction
- Gary Bachula, U.S. Department of Commerce
- Tom Bee, Office of the Secretary of Defense
- Mark Bernstein, Office of Science and Technology Policy
- Liza K. Bowles, NAHB Research Center
- Pat Bridges, Bridges & Associates
- Brian Burrows, USG Research Center
- Nelson Carbonell, U.S. Department of HUD
- Dan Cautley, NAHB Research Center
- Mari C⇔t—, NCSBCS
- David J. Dacquisto, NAHB Research Center
- David Engel, U.S. Department of HUD
- Andy Fowell, National Institute of Standards and Technology
- William Freeborne, U.S. Department of HUD
- Tom Frost, BOCA International
- Angela Garcia, Housing Subcommittee
- Wesley Giles, HBA of Greenville, SC
- Bill Gilmartin, The Jefferson Group
- Rose Geier Grant, State Farm Insurance
- Bob Hanbury, House of Hanbury Builders
- Dave Harris, National Institute of Building Sciences
- Dick Hauer, Andersen Corporation
- Richard Karney, U.S. Department of Energy
- Will Kirksey, Civil Engineering Research Foundation
- Dick Kuchnicki, Council of American Building Officials
- Nancy Libson, Housing Subcommittee
- John Mervine, Nanticoke Homes
- Tom Newton, CertainTeed
- Tom Rutherford, Office of the Secretary of Defense
- John Talbott, U.S. Department of Energy
- Robert Wible, NCSBCS
- Jim Work, Armstrong
- Richard Wright, Nat'l Institute of Standards and Technology
- Larry Zarker, NAHB Research Center
- Joel Zingeser, Nat'l Institute of Standards and Technology

PRIORITY #1 **Establish and maintain an information infrastructure responsive to the needs of builders, designers, subcontractors, manufacturers, code officials, and consumers.**

Rationale

- Providing information to decision makers in the highly fragmented home building industry has always presented a challenge. In the past, product manufacturers and their representatives were able to provide builders with a level of direct personal service that is no longer possible in today's environment of cost-cutting and corporate downsizing. This loss of service has been particularly detrimental to small and medium-sized building firms. A new information infrastructure is needed to replace the traditional one that has largely disappeared.

- The rapid growth in electronic access to large volumes of information has transformed many industries, but the information age has had far less impact on the operations of home builders, trade subcontractors, and regulators and the actual construction of homes. Applications of communications technology can facilitate change and improvement throughout the residential building industry. Users can benefit from instant access to the latest product information, technical specifications, installation requirements, distribution and pricing data, third-party evaluation studies, and safety data. Access to information can simplify and encourage the use of current and future technologies that reduce costs, shorten cycle time, and improve durability.

- A more receptive climate for new products will make R&D and new product development more attractive. Opportunities for product users to exchange information about their experiences and for manufacturers to receive rapid, direct feedback from consumers will help identify the need for product improvements at an early stage in the product life cycle.

- Projected users of new or enhanced information systems include home builders, trade contractors, manufacturers, product developers, design professionals, code officials, homeowners, and prospective homebuyers.

- Some basic concepts to be followed in putting new and improved information infrastructure in place include providing high-quality content; linking information from multiple sources; maximizing access of all interested groups; developing user tools that make content accessible and easy to use; providing assistance in problem solving; and increasing the system's value by defining, developing, testing, and implementing new services.

Background

"*What we have here is . . . failure to communicate*." (Strother Martin to Paul Newman in *Cool Hand Luke.)*

The building community relies on poorly developed channels for delivering information on new technologies to builders, remodelers, and trade contractors. The structure of the industry has made it difficult to disseminate reliable information on new products and systems to the field and to report needs back to manufacturers. The problem has been compounded by the trend toward the replacement of professional building supply companies with large home supply centers and the replacement of technical specialists with sales clerks who are not sufficiently knowledgeable to help practitioners understand and

take advantage of new technologies. Even today, most new product developments gain acceptance through imitation and word of mouth, which explains why innovative building technologies take an average of 15 years to find adoption in building practice.

Manufacturers have tried to address the information problem through stepped-up advertising and promotion. Printed material such as trade publications is one source of technology information for builders, but it is provided in the context of other types of information on product features such as style and color and therefore lacks objective, technical content. Another trend among product manufacturers is increased reliance on toll-free numbers. Builders, however, may be reluctant to call companies for fear that they will reach sales personnel rather than technical experts.

While combined uses of new and existing information technology offer broad opportunities for more effective communication, they depend on a better understanding of the information needs of the home building industry and the packaging of information on new technologies in formats that the intended users can readily understand and process. New technologies that offer promise for the building industry include CD-ROM, the Internet, faxback, and interactive knowledge-based systems. Any of these technologies can be incorporated as needed into a unified system that can also include convenient, toll-free telephone access to technical experts and educational presentations to help builders assess the merits of new materials and systems.

The building industry also needs feedback on the performance of new technologies. Problems and complaints must be recorded and relayed to product manufacturers. Evaluation of performance of new systems in houses can provide early warning of problems that may develop or grow more severe over time.

Program Plan

Task Group 1 concluded that the NAHB Research Center's HomeBase program, launched in 1995, appears to be best suited as the network for delivering technical information. The need for a program such as HomeBase emerged as early as the 1980s, when the industry began to experience several major product failures and lacked an early warning system to inform manufacturers of emerging problems. For example, fire retardant treated (FRT) plywood failed on thousands of townhouse roofs, and more recently, a large number of houses experienced failure of synthetic stucco and engineered wood siding products. In particular, HomeBase was developed as a response to concerns over poorly developed communication channels between builders and product manufacturers as expressed in a roundtable dialogue between the two groups. Features of the HomeBase program include:

- A toll-free number that members of the building industry may call for information on technology or for answers to problems they are experiencing in the field. In addition to providing information to builders, the hotline receives and records feedback, which can alert product manufacturers to potential problems before they become widespread;

- *HomeBase News*, a quarterly technology newsletter distributed to more than 40,000 builders through local home builder associations;

- A *Catalog of Building Products and Services published* on CD-ROM and the Internet;

- A fax-on-demand service that provides technical information and reports; and

- A website and a builders forum on the Internet.

Given that HomeBase provides an existing "search engine" that can help users find information quickly, the program envisioned by the task group would use the HomeBase structure and expand on it. Task group1 listed the following activities as elements in the required infrastructure development:

1. Determine Information Requirements

Target audiences for information must be carefully defined and their needs determined. Information content varies with different audiences. Information on the needs of each audience can assist manufacturers and other information providers in organizing and presenting information.

Primary target groups are

- Builders;
- Remodelers;
- Trade contractors; and
- Product/system manufacturers (through feedback from users).

Secondary audiences include

- Real estate professionals;
- Code and regulatory officials;
- Architects and engineers;
- Mortgage finance officials;
- Insurance agents; and
- Consumers.

The task group recommends creating a "strawman" model for defining content requirements for each user audience. The model would include criteria both for selecting formats and evaluating the success of reaching various audiences with different communications approaches. The model would direct manufacturers to useful sources of information within research organizations, government agencies, and the university community to improve the technical value of their communications and help builder-users find solutions to problems experienced in the field.

2. Define Presentation Options

Currently available formats for providing information include

- Toll-free hotlines to technical experts;
- CD-ROM;
- Internet and World-Wide Web;

- Fax-on-demand;
- The trade press, including publications and newsletters;
- Seminars and personal interface;
- Cable TV and DSS networks; and
- Interactive systems.

Formats vary in their effectiveness for disseminating different types of information to different user groups.

3. Publicize Communications Channels

The availability of the communications channels must be publicized. Publicity will differ according to audience, type of information, and format. Channels for such publicity include the publications and conventions of builder, remodeler, and Realtor associations.

Technical assistance for using new media must be provided. For more technical or electronic formats, assistance may include a "help" function or graphical user interface that leads users through an instructional introduction.

4. Obtain Feedback on Format and Presentation

Feedback must be secured to determine how well the information delivered by various means is reaching the target audiences and to assess the effectiveness of various formats and types of presentation. Is the newsletter read? Is the CD-ROM installed and used regularly? Is the hotline able to answer the questions asked? Information on effectiveness of format and presentation can be obtained through mail/telephone surveys, focus groups, evaluation of information collected on hotlines, and online surveys. Feedback should also be solicited on the impact of the information on performance. Is productivity enhanced? Does the information promote attainment of the National Construction Goals objectives? These issues are discussed in item 6 below.

5. Evaluate Alternative Communication Approaches

As new information technologies become available, their value for the program must be evaluated. New and evolving technologies in the rapidly changing communications field include digital video disks (DVDs) as next-generation CD-ROMs; wireless data communications technologies such as cellular digital packet data (CDPD); intranets, which are private networks with better performance than the Internet; and digital satellite system (DSS) interactive learning systems. Information technologies must be evaluated in terms of the present or future capability of users to access them; the difficulty of use; cost, particularly to users; and effectiveness in delivering various types of information.

6. Monitor and Evaluate the Impact on Building Practices

An information technology program must help change and improve industry practices. It must develop the means for conducting an ongoing evaluation of the impact of the proposed information delivery system on reducing construction costs and/or enhancing product and system durability. Such measures as jobsite productivity, construction cycle time, cost of callbacks, cost of maintenance and repair, overall building operating costs, and construction first costs and life-cycle costs could help in judging the overall merit of the effort. The results of the evaluation can provide the basis for a continuing evaluation of program priorities.

It will be relatively easy to determine whether individual users are satisfied with the information they receive and thus find the program effective. It will be more difficult to measure program effectiveness in terms of return on the dollar. In its R2000 program, Canada hired a consulting firm to carry out independent surveys, evaluations, and extrapolations. A similar approach may be desirable to provide continuous measurement of the present program's impact on construction costs and productivity.

PRIORITY #2 **Develop and implement improved methods for assessing and increasing the durability of specific types of building products.**

Rationale

- The durability or service life of products and materials is an important contributor to the longevity of structures and the total cost of operation over time. Variables influencing durability include product design and material formulation; quality of installation; conditions of use, including environmental exposure; and maintenance. These variables produce different expected and actual service lives both within and across product and material categories.

- Variables that influence durability should be distinguished from factors that are not durability issues and that sometimes trigger replacement of products before the end of their service lives. Such factors include changes in taste, styles, or occupant needs and nonfunctional obsolescence.

- Premature failure or the short service life of products required for code compliance raises important questions about building safety. The service life of such products is important to insurers who may face claims for property damage, to manufacturers and builders who may be required to repair or replace defective products, and to consumers who bear the cost of repair or replacement when nobody else is responsible or liable.

- One requirement for improving durability is the capability to assess or predict durability relatively quickly and with reasonable accuracy. Assessing or predicting durabililty involves the use of standardized test methods and protocols, the results of which are correlated with real-world experience. Current product standards largely lack empirical validation. Product manufacturers may devise their own methods for testing or assessing durability, but results may not be accessible or understandable to the user or comparable across products or materials.

- A more rigorous approach to predicting durability would be based directly on knowledge of material properties and degradation processes. However accomplished, quantification of durability performance leads to improvements in durability, reduction in the cost of providing a given level of durability, or both.

- Documenting the performance of current products and systems will provide benchmarks by which to gauge progress and to help determine priorities. Advancing the capability to predict service lives will be required to improve test methods and standards. Improving the quality of installation will increase durability independently of introducing product enhancements. Appropriate maintenance will extend the life of products.

Action Items

Action Items identified by Task Group 2 are summarized below in priority order.

1. Develop standard product durability ratings.
2. Review existing knowledge and perform additional research to identify typical product lifetimes, failure modes, and reasons for replacement.
3. Conduct field studies of durability test methods and revise them as appropriate.

4. Compile and maintain a classification system of durability test methods as derived from existing codes and standards.
5. Identify typical and extreme conditions of use and exposure for building products.
6. Identify products for which quality of installation is a major determinant of performance and develop methods to raise installation quality.
7. Use existing consensus processes to develop new or improved durability tests and measurement methods.
8. Identify products that require significant maintenance for satisfactory performance and work to communicate maintenance requirements to homebuyers and occupants.

PRIORITY #3 **Improve the efficiency of the housing production process.**

Rationale

- A frequently cited reason for the rise in housing prices is stagnation of labor productivity. Rising wages without a corresponding growth in productivity increases the cost of labor required to build a house. The same is true for the labor required to perform the overhead functions of operating a building company. The ability to manage the construction of houses smoothly and efficiently can control the direct costs of production while an efficient management operation can reduce overhead costs.

- Constructing a house is a process involving more than a dozen trades, hundreds of products, and thousands of steps that must be scheduled, coordinated, and performed quickly and correctly. The process offers many opportunities for incremental improvement. While experienced builders generally develop a set of approaches—some straightforward and some highly creative—not all builders are willing to share the secrets of their success. In addition, turnover in the industry creates the need to repeat the process of education with new market entrants.

- Although many builders are trained and experienced in construction, the industry's heavy reliance on trade contractors causes many builders to function largely as managers. If builders cannot manage efficiently, their costs will rise and their business may fail, even if they are experts at construction.

- Opportunities for reducing production costs and accelerating cycle time can be pursued independently of matters relating to the adoption of new products, materials, or systems. Information on successful methods can be secured from builders who have adopted efficiency measures. Successful methods can be supplemented by information on approaches used in other industries and adapted for use in home building. Information gathering and operational improvement based on that information must occur on a continuing process.

Action Items

Action items identified by Task Group 3 are summarized below in order of priority.

1. Expand the supply of labor through training and reducing turnover.
2. Document and publicize methods for improving efficiency in construction.
3. Document and publicize methods for improving efficiency in construction management and business management.
4. Foster development of computer-aided design (CAD) systems for small building companies.
5. Recognize efficient and innovative construction and business management practices through well-publicized award programs.

PRIORITY #4 **Improve the efficiency of the regulatory and new product approval processes.**

Rationale

- The home building process is highly regulated at the state and local levels such that the industry is heavily dependent on the smooth functioning of the building permit, plan review, and site inspection processes. Regulation, in turn, rests in part on a wide variety of product approval systems embodied in the model codes and state and local requirements. Redundant systems have direct implications for manufacturers who introduce or are considering development of new products and systems.

- The regulatory system was created to protect the health, safety, and welfare of building occupants. Over time, many features of the system have become burdensome, and in too many jurisdictions the system poses a stumbling block to housing production by adding cost and time to the construction process without providing adequate compensating benefits. As the model code organizations pursue greater efficiency and uniformity through the International Code Council (ICC), it is equally important for local building permit and inspection departments to streamline their operations. The more smoothly local building departments perform plan reviews, permitting, and inspections, the fewer delays their requirements introduce into the system and the lower the overall regulatory impact on the cost of the finished home. An efficient, prompt, rational, widely accepted product approval process would simplify market introduction and promote innovation.

- A comprehensive program of investigation and analysis is necessary to improve the understanding of the current building regulatory process and its impacts and to identify and work toward the most desirable regulatory environment. This program should be supplemented with an education and outreach effort directed at the elected officials in a position to determine the nature and pace of change.

Action Items

Action tems identified by Task Group 4 are summarized below in order of priority.

1. Investigate and develop a model system for third-party or self-certified inspections and plan reviews.
2. Study existing permitting procedures to identify the characteristics of those procedures that work efficiently.
3. Seek implementation of an enhanced national evaluation system.
4. Design and disseminate one or more model “one-stop” permitting processes.
5. Investigate and document disparities caused by local and state amendments to the model codes.
6. Survey government agencies to identify cost-benefit criteria used in the code adoption process and to develop a prototype cost-benefit screening mechanism.
7. Provide a forum for educated elected officials on the positive relationships between an efficient regulatory system and local economic development.
8. Investigate existing product approval systems and the feasibility of a state/national approval network.
9. Provide a forum or mechanism for regulatory officials to share success stories on new products and systems.
10. Review and report on state-of-the-art computerized plan review systems.

PRIORITY #5 **Develop an improved understanding of the performance of conventionally built light-frame structures.**

Rationale

- Analyzing and understanding the structural performance of light-frame, repetitive-member buildings, which is the usual structural style of new homes, can be more complex than analyzing larger structures made of steel or reinforced concrete. A house gains its strength from the interconnection and interaction of a large number of components rather than from a few massive, homogeneous elements. Conventional construction methods such as those prescribed in the CABO *One- and Two-Family Dwelling Code* achieved acceptance on the basis of long experience, not because they could be validated analytically.

- Research to improve the scientific understanding of how light-frame houses resist loads over their service lives will make it possible to develop tools for optimizing designs that reduce cost without compromising structural durability, that improve structural durability without raising cost, and that pursue both objectives simultaneously. The issue is not new, but a recent series of widely publicized hurricanes, earthquakes, and floods has generated unprecedented national interest in the way houses are designed and built and the way houses perform under extreme conditions from which no area of the country is immune. The latest revisions to ASCE-7, *Minimum Design Loads for Buildings and Other Structures*, raise new questions about the adequacy of conventional construction techniques and their consistency with current engineering knowledge and criteria.

- American homes are well built, and builders seek to build homes that are safe and sturdy. Many builders, however, are growing concerned that in the future all new homes may require code approval based on site-specific engineering analysis, which would increase costs and significantly compromise housing affordability. Others share builders' concerns. Property insurance companies are concerned about how houses are designed and built because of the potential for large losses and claims. Some insurers are evaluating their ability to continue doing business in high-risk areas. The Federal Emergency Management Agency (FEMA) is concerned because it faces large costs for disaster relief when properties are uninsured. Proposed federal legislation would limit future cost impact. Homeowners are concerned because they want assurances that their houses will withstand the forces of nature. Code officials are concerned because structural failures may be seen as evidence of lax code enforcement.

- A comprehensive program of investigation, testing, and analysis of the performance of low-rise, light-frame construction is required to rationalize the design of typical new homes. The program would study how well homes have performed, how well they are performing, and how well they can perform given the development, validation, and implementation of improved methods of design, construction, and quality assurance. When possible, the many interested parties should work jointly on the program. The results should be widely publicized to support appropriate changes to engineering standards and model codes.

Action Items

Action items identified by Task Group 5 to implement are summarized below in order of priority.

1. Perform research to determine appropriate building load design criteria and assembly resistance.
2. Develop and promote quality assurance procedures for structural systems.
3. Develop and disseminate prescriptive guidance and improved design tools for low-rise residential structures.
4. Perform statistically based, postdisaster performance assessments of homes.
5. Work with a broad cross-section of stakeholders to define a “baseline” for acceptable structure performance.

PRIORITY #6 **Foster the development and commercialization of innovative products and systems based on input from the building community.**

Rationale

- Innovative building materials, products, and systems represent an important source of opportunities for reducing production costs, compressing construction schedules, and improving durability. Yet the homebuilding process is widely viewed as slow to change. Further, the many barriers to change, including a fragmented industry structure, liability concerns, and incomplete access to information, are well documented. Nonetheless, the industry's willingness to accept change is demonstrated by the many innovations that have found widespread use in recent decades, including roof trusses, gypsum drywall, plastic plumbing pipe, engineered wood products, ridge venting, prehung doors and windows, flex-duct, one-piece tub/shower units, and prefabricated chimneys. As additional innovations become available, market forces will determine which ones achieve the greatest acceptance. Research into the processes of innovation and technology diffusion in the home building industry has shown that the key characteristics of successful innovation are *improved productivity* and *improved functionality*, both measured relative to a baseline of *best current practice*.

- With few exceptions, the home building industry looks to private sector product developers and manufacturers as the source of new products and systems. No attempt is made here to list or prioritize the specific products or systems that should become the focus of private sector development work. Rather, it is safe to say that opportunities abound for innovation in every aspect of residential construction. The challenge is to address barriers to change and create a market environment in which product developers know the unmet needs of their potential customers, builders are receptive to change, and innovators can reap rewards from commercialization of their applied research. The outcome will help stimulate the process of innovation and guide it in a direction that maximizes overall value.

Action Items

The action items discussed under this strategic approach are limited to those that would create a more receptive environment for innovation or meet needs not likely to be addressed efficiently by individual companies or the private sector as a whole. Such activities are most appropriately carried out in a joint public/private context or through the public sector.

Action items identified by the Task Group 6 are summarized below in order of priority.

1. Perform research to develop cost-effective rehabilitation techniques.
2. Develop and promote acceptance of consensus-based performance standards.
3. Monitor, analyze, and publish reports on new homebuilding products and materials.
4. Systematically identify, study, and report on alternatives to conventional products and materials.
5. Sponsor and publicize demonstrations of new products and systems in completed homes.
6. Organize and promote regular workshops and other meetings of product developers, regulators, and end users.
7. Investigate and publicize opportunities for achieving energy savings as well as cost reductions and/or improved durability.
8. Investigate and assess the feasibility of insurance/warranty coverage for innovative products.
9. Expand opportunities for reducing production costs through the use of recycled materials.

PRIORITY #7 **Expand markets and marketability for products and systems that reduce cost or improve durability.**

Rationale

- The home building community naturally gravitates toward alternative technologies that reduce cost or improve durability. Yet the pace of progress in expanding the supply and availability of technological alternatives is not determined solely by the existence of the alternatives. It is also influenced by the receptiveness of end users. If homebuyers demonstrate their preference for more durable construction products by requesting them, builder motivation to use them will increase. Similarly, if homebuyers accept or prefer nontraditional products or innovative construction practices that reduce cost, builder interest in such products or practices will increase.

- Creating more receptive markets will maximize the impact of other activities designed to encourage innovation. The approach involves creating an environment in which decision makers have incentives to act in ways that contribute to expanded markets. For every activity focused on the supply side, it is reasonable to ask whether a complementary demand-side activity would be beneficial.

Action Items

Action items identified by Task Group 7 are summarized below in order of priority.

1. Document and promote the practices of builders who are successfully marketing innovative cost-reducing products and/or durability features.
2. Investigate durable products and types of construction that can reduce insurance losses.
3. Provide builders and consumers with information on the advantages of innovative products and methods.
4. Develop or expand recycling markets for major construction waste products.
5. Quantify the impediments created by large home centers in introducing new products.

Residential Sector Participants

Strategic Approaches Workshop

The following individual participated in the workshop to develop the seven strategic approaches necessary to achieve the two high-priority goals of the residential segment of the construction industry:

Andy Anderson (Anderson Construction Services), Peter Billing (Insurance Institute for Property Loss Reduction), Pat Bridges (Bridges & Associates), Brian Burrows (USG), Bill Duncan (The Enterprise Foundation), Charles Field (NAHB), Bob Fowler (City of Pasadena), Tom Frost (BOCA), Rose Geier Grant (State Farm Insurance), Pat Hamill (Oakwood Homes), Bob Hanbury (House of Hanbury Builders), Dick Hauer (Andersen Corporation), Ray Kothe (Kothe & Hart), Dick Kuchnicki (CABO), John Mervine, Sr. (Nanticoke Homes), Mike Myers (U.S. DOE), Tom Newton (CertainTeed Corporation), Cliff Oliver (FEMA), Brian Sherry (G.E. Appliances), Robin Snyder (U.S. EPA), David Wismer (City of Philadelphia), and Jim Work (Armstrong World Industries).

Task Groups

The following individuals participated in the seven task groups that developed the action items and implementation plans for each strategic approach:

TASK GROUP 1
Wesley Giles, HBA of Greenville, SC
Larry Zarker, NAHB Research Center
Tom Rutherford, Office of the Secretary of Defense
Tom Newton, CertainTeed
Earle Kennett, National Institute of Building Sciences
Dave Engel, U.S. Department of Housing and Urban Development
Joel Zingeser, National Institute of Standards and Technology
Chuck Nichols, Civil Engineering Research Foundation
Larry Kaetzel, National Institute of Standards and Technology

TASK GROUP 2
Brian Burrows, USG
Tom Frost, BOCA
David Dacquisto, NAHB Research Center
Rose Geier Grant, State Farm Insurance
Dick Hauer, Andersen Corp.
Andy Anderson, Anderson Construction Services
Andy Fowell, National Institute of Standards and Technology
John Martin, National Institute of Standards and Technology

TASK GROUP 3
John Mervine, Sr., Nanticoke Homes
Bob Hanbury, House of Hanbury Builders
Andy Anderson, Anderson Construction Services

TASK GROUP 3 (continued)
Tom Bee, Office of the Secretary of Defense
Nelson Carbonell, U.S. Department of Housing and Urban Development
David Dacquisto, NAHB Research Center
Kent Reed, National Institute of Standards and Technology
Joel Zingeser, National Institute of Standards and Technology

TASK GROUP 4
Mari Cote, National Conference of States on Building Codes and Standards
Pat Bridges, Bridges & Associates
Nelson Carbonell, U.S. Department of Housing and Urban Development
Dick Kuchnicki, Council of American Building Officials
Earle Kennett, National Institute of Building Sciences
Tom Frost, BOCA
Tom Bee, Office of the Secretary of Defense
Andy Fowell, National Institute of Standards and Technology
David Dacquisto, NAHB Research Center

TASK GROUP 5
Rose Geier Grant, State Farm Insurance
Pat Bridges, Bridges & Associates
Dick Kuchnicki, Council of American Building Officials
Jay Crandell, NAHB Research Center
Joel Zingeser, National Institute of Standards and Technology
David Dacquisto, NAHB Research Center

TASK GROUP 6
Jim Work, Armstrong World Industries
Dick Hauer, Andersen Corp.
Larry Zarker, NAHB Research Center
Bill Freeborne, U.S. Department of Housing and Urban Development
Bob Hanbury, House of Hanbury Builders
Tom Frost, BOCA
Joel Zingeser, National Institute of Standards and Technology
Kathleen Almand, Civil Engineering Research Foundation
George James, U.S. Department of Energy

TASK GROUP 7
Richard Belle, Civil Engineering Research Foundation
Dave Engel, U.S. Department of Housing and Urban Development
George James, Department of Energy
John Mervine, Sr., Nanticoke Homes
Tom Newton, CertainTeed
James Work, Armstrong World Industries
Joel Zingeser, National Institute of Standards and Technology
Peter Yost, NAHB Research Center
Larry Zarker, NAHB Research Center

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #1	**Develop standardized durability ratings by product type on the basis of standardized tests. Encourage disclosure of durability ratings in technical product literature and marketing materials.**
Time Frame	For products for which durability tests are available, standardized preliminary ratings could be established within two years, but availability of information about the ratings of specific products will depend on whether manufacturers have initiated durability testing. Where test methods are not yet available, ten to 15 years may elapse before durability information is available in product literature or marketing materials.
Related Work	The American Society for Testing and Materials (ASTM) E.06 is currently developing building performance criteria that can form the basis of durability ratings for specific products.
Available Expertise	The Civil Engineering Research Foundation (CERF) Partnership for Building Innovation is developing a program for evaluating the performance of innovative products. The program involves experts in identifying performance criteria and the National Evaluation Service (NES) in performing or monitoring testing. Durability will require laboratory evaluation. Manufacturers of products such as roofing materials, siding, and paint provide durability information, but they do not obtain all of the information from standardized tests. Manufacturers will need to play a key role in establishing standardized rating systems.
Resources Needed	The leadership of an organization such as the National Association of Home Builders (NAHB) will need to solicit the cooperation of manufacturers' organizations.
Potential Support	Manufacturers' organizations should be encouraged to formalize standardized rating systems and to make product information available. The automobile tire rating system provides an example of the value of durability information.
Impediments	The time required to complete durability testing can make some products obsolete before reliable test information can be made available.
Next Steps	A survey of currently available standardized tests is needed, as noted in Priority 4 below. Manufacturers' organizations should be encouraged to develop product and durability classifications.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #2	**Review existing literature and perform additional research on products and systems as needed to benchmark typical lifetimes, to identify failure modes, and to determine reasons for replacement.**
Time Frame	Research, including literature review, interviews, and data analysis, would require six to eight months. Preparation of a final report would require another one to two months.
Related Work	An article by G. Ahluwalia and A. Schackford, "Life Expectancy of Housing Components," *Housing Economics,* August 1993, provides estimated life expectancies by product type and cites industry sources for the data. The NAHB Research Center's Survey of Consumer Purchases for Repair and Remodeling Products can be used to estimate frequency of repair or replacement of various products.
Available Expertise	No single authoritative source is known. Trade associations, product manufacturers, and researchers are among the sources of information on lifetimes and failure modes. Remodeling contractors can offer useful perspectives. Other sources include building officials, property maintenance inspectors, property insurers, and design professionals. Most data are likely to be judgment or experience-based, although some scientific studies have been completed.
Resources Needed	Six to nine person-months, divided between a senior and a junior researcher/analyst, will be needed. Cost will total approximately $65,000 to $85,000 depending on the range of products and systems under study.
Potential Support	It is not clear what private sector organizations would likely sponsor the needed research. Sponsorship by public sector organizations with an interest in housing and product durability will probably be required.
Impediments	Failure is not the only reason for product replacement. Others include visible wear, obsolescence, and changing tastes. The task of isolating the contributions made by installation procedures, maintenance, exposure, and obsolescence is usually complex; therefore, partial reliance on anecdotal or opinion data will be necessary. "Best-case" and "worst-case" lifetimes presumably exist for most products and may differ significantly for some. Turnover of owners/occupants complicates reconstructing product lifetimes, and difficulty in identifying producers may hinder data analysis. The array of home-building products and systems will require screening to determine the most important candidates for study. Priority should be assigned to products that are widely used and costly to purchase, install, maintain, and replace.
Next Steps	Identify potential sponsors and develop a request for proposals.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #3	**Design and perform field studies of current and new or improved durability test methods. Revise test methods as appropriate.**
Time Frame	Given that most building products degrade slowly, this task will require several years for completion.
Related Work	Most manufacturers test their products to verify compliance with typically minimum code and procurement requirements. Field experience provides working knowledge of product durability. Quantitative data or test protocols pertaining to product durability in the field or under simulated field conditions are largely lacking.
Available Expertise	Available materials include M. Bomberg and D. Allen, "Use of Generalized Limit States Method for Design of Building Envelopes for Durability," *J. Thermal Insul. and Bldg. Envs.,* July 1996. Sources of expertise include government agencies in the United States and Canada and trade associations (National Association of Home Builders).
Resources Needed	It will be necessary to prioritize the products and systems to be studied. Work could begin with structural or load-bearing elements and the building shell. Studies can be based on the tests enumerated in Priority 1. Since moisture is a prime factor in product degradation, it will be necessary to conduct field studies over substantial periods of time in various climatic regions of the country. The program should include development of protocols for accelerated testing and the correlation of tests to real-time data.
Potential Support	Recent problems with Exterior Insulation Finishing Systems (EIFS) and Oriented Strand Board (OSB) siding have sensitized government agencies, manufacturers, builders, insurance companies, and code organizations to the need for better durability testing protocols and standards and, as a result, should stimulate potential support for improved testing.
Impediments	Testing will be required over substantial periods of time. The private sector is too fragmented to provide a likely sponsor. It will be necessary for a government agency or laboratory to take the lead in supporting this activity.
Next Steps	Next steps call for nominating the National Institute of Standards and Technology (NIST) as lead government agency; securing the cooperation of manufacturers, builders, and other interested parties to review the current situation and develop an action plan; seeking multiyear funding; and carrying out the program.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #4	**Review current codes and standards to identify existing durability test methods and to classify them by product, type of test, validation method, and minimum criteria. Compile the information in a systematic format and keep it current.** Analyze and classify durability assessment methods contained in model building codes or referenced standards by product type, test method, and criteria for measuring durability. Assessment methods in standards that are not code-referenced should be included where appropriate.
Time Frame	Six months.
Related Work	None.
Available Expertise	Expertise resides with the National Institute of Standards and Technology, material producers, model code organizations, standards-promulgating organizations, the Construction Specifiers Institute (CSI), and the American Institute of Architects (AIA).
Resources Needed	Depending on level of detail, an estimated $50,000 is needed in external funding.
Potential Support	Home builders, the National Institute of Standards and Technology, theU.S. Department of Housing and Urban Development (HUD), the U.S. Department of Energy (DOE), and the U.S. Department of Defense (DOD) are likely sources of support.
Impediments	The appropriate degree of detail for this review should be determined at an early stage. A comprehensive assessment could be extremely expensive. A representative sample might provide a satisfactory overview of available methods while demonstrating the need for development of a standardized durability assessment methodology.
Next Steps	Form a task group to determine the appropriate level of detail and explore funding opportunities.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #5	**Specify typical and extreme conditions of use and environmental exposures for home-building products by product and, where appropriate, by region or other variables.**
Time Frame	Twelve months.
Related Work	The recent EIFS and OSB siding failures have directed attention to environmental exposure as a cause of product failure. With regard to EIFS, the U.S. government has been collaborating with the Institute for Research and Construction (IRC), which is part of the National Research Council of Canada. The collaboration has resulted in an article by W. Brown et al., *J. Thermal Insul. and Building Envs*., January 1997.
Available Expertise	Most manufacturers of products that are subject to environmental degradation apply test protocols and regimes for evaluating product performance under both real-time and accelerated conditions.
Resources Needed	A panel of building science consultants, manufacturers' representatives, and representatives from national laboratories such as NIST and trade organizations such as NAHB would need to develop a consensus on typical and extreme conditions of use by region.
Potential Support	Neither a great deal of time or money should be needed. Most of the information is probably already available. The more challenging aspect of the task will be to forge a consensus among the affected parties. A project manager/consultant with a $40,000 budget could probably collect and package the necessary information in six months.
Impediments	Some manufacturers may be reluctant to reveal their test procedures. It may be difficult to agree on what constitutes extreme conditions within a region.
Next Steps	Next steps call for first, appointing a project manager and establishing an objective, budget, and milestones and, second, working with the project manager to select a target list of independent laboratories, trade organizations, and manufacturers that might wish to provide input.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #6	**Identify home-building products for which quality of installation is a major determinant of performance and service life. Develop and implement methods such as internal quality assurance systems and third-party installer certification for raising the quality of installation of products whose performance depends on installation.** Installation quality affects the performance of virtually all products. In addition, problems can occur where products interface. To avoid such problems, manufacturers must communicate with one another early in the product development phase.
Time Frame	It is difficult to establish a time frame until products and systems are identified. The first step is to conduct discussion group meetings of builders and manufacturers for the purpose of identifying by component/product, problem areas, and causes. Development of solutions through product redesign, third-party installer certification, and/or educational activities can then begin.
Related Work	Detailed information on this subject has not been complied. Developing the necessary information will require meetings and forums that bring together builders, manufacturers, and researchers.
Available Expertise	Builders, trade contractors, and industry associations are the major sources of input for manufacturers during product development and of feedback after market entry. Other information sources include home repair contractors, home inspectors, and homeowners' associations.
Resources Needed	Consideration should be given to developing hotline links among builders, manufacturers, and associations to prevent problems from becoming serious before they can be addressed.
Potential Support	Potential sources of support include labor organizations, the National Association of Home Builders, and product manufacturers and their associations.
Impediments	When problems occur, manufacturers are not always aware of them and do not always know what causes them. Manufacturers assume that the skills required to install their products are available and that installers read and follow product instructions. Fragmentation of the home building trades and problems in hiring skilled labor undermine these assumptions. For building practices to evolve smoothly, participants in the home-building process need a thorough technical understanding of the characteristics of building products and materials, proper installation techniques, and necessary practices for operation and maintenance. In practice, however, modest skill levels often characterize the labor pool.
Next Steps	Next steps call for, first, identifying—with the assistance of builders—major problem areas and specific causes, including product failures, product-to-adjoining-product failures, craftsmanship errors, supervisory shortcomings, and misunderstanding of installation requirements and, second, identifying products and/or systems that are the most difficult and time-consuming to install and establishing the skill levels required for correct installation.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #7	**Based on conditions of use and environmental exposure, use existing consensus processes to develop new or improved durability test methods and metrics by product type.**
Time Frame	The time required to develop test methods for measuring durability varies with the product but in most cases is about ten years. Accelerated testing techniques such as more rapid cycling and increased load have been used for mechanical products in other industries. Similar principles can be applied to testing home-building products. For products such as siding, roofing materials, and paint, whose useful life is determined by the effects of outdoor exposure, new testing equipment and techniques now under development can subject the products to severe conditions such as increased levels of ultraviolet radiation. Development of these techniques involves research on the degradation mechanisms associated with temperature, radiation, and moisture. When test methods have been developed, they should be evaluated and validated through round-robin testing in various laboratories.
Related Work	Manufacturers test their products for durability, but the tests are seldom based on national standards. NIST is currently working on accelerated testing that subjects coatings to increased levels of ultraviolet radiation. It is performing the work in cooperation with a consortium of coating manufacturers and users. NIST is also carrying out research on the durability of roofing material joints and concrete. The National Science Foundation (NSF) and Federal Highway Administration are funding research at Catholic University on the durability of composites.
Available Expertise	ASTM Subcommittee E.06.22 is one of many ASTM subcommittees that sets durability standards for construction materials. Many of the standards are material-specific and use empirical tests. It is therefore difficult to compare competing materials on the basis of common criteria. NIST is prepared to address the question of new standards and improved durability (or "service life") tests. Testing laboratories will assist in round-robin testing. Developing standards for predicting service life requires the expertise of chemists and engineers with an understanding of the physical and chemical degradation mechanisms of polymers, metals, and inorganic materials and with experience in identifying degradation mechanisms and developing measurement methods. This expertise is available at NIST. NIST and the materials industry also have experience in writing ASTM standards.
Resources Needed	A $10 million, ten-year program is needed to extend the understanding of degradation processes and to develop standardized durability tests for most building materials.
Potential Support	The research programs at NIST are expected to continue at their current level of funding. NSF wishes to expand its research program on predicting the service life of building materials. Several projects under the joint public/private sector construction materials research program (CONMAT) relate to durability; CONMAT funding is expected to exceed $200 million.
Impediments	The principal impediment to the development of the needed test methods is the lack of funding to perform the necessary research.
Next Steps	The next steps are to identify classes of products whose current durability is considered less than adequate or whose cost could be reduced if methods to evaluate the effects of cost-saving measures on durability were known; to identify the parameters that influence the durability of these products; and to secure agreement among manufacturers, builders, and owners on the expected range of these parameters.

National Construction Goals Task Group 2

Develop and Implement Improved Methods for Assessing and Increasing Product Durability

Priority #8	**Identify products for which significant maintenance by the occupant is necessary for satisfactory performance. Review the methods by which maintenance requirements are communicated to users. Develop methods to ensure that the need for maintenance is clearly communicated to and easily understood by users.** Assembling a complete database of products requiring substantial owner maintenance and reviewing the methods by which maintenance requirements are communicated to users is not a feasible task. Extensive variation exists among products, materials, systems, components, and equipment and among product types, local usage customs, and the activities of parties involved in the sale of homes and products. While reliance on anecdotal data should be minimized, these data often provide useful information about the advantages and disadvantages of products, methods, and systems. Developing a list of generic and/or specific products and compiling information on the ways that maintenance requirements are communicated to users involves the collection of data from a representative sample of manufacturers, distributors, installers, builders, subcontractors, owners, occupants, repair contractors, maintenance services, regulators, designers, and others with a relationship to the products. Survey questionnaires should be designed by survey experts in concert with subject matter experts to avoid bias and to ensure statistical validity.
Time Frame	Data collection and program development could be accomplished in 18 months.
Related Work	Numerous printed sources and a growing body of electronic sources relate to maintenance of homes; however, there are no known related research activities.
Available Expertise	Sources include manufacturers, home inspectors, home repair contractors, and home/condominium/apartment owners' associations.
Resources Needed	Approximately $250,000 will be needed.
Potential Support	Potential supporters include HUD, NAHB, product producers, and other beneficiaries.
Impediments	Some manufacturers may understate the maintenance needs of their products or overstate the maintenance needs of competing products.
Next Steps	The next step calls for developing a proposal and seeking shared funding from potential sponsors.

National Construction Goals Task Group 3

Improve Efficiency of the Production Process

Priority #1	**Expand the supply of trained or readily trainable labor in the major construction trades by supporting vocational training and similar methods for increasing the pool of skilled and entry-level workers. Investigate and report on opportunities for reducing labor turnover.** Skilled labor shortages and high turnover are important causes of low productivity in the housing industry. Modern home building requires craftspersons who are intelligent and can function as engineers, artists, social workers, and economists. They must produce houses within cost, on schedule, in compliance with many regulations and life safety concerns, and in keeping with the buyers' expectations for performance, quality, and appearance.
Time Frame	Documenting the problem and investigating the means for increasing labor supply and/or reducing turnover will require 12 months. Achieving significant increases in supply will require much longer.
Related Work	"Attracting and Maintaining a Skilled Construction Workforce," a Construction Industry Institute (CII) project, is addressing parts of this issue from the standpoint of the owner and contractor in commercial construction.
Available Expertise	Some home-building firms have presumably dealt successfully with the problem. Their input will be sought for this project.
Resources Needed	Thorough documentation and an inventory of opportunities could be developed for $100,000 to $200,000.
Potential Support	Potential sources of support include NAHB, HUD, the Department of Labor (DOL), and trade contractor organizations.
Impediments	Impediments include the multidisciplinary nature of the problem and the diversity of interest groups whose participation is required for a lasting solution.
Next Steps	The next step is to collect information from home builders to document the extent of the problem in residential construction and to identify suggested solutions This work should be coordinated with the ongoing CII project.

National Construction Goals Task Group 3

Improve Efficiency of the Production Process

Priority #2	**Document and publicize new or underused methods for improving efficiency in construction. Possibilities include just-in-time delivery systems; concurrent scheduling of tasks that are traditionally performed in sequence; bar-coding of construction materials with optical scanning on site and/or sequencing of materials before site delivery to simplify installation; and implementation of methods for instant communications and transfer of paper between offices and construction sites.** Appropriate vehicles for presenting the results of this work include educational programs, books, or pamphlets; columns in the trade press; and detailed case studies documenting innovative approaches.
Time Frame	Activities should take place on an ongoing basis.
Related Work	Publications have documented various underused methods for improving construction efficiency. A recent example is *Cost-Effective Home Building,* NAHB Research Center, Upper Marlboro, MD, 1994. Studies of improved production efficiency in manufacturing environments from other industries may be directly applicable to modular and panelized home building and suggest useful approaches in the site-built sector.
Available Expertise	Home-building firms in different segments of the industry are the best source of new ideas and the most credible source of insights into the strengths and weaknesses of newly emerging methods. Firms with award-winning Total Quality Management (TQM) systems in place may be useful sources of new techniques. Valuable ideas could come from applications for award programs with appropriate criteria; see Priority 4 for Task Group 3.
Resources Needed	Case studies of builder experiences with specific techniques could range from $20,000 to $50,000 depending on scope and level of detail. The cost would be considerably lower for simply reporting on new techniques without field verification or independent analysis; however, the accuracy and long-range impact of a more casual approach are likely to be questionable.
Potential Support	Potential supporters include building product manufacturers and other private or public sector entities.
Impediments	Some building firms would prefer to treat their innovative practices as trade secrets rather than share them with other builders. Some innovations have no natural private sector supporters other than home builders because they involve doing more with less.
Next Steps	Next steps call for conducting an inventory of existing resources and working with potential sponsors to identify specific outputs.

National Construction Goals Task Group 3

Improve Efficiency of the Production Process

Priority #3	**Document and publicize methods for improving efficiency in construction management and business management. Possible methods include partnering with subcontractors under shared savings arrangements; implementing worker safety training programs to reduce lost-time accidents and decrease workers' compensation costs; developing systems for "paperless" product ordering and electronic payments; inaugurating construction waste management programs; initiating volume purchasing; expanding use of CAD systems; and using the set of approaches generally described as Total Quality Management (TQM).** Appropriate vehicles for this activity include educational programs such as seminars and panel presentations; books and pamphlets for home-builder audiences; and articles and regular columns in trade publications and specialized newsletters.
Time Frame	Activities should take place on an ongoing basis.
Related Work	Applications for the National Housing Quality Awards and the National Remodeling Quality Awards include a great deal of information on management practices of successful home-building firms. TQM training programs offered by the NAHB Research Center address some aspects of this priority.
Available Expertise	Expertise concerning relevant and appropriate methods exists throughout the home building industry. The NAHB Research Center and other organizations have the ability to package and disseminate the information.
Resources Needed	Building firms must be willing to share their ideas and experiences. Funding may be required to develop publishable materials and training curricula. Though relatively inexpensive, seminars or educational programs at the NAHB annual convention do not generate revenue.
Potential Support	Potential supporters include building product manufacturers and other private or public sector entities.
Impediments	Impediments include lack of resources for developing or updating educational programs and for presenting them at distant venues or at times other than the NAHB annual convention.
Next Steps	Next steps call for conducting an inventory of existing resources and working with potential sponsors to identify specific outputs.

National Construction Goals Task Group 3

Improve Efficiency of the Production Process

Priority #4	**Foster development of enhanced microcomputer CAD systems suitable for small building companies, Systems should integrate design with the production of field drawings, material take-offs, ordering, scheduling, code compliance review, and other capabilities.** Even though many software developers offer CAD systems for building companies, most systems address the needs of large firms. Moreover, smaller home builders may find it difficult to get useful information about CAD systems. In addition, because they are not involved in ongoing national and international activities to develop integrated, vendor-independent CAD solutions for the building industry, smaller builders may lack direct channels for communicating their current needs to system developers. A CAD/Information Technology clearinghouse focusing on small builders could address current deficiencies by defining the user requirements of small builders, serving as a test bed for demonstrating commercialized or prototype software, sponsoring training or educational programs for small builders, and advocating small builder needs in the software standards development process. This approach would lead to an environment in which software development would meet the needs of both larger and smaller users.
Time Frame	In view of the pace of evolution in software, this activity should be planned as an ongoing process over at least a five-year period.
Related Work	Several developers of CAD-type software serve the building industry. NAHB has operated a system for reviewing and certifying software for home builders. The National Institute of Building Sciences (NIBS) runs a CAD Council. The International Alliance for Interoperability is involved in standards development to support a competitive marketplace in CAD software. For a time, the NAHB Research Center published an annual directory of software for home builders.
Available Expertise	Sources of expertise include HUD contractors, NIST, NIBS, the U.S. Department of Defense (DOD), the U.S. Department of Commerce (DOC), and many software design firms and companies.
Resources Needed	Launching a CAD/information technology clearinghouse would require approximately $100,000. A staff of one to 1.5 full-time persons would be responsible for outreach to small builders as well as for research and analysis to communicate small builder needs to software vendors and some involvement in standards work.
Potential Support	Potential supporters include HUD, NIST, DOE, private software companies, and NAHB. User fees could cover part of operating costs.
Impediments	The effort depends on securing funding.
Next Steps	The next steps are to identify funding sources and to develop a startup plan.

National Construction Goals Task Group 3

Improve Efficiency of the Production Process

Priority #5	**Recognize innovative construction and business management practices that promote efficiency through well-publicized award programs.**
Time Frame	Award programs in the home building industry typically operate on an annual cycle. Repetition is important to building an audience, attracting interest, and improving the awards process.
Related Work	Ongoing award programs include the National Housing Quality Awards, the National Remodeling Quality Awards, and the HUD-sponsored Innovative Housing Technology Awards. The quality award programs are directed to business practices and the technology award to construction methods. Other award programs also exist.
Available Expertise	NAHB and the NAHB Research Center are experienced in operating builder award programs, including development of award criteria, soliciting applications, managing the judging process, organizing the award presentation ceremony, and arranging for publicity.
Resources Needed	Most award programs cannot be funded entirely out of application fees and thus require outside sponsorship to cover costs. Impartial expert judges with staff support are also required. Modification of an existing program within an established general approach is relatively straightforward.
Potential Support	Development and operation of award programs has been funded by application fees supplemented with revenues from sponsorship by major manufacturers and trade associations and/or grants. Multiple sponsors are typically required.
Impediments	Creating new award programs potentially dilutes interest in existing programs. Positioning to avoid overlap is essential.
Next Steps	Next steps call for reviewing current award program judging criteria and determining whether they can and should be modified to encompass the desired criteria; revising judging criteria and application forms as necessary; or studying the feasibility of establishing a new program or programs.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #1	**Study and report on the possibility of establishing a construction certification program that allows some plan reviews or inspections to be waived, performed by third parties, or performed in-house by qualified, certified staff. Identify jurisdictions that have experience with such programs and assess the programs' effectiveness, cost impact, and implications for public safety. Develop a model system or systems for third-party plan reviews and inspections based on the findings and disseminate information on the system or systems for consideration by local jurisdictions.** Delays in excess of four weeks in completing plan reviews are common in many jurisdictions. Because residential construction activity is seasonal in many areas of the country and subject to the cyclical nature of the economy, local building departments face significant difficulties in providing uniformly adequate staffing to achieve timely plan reviews and, to a lesser degree, timely inspections. A national residential contractor and third-party certification program for limited plan review/field inspection may be a feasible way to relieve local building departments of their seasonal/cyclical problems. The primary goal would be reduction in plan review time for low-rise residential buildings to a maximum of one week, thus providing a significant reduction in production time.
Time Frame	The study can be performed and a final report completed within one year.
Related Work	Related work and sources of information include existing model code plan reviewer/building inspector certification programs and International Standards Organization (ISO) data on jurisdictions that accept third-party plan reviews and/or inspections.
Available Expertise	Expertise can be found in jurisdictions experienced in using alternative approaches.
Resources Needed	The project would require $100,000 to $150,000 for data collection and development of candidate model systems.
Potential Support	Potential sources of support include the NAHB Research Center, HUD, the National Conference of States on Building Codes and Standards (NCSBCS), ICC, and the Council of American Building Officials (CABO).
Impediments	Impediments include lack of awareness of both the importance of the problem and the potential benefits that could accrue from dealing with it successfully. Local enforcement officials might resist the effort as an "invasion of their turf." Lack of adequate funding would make it impossible to carry out the program.
Next Steps	Next steps call for seeking funds for the study and then soliciting the participation of affected stakeholders.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #2	**Study existing permitting procedures to determine which work most efficiently and why. Assess permitting cycle times, methods for addressing overriding federal and state laws, procedures for infrastructure project permits, and the impact of fluctuating levels of construction activity on the operation of the permitting system. Disseminate the results throughout the code community.** NCSBCS has initiated a study entitled "Streamlining the Nation's Building Regulatory Process" to identify regulatory barriers imposed on development by redundant and overlapping government regulations promulgated at the city, county, state, and federal levels. The goal of the study is to produce user-friendly, streamlined model procedures for reducing the time and effort needed to acquire permissions for home construction. The expected reduction in processing time and the elimination of red tape will benefit both developers and enforcement agencies.
Time Frame	The NCSBCS project was launched in September 1996. Phase I, Organization and Development of Models, ended in August 1997. Phase II, Implementation, will conclude in September 1998.
Related Work	Several states, counties, and cities seeking to maximize opportunities for economic development are performing related work. They include Ohio (A Case Study of Building Regulatory Reform at State, County, and City Levels); Kitsap County, Washington; and the Commonwealth of Virginia. Other sources include the Industrialized Building Commission (IBC); APA Growing Smart; National Partners in Home Ownership; and the National Governors Association (NGA) Best Practices.
Available Expertise	Sources of expertise include the NCSBCS Regulatory Affairs Committee, Steering Committee, and National Project Review Committee; the Council of State Community Development Agencies (COSCDA); NIST; the White House Office of Science and Technology; the NAHB Research Center; CERF, HUD, and 40 other national organizations participating in the NCSBCS project.
Resources Needed	Grants from federal agencies and in-kind services from national organizations and state and local governments are already in place. Further funding from nonfederal sources is essential. Total funding required is $700,000 to $800,000.
Potential Support	Potential support can be secured from the 50 current participants in the NCSBCS project plus the White House Office of Science and Technology.
Impediments	Potential impediments include the time frame, the magnitude of the project, and insufficient funding.
Next Steps	Organizations participating in Group 4 should become actively involved in the NCSBCS project. As work products from other action items are completed, they should be included in the activity.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #3	**Seek implementation of an enhanced national evaluation system.** An independent technical evaluation service that can evaluate the performance of new technologies and address issues such as durability and service life would help reduce the risk to home builders in the first use of new technology. Endorsement of this process by local building officials would also facilitate acceptance of new technology at the local level. The steps required to develop a system include an assessment of the unique needs of home builders, an appropriate communications system for widespread dissemination of results, identification of candidate technologies, and pilot testing of the program.
Time Frame	The plan would build on an ongoing program under development by CERF and the National Evaluation Service (NES). Three months would be required to assess and identify candidate technologies, followed by a two-year pilot evaluation.
Related Work	Related work includes the Partnership for Building Innovation, the HUD Technical Suitability of Products Program (TSPP), and the NES.
Available Expertise	Sources of expertise include the Partnership for Building Innovation Steering Team, the NAHB Research Center, CERF, NES, and HUD.
Resources Needed	The project would require $20,000 for the assessment and an estimated $50,000 to $100,000 for the pilot program.
Potential Support	Potential supporters of the pilot program include HUD, CERF, NAHB, and manufacturers.
Impediments	None identified by the Task Group 4.
Next Steps	The next steps are to form a home-builder task force to plan the program, initiate the assessment, and plan the pilots.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #4	**Design and disseminate one or more model "one-stop" permitting processes and support related educational programs targeted to all sectors of the construction industry. Monitor adoption of the model, report on results, and refine the model as necessary.** Given the several of examples of successful model "one-stop" permitting processes and the ongoing work of NCSBCS in assisting each level of government in the adoption and implementation of streamlined building regulatory processes, it would be prudent to build on this work rather than trying to design a new "one-stop" permitting system.
Time Frame	The task involves reviewing draft models identified by the NCSBCS project, agreeing to final models by February-March 1998, and beginning work on development of educational programs. Promotion of adoption of models will begin in May 1998 concurrently with the delivery of educational programs.
Related Work	Related work includes the NCSBCS project.
Available Expertise	Expertise is available from NCSBCS, model code organizations, and the NAHB Research Center.
Resources Needed	A committee is needed to work with NCSBCS to identify models. Resources such as the model codes' training and education departments are needed to conduct the promotion program and to develop and conduct education programs.
Potential Support	None identified by Task Group 4.
Impediments	Impediments could include failure to secure financial support to promote the models and to develop and conduct the education programs.
Next Steps	The next steps call for establishing a planning committee to work with NCSBCS in identifying models and to locating resources and sources of financial support.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #5	**Investigate and document the disparate requirements introduced into the model codes as they are adopted by state and local governments as well as variations in the systems for developing and documenting code interpretations.** This project involves a survey to determine the number and nature of amendments that states, counties, and communities introduce into the model codes in the process of adopting the codes. The survey will determine the nature and scope of redundancy and overlap. The information would be useful to NCSBCS in its project on streamlining the building regulatory process.
Time Frame	Work should begin immediately in order to run concurrently with the NCSBCS project.
Related Work	The project relates to the NCSBCS project.
Available Expertise	Expertise is available from the NCSBCS Regulatory Affairs Committee, Steering Committee, and National Project Review Committee; COSCDA; NIST; the White House Office of Science and Technology Policy; the NAHB Research Center; model code groups; and ISO.
Resources Needed	Some of the work can be performed through the NCSBCS project and the ICC-NCSL model enabling legislation project. Funding for the balance of the effort should be sought from partners in the NCSBCS project and possibly from HUD.
Potential Support	Potential support can be sought from participants in the National Construction Goals project, NHPO, the NCSBCS project, and the ICC-NCSL model enabling legislature project. Other support should be sought from partners in the NCSBCS project and possibly from HUD.
Impediments	Impediments include the short time horizon and the possible lack of financial resources. Some data are readily available, but collecting and interpreting additional data will be costly and time-consuming.
Next Steps	The next steps are to determine the most appropriate scale for the activity and to identify sources of funding.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #6	**Survey federal, state, and local governments to determine the cost-benefit criteria used in the code adoption process. On the basis of past research and survey results, develop a prototype cost-benefit screening mechanism that could be applied to all proposed changes in the model codes or to similar state and local codes.**
Time Frame	To conduct a survey of federal/state/local code adoption criteria, two months will be required. To develop a consensus standard for cost-benefit review of building code changes, three to six years will be required.
Related Work	Several National Bureau of Standards (now the National Institute of Standards and Technology) publications address cost-benefit analysis of code changes. The NAHB Research Center published a methodology for analyzing the impact of code changes on production cost. Several ASTM E.06 standards on building economics address different aspects of cost-benefit analysis. Federal agencies often apply cost-benefit analysis to regulatory proposals.
Available Expertise	Expertise in building economics is available at NIST, the NAHB Research Center, universities, and other organizations.
Resources Needed	An estimated $25,000 to $30,000 will be required to gather information from states and selected large jurisdictions regarding any specific criteria in use and to issue a report on results. Estimated funding of $100,000+ per year will be required to support research relating to standards activities. This funding level does not include the cost of participation by committee members.
Potential Support	Potential supporters include the model code organizations and NAHB.
Impediments	Impediments include unrealistic expectations. A methodology or analysis framework would be an important improvement in the code-setting process and could reduce, but not eliminate, disagreement over input values, likely outcomes, and the appropriateness of proposals. The project will focus discussion and help uncover ambiguities or problems in interpreting code change proposals before they are enacted. Many code changes will not be susceptible to meaningful cost-benefit analysis.
Next Steps	The next step is to investigate creation of a consensus committee sponsored by ASTM, NIBS, or other suitable organizations.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #7	**Provide a forum to educate elected officials about the positive relationship between an efficient regulatory system and local economic development.** The purpose of this activity is to develop legislative and executive support for the adoption and implementation of legislation, rules, regulations, and procedures to improve the efficiency of the regulatory process and to foster the adoption and use of new products and materials. Information for dissemination will include documents, materials, and processes developed in this project.
Time Frame	The activity builds on an ongoing program and related initiatives. Three months will be required to specify the most appropriate forums, identify elected officials at the federal, state, and local levels, and assign priority to venues. Full implementation will require two to three years.
Related Work	Related work includes the NPHO initiatives, the NCSBCS project, the Partnership for Building Innovation, HUD's Technical Suitability of Products Program, and the NES.
Available Expertise	Expertise is available from NCSBCS, CABO, HUD, NIST, the American Institute of Architects (AIA), NAHB, the NAHB Research Center, CERF, NES, ICC, the insurance industry, and related construction industry organizations.
Resources Needed	The effort should tie directly into the NPHO initiative and its resources and into the NCSBCS project with its opportunities for public speaking. Other needed resources will be identified. The assessment will require $10,000. An estimated $50,000 to $100,000 will be required for travel to speaking engagements. Some support can be provided through in-kind services.
Potential Support	Potential supporters include the entire construction community, NCSL, the Council of State Governments (CSG), NGA, the U.S. Conference of Mayors, the National Association of Counties (NACo), and the National League of Cities.
Impediments	None identified by Task Group 4
Next Steps	The next steps call for formation of a work group to plan the assessment study, assign priority to venues, identify technologies and regulatory streamlining practices to be promoted to elected officials, and seek funding resources.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #8	**Review and document existing systems for product approval in jurisdictions around the country. Investigate the feasibility of a state/national product approval network.**
Time Frame	The task should be undertaken immediately.
Related Work	Related work includes the 1987 National Institute of Building Sciences report entitled "Building Product Approval/Acceptance Processes" and CERF Report #96-5021 entitled "The Foundation for a New Approach to Implement Building Innovation."
Available Expertise	Expertise is available from CERF, NES, the NAHB Research Center, and HUD.
Resources Needed	None identified by Task Group 4.
Potential Support	Potential supporters include HUD, CERF, NES, and NAHB.
Impediments	None identified by Task Group 4.
Next Steps	The next step is to contact CERF for coordination with the Partnership for Building Innovation and to disseminate materials to all state and local agencies that perform a product approval function.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #9	**Provide a forum or mechanism that permits regulatory officials to share success stories on new products and systems.** This activity would formalize the exchange of field experience associated with innovative products, construction methods, and/or materials. Potential forums for dissemination of information include the following: • Magazines and bulletins of the model code organizations; • NES and other evaluation service (ES) websites; • NES and ES committee meetings; • Model code annual business meetings; • Model code-based educational programs; • National Research Council (NRC) Federal Facilities Council; and • Special symposia. In meetings and symposia, specific innovative technologies would be identified and comments invited. In selected instances, reports of proceedings would be made available.
Time Frame	The task can be carried out in one year.
Related Work	Except for symposia, the forums currently exist.
Available Expertise	Expertise is available from NES or the CERF-NES enhanced evaluation system and the individual evaluation services of the model code bodies.
Resources Needed	Resource requirements are relatively small if the project is carried out in conjunction with existing events/venues.
Potential Support	Potential supporters include NAHB, NIST, HUD, CERF, NES, the Building Officials and Code Administrators International Evaluation Service, and producers of innovative products and systems.
Impediments	Possible impediments include potentially low interest in discussing successful performance of innovative products. Given that most innovative products perform as expected, failures are noteworthy.
Next Steps	The next step is to contact the NES and/or the CERF Partnership for Building Innovation to coordinate forums.

National Construction Goals Task Group 4

Improve Efficiency of the Regulatory and New Product Approval Processes

Priority #10	**Review and report on the state of the art in computerized plan review systems for reviewing house plans submitted on diskette and printing conclusions with minimal staff interaction.**
Time Frame	The task can be completed in six months.
Related Work	The model code groups offer or are developing software to assist plan reviewers in their work through electronic checklists, standardized comments, and more efficient record-keeping.
Available Expertise	Expertise is available from CAD software manufacturers, NIST, HUD, and model code groups.
Resources Needed	An estimated $50,000 will be required to review, catalog, and report on features of existing software and to identify potential enhancements.
Potential Support	Potential sources of support include NIST, HUD, CABO, and NAHB.
Impediments	The lack of uniform code adoptions by jurisdictions creates deviations that will require the involvement of a plan examiner. Site reviews will require some interaction; however, a structure's review can be automated.
Next Steps	The next step is to secure funding.

National Construction Goals Task Group 5

Improve Understanding of Structural Performance

Priority #1 **and** **Priority #3**	**Perform research to determine appropriate loads, load combinations, assembly resistances, and system factors for use in designing low-rise light-frame residential structures. Pursue revisions to consensus standards and model codes as warranted by the results.** **Based on research results, develop and disseminate prescriptive guidance and improved tools for design and analysis of low-rise residential structures.**
Time Frame	Research and implementation activities are projected to extend over at least five years.
Related Work	NAHB has initiated a five-year Housing Affordability through Design Efficiency program that is planned to include research into light-frame assembly resistances (e.g., perforated shearwalls, ceiling/roof diaphragms, interassembly connections), structural loads (estimation of wind loads in hurricane areas, measurement of near-ground wind characteristics and loads in full-scale test houses, lateral loads on foundation walls), and application of probability-based design concepts to residential construction. The NAHB plan also calls for follow-up standards (ASCE-7) and model code work as well as for outreach to the home building industry with improved design methodologies. HUD is a major contributor to this activity.
Available Expertise	Public sector: NIST, the U.S. Department of Agriculture/Forest Products Laboratory (FPL), and FEMA all command expertise. Private sector: the NAHB Research Center, academic experts, the American Forest and Paper Association (AFPA), the American Plywood Association, and model code organizations all command expertise.
Resources Needed	Total cost of the work as planned by NAHB is over $3 million. Future NAHB funding is contingent on availability of matching funds/cost sharing at a 3:1 ratio.
Potential Support	HUD, FEMA, other federal agencies, property insurers, NAHB, and other private sector trade associations and material interests can potentially provide support.
Impediments	The nature of light-frame, repetitive-member construction does not lend itself to analysis of system properties through other than empirically based or empirically validated methods. Variations in designs and design conditions complicate generalizations from test data.
Next Steps	Next steps call for continuing to pursue the NAHB work program and to revise the agenda as needed and for identifying additional cosponsors to perform or cofund research tasks.

National Construction Goals Task Group 5

Improve Understanding of Structural Performance

Priority #2	**Develop and promote the use of quality assurance procedures to ensure that structural systems are built as intended and will deliver anticipated levels of performance.** Build on present quality awards and Total Quality Management (TQM) programs, with further integration of ISO 9000 concepts and procedures as appropriate for home building.
Time Frame	A comprehensive quality assurance/TQM program focusing on structural performance, including performance-based requirements, criteria, and evaluation measures for implementation, could be developed in six to 12 months. Program roll-out, including materials, methods, promotion, and an awards component, would require another six months, with the program continuing after that time. R&D needs would be identified and prioritized throughout the process, and new knowledge would be incorporated as it became available.
Related Work	Related work includes the NAHB Research Center's Quality Awards program and TQM program and NIST's Development of Pre-Standard Guide for the Specification and Evaluation of One- and Two-Family Dwellings.
Available Expertise	Expertise includes the NAHB Research Center's Quality Program staff, the NAHB Research Center Structures Division, and the NIST Structures Division.
Resources Needed	Resources needed from the private sector include endorsement and financial support. Financial support is needed from the public sector for research and development.
Potential Support	Potential private sector supporters include materials manufacturing companies and associations and NAHB. Endorsement can be sought from the American Society of Civil Engineers (ASCE). Recognition by building officials can be sought from the ICC and CABO. Support and acceptance can be sought from the insurance industry. Sources of public sector support could include NIST for funding and research; HUD for funding and endorsement; the U.S. Department of Agriculture's FPL for research and endorsement; and DOD.
Impediments	Lack of formal recognition of TQM and quality assurance measures by regulatory officials or property insurers and lack of recognition and appreciation of structural quality by homebuyers limit home builders' incentive to implement structural quality assurance. Research in support of these programs and development of tools to implement them are low-priority objectives.
Next Steps	Next steps call for forming a task group to define the program and its requirements more fully and securing support from the necessary organizations and individuals.

National Construction Goals Task Group 5

Improve Understanding of Structural Performance

Priority 4	**Perform statistically based assessments of the performance of houses exposed to natural disasters such as hurricanes, earthquakes, and floods. Publish and disseminate the findings of follow-up field studies.**
Time Frame	The time frame for this study must be flexible in that the timing and severity of natural disasters cannot be predicted. A minimum of ten years is recommended. Hurricanes, tornadoes, and other wind events generally occur every year, but frequency and intensity vary considerably. The hurricane "season" is documented, but wind speed, pressures, and landfall cannot be predicted accurately even within 24 hours of advance. Major earthquakes also defy prediction. The potential for wild fires can be predicted on the basis of seasonal weather patterns, but specific outbreaks cannot be predicted. The potential for flooding exists in known watershed areas, but floods cannot generally be predicted.
Related Work	The large volume of related work in this field includes the NAHB Research Center disaster surveys; the roofing industry and American Association for Wind Engineering (AAWE) surveys; and university and international work (Kobe, Japan).
Available Expertise	**General:** Natural hazards research and applications'—University of Colorado at Boulder, insurance industry; **Wind:** Clemson University, Texas Tech University, Texas A&M University, insurance industry, State Farm, American Plywood Association, Simpson Strong Tie, Inc., ASCE, and NAHB; **Earthquake:** Earthquake Engineering Research Institute, NAHB, Applied Technology Council, California Department of Emergency Services, U.C. Berkeley, Buffalo, Central United States Earthquake Consortium (CUSEC), FEMA, U.S. Geological Survey; **Wild Fire:** U.S. Forest Service, NFPA, FEMA, Western Governors Association, insurance industry; **Flood:** Association of State Floodplain Managers, FEMA, U.S. Geological Survey, U.S. Army Corps of Engineers.
Resources Needed	Assessments of specific wind and seismic events involving 200 to 300 statistically chosen homes have ranged in cost from $30,000 to $100,000. A $10 million funding pool carried from year to year would support quick action as events warrant over a ten-year period.
Potential Support	FEMA and state emergency management fund for mitigation may be available for this work. Some portion of postdisaster relief funding could be allocated to analyzing housing performance. HUD has sponsored several disaster assessments. Insurance industry support is possible.
Impediments	Immediate postevent assessment is important for accurate determinations of performance. Subsequent environmental circumstances or human actions may disturb the evidence. Access to locations, especially private property, has been difficult to obtain. Typical "sidewalk surveys" may not provide sufficient performance detail. Separate interests create divergent needs and priorities. Lack of coordination in deploying multiple teams to study special features such as structural properties, roofing, or glazing dilutes available resources.
Next Steps	Next steps call for identifying groups currently involved in performance assessment activity and coordinating their efforts and skills; creating a National Natural Disaster Performance Investigation Team; establishing site access protocols that will be honored by federal, state, and local government agencies; jointly authoring investigative reports and establishing a peer review process to review the findings for each event; and publishing the findings.

National Construction Goals Task Group 5

Improve Understanding of Structural Performance

Priority #5	**Work in a public forum or through a consensus process involving a broad cross-section of stakeholders to define baselines for acceptable structural performance of low-rise residential buildings.**
Time Frame	The task would require two to five years, inclusive of typical American National Standards Institute approved (ANSI) consensus committee requirements.
Related Work	ASTM currently provides a forum for the discussion of performance issues through Committee E.06 on Building Performance and its Subcommittee E06.66 on Performance Standards for Dwellings. Most of the interested parties probably are already addressing performance issues through these groups.
Available Expertise	Organizations and groups with expertise in the field include NIBS, NIST, NAHB, ASCE, ASTM ANSI, building material manufacturers and their associations, the USDA/Forest Products Laboratory, the insurance industry, building officials, the National Consortium of Housing Research Centers, various schools of engineering and architecture, and federal agencies such as FEMA and HUD.
Resources Needed	Sponsorship through an existing consensus group such as ASTM E06.66, ANSI, or ASCE would be desirable. Key interests should be surveyed to determine each group's desired baseline. Study is required to determine the extent of the need to refine definitions of affordability and appropriate cost-benefit criteria. Contract work in support of the full effort could cost an estimated $250,000 per year.
Potential Support	Potential sources of support include ASTM, ASCE, ANSI, ICC, NAHB, the insurance industry, FEMA, HUD, and NSF.
Impediments	Determining which factors to use to establish baselines and the relative weight to be assigned to each will pose great difficulties. Lack of accurate research information in areas such as actual performance and whole-structure modeling will contribute to the level of inaccuracy inherent in setting calculable base points. The definition of cost-benefit criteria is likely to vary among participants. Separate baselines may be required for different types of risks and disasters. Other issues include consumer attitudes toward the importance of structural performance, concerns for affordable housing, and different viewpoints among key interests.
Next Steps	Next steps call for surveying key interests to determine the extent of disparities in approach and viewpoint, determining the various interests' optimum baselines, and obtaining funding for affordability/cost-benefit research. Other actions call for investigating the possibility of including this work under ASTM E06.66; applying for committee, subcommittee, or task group status at ASTM and Materials; or encouraging the formation of a standards committee at ASCE.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #1	**Perform research leading to development of cost-effective rehabilitation techniques for major systems such as foundations, mechanical systems, and electrical systems; for increasing energy efficiency; and for reducing the cost of lead-based paint abatement.**
Time Frame	At least four years will be required to gear up and achieve major accomplishments, although limited work is already underway.
Related Work	Related work includes the HUD-sponsored: *The Status of Building Regulations for Housing Rehabilitation* and *Nationally Applicable Recommended Rehabilitation Provisions; Innovative Rehabilitation Technologies—A State of the Art Overview*; *U.S. Department of Housing and Urban Development Rehabilitation Energy Guidelines for Multi-Family Buildings, for One-to-Four Family Dwellings*; *The Rehab Guide: Foundations* (first in a series); *U.S. Department of Housing and Urban Development Rehabilitation Guidelines*; and *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*.
Available Expertise	Sources of expertise include HUD indefinite quantity contractors, The Enterprise Foundation, the HUD Lead-Based Paint Office, NIBS, the NAHB Remodelors™ Council, DOE, the insurance industry, and building officials.
Resources Needed	At least $2 million in funding for research would be required. The project would also require demonstration sites and interested participants.
Potential Support	Potential supporters include the federal and state governments, the NAHB Remodelors™ Council, universities, Realtors, home inspectors, building code departments, and other groups working in inner cities.
Impediments	Impediments include a preference for creating new suburbs and the accompanying resistance to investment in existing housing stock and a lack of incentives.
Next Steps	The next step is to gain greater support for rehabilitation within existing initiatives such as the National Construction Goals Project, Buildings for the 21st Century, and HUD's National Homeownership Strategy program. It will be necessary to define user needs and to pass on to manufacturers opportunities for solving major problems.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #2	**Develop consensus-based performance standards for residential construction that can also guide product development. Promote national and international acceptance of the standards. Develop companion evaluation criteria and methods to guide product, system, and house design approvals.** This task involves identifying performance attributes unique to residential construction for which national consensus-based standards do not exist; determining if interest is sufficient to create a "balanced" committee as required by the ASTM or ANSI process; and initiating the standardization process, including creation of acceptance criteria by following either the ASTM or ANSI process.
Time Frame	The task will require three to five years.
Related Work	Related work includes development of the ICC Codes: ASTM EP6.66 and ISO WG-10.
Available Expertise	Sources of expertise include home builders, manufacturers, model code organizations, HUD, NIST, the NAHB Research Center, ASTM, and ANSI.
Resources Needed	Funding by interested parties and organizations is required to support participation in the national voluntary standards process.
Potential Support	Potential supporters of the project include home builders, manufacturers, NES, NIST, and the model code organizations.
Impediments	The work will be hampered by the time required to achieve consensus, particularly the resolution of all substantive negative ballots as required by the ASTM and ANSI processes.
Next Steps	The next step is to create a task force to identify standardization opportunities.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #3	**Monitor, analyze, and publish reports on new home-building products and materials in order to provide potential adopters with information about their uses, features, reliability or effectiveness, and the needs they could serve.** This project would use concise engineering analysis as the basis for approval of innovative products, materials, construction systems, and design methods. Reports would include information on compliance with applicable codes and standards and would describe parameters for proper installation and use. Enhancements to the current product evaluation system would improve measures of reliability, effectiveness, and performance needs that extend beyond regulatory requirements. Widespread use of such an enhanced evaluation system by home builders would help reduce the risk associated with using new technologies.
Time Frame	Three months would be required for assessment and identification of candidate technologies and two years for a pilot evaluation.
Related Work	Related work includes the CERF Partnership for Building Innovation, NES, and HUD's Technical Suitability of Products Program.
Available Expertise	Sources of expertise include CERF, NES, and the NAHB Research Center.
Resources Needed	The project would require $20,000 for the assessment estimate and $50,000 to $100,000 for the pilot program.
Potential Support	Potential supporters include HUD, CERF, NES, NAHB, NIST, DOE, and manufacturers.
Impediments	Impediments include providing enhanced national evaluation service reports to home builders.
Next Steps	Next steps call for the development of detailed procedures for an enhanced national evaluation service, the identification of experts to serve on evaluation panels, and the recruitment of home builders to participate in the planning process.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #4	**Systematically identify, study, and report on alternatives to conventional building products and materials. Disseminate the findings throughout the home-building and regulatory communities.** The rapid rise in lumber prices in the early 1990s stimulated general interest in alternatives to conventional building products. In response, the following tasks have been identified: • Conducting a needs assessment through market research; • Performing evaluations of emerging materials; • Developing and introducing standardized techniques for production and installation; • Documenting results and widely disseminating the information to the building industry and regulatory officials; • Conducting training and educational programs to introduce new products and techniques to builders and trade contractors; • Identifying changing needs in the industry and seeking product and materials solutions; and • Coordinating communications outreach through the NAHB Research Center's HomeBase program.
Time Frame	This multiyear program would track changing needs in the industry.
Related Work	Under contract to HUD, the NAHB Research Center has conducted an extensive evaluation of steel and concrete structural systems. The Research Center developed standards for residential steel framing and introduced them successfully into the *CABO One- and Two-Family Dwelling Code*. It is also performing work on precast and prestressed concrete systems and innovative concrete masonry systems. The lumber industry has undertaken considerable development of engineered wood products and systems. Additional work in plastics and composite materials is under development.
Available Expertise	The NAHB Research Center possesses expertise in wood, concrete, and steel. Expertise in materials is available at the American Iron and Steel Institute, National Concrete Masonry Association, Portland Cement Association, the Society of the Plastics Industry, the American Plywood Association, and the U.S. Department of Agriculture's Forest Products Laboratory. Additional expertise is available at HUD, selected universities, the R&D departments of product manufacturers, the national laboratories, the CONMAT program of CERF, NIST, and NES.
Resources Needed	HUD has played a pivotal role in the investigation of alternative building materials for the building industry. It has generally required matching private sector funding for work in this field. A $1 million combined federal/private budget is needed for this project to undertake alternative materials identification, evaluation, documentation, and information dissemination.
Potential Support	In addition to HUD, continued private sector support will be required from the steel, concrete, concrete masonry, wood, plastics, and composite materials industries.
Impediments	A potential impediment is HUD's failure to provide the continued funding that would stimulate matching private sector involvement.
Next Steps	Next steps are to develop a strategy to obtain continued federal support matching funding from manufacturers of emerging building technologies.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #5	**Sponsor and publicize comprehensive demonstrations of an array of new products and systems in completed homes, with follow-up monitoring, evaluation, and reporting.** Some innovative building technologies promise to bring proprietary benefits to an entrepreneur or sponsoring organization. In these cases, private industry has an incentive to fund field evaluations of product performance so that the building industry can determine whether to adopt a product. Other building technologies, such as frost-protected shallow foundations, are not proprietary. Such technologies offer the public sector an opportunity to advance the understanding of installed performance. In either case, a real-time program of systematic research and evaluation of building technologies that involves builders and contractors is clearly needed. This program would develop demonstration houses that incorporate a range of innovative building products. It would also evaluate new materials and techniques in builders' for-sale houses. Long-term performance should be tracked, but studies of installation and short-term performance should also be conducted.
Time Frame	This project is a multiyear effort.
Related Work	The NAHB Research Home Park provides an environment for the public and private sectors to sponsor research houses for testing and evaluating new building technologies. Both product manufacturers and HUD sponsor evaluations of new building technologies in for-sale housing throughout the country. HUD also created the Joint Venture for Affordable Housing, a national demonstration of innovative techniques and products. DOE is sponsoring research and demonstrations in several locations through its Build America program.
Available Expertise	Sources of expertise include the NAHB Research Center, product manufacturers, HUD, DOE and its contractors, and the national laboratories.
Resources Needed	Field evaluations and demonstrations of technologies involving public sector support would require approximately $1 to $2 million per year. The building industry would match the funds.
Potential Support	Potential supporters include HUD, DOE, EPA, FEMA, and DOD in addition to private sector industry participants.
Impediments	Many difficulties are involved in bringing together numerous materials and resources important to research and evaluation projects. To complicate the task, the home must be built in a short period so that results can be made available to the industry in a timely manner.
Next Steps	The next step is to create a focused program of field evaluation and demonstration that provides efficiencies in research investments.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #6	**Organize and promote regular workshops, conferences, and other meetings of representatives of product developers, regulators, and end users to define needs and explore opportunities relating to building materials, products, and systems. Develop and publish results of the discussions.**
Time Frame	This activity would require 12 months to define an entity to manage the activity, specify research topics, choose meeting locales, plan sessions and prepare promotional materials, and assemble staff. The program would require two to three years of operation before its value could be clearly established.
Related Work	The NAHB Research Center has been active in sponsoring or cosponsoring meetings and seminars on topics of interest to builders. The Research Center also cosponsors an annual roundtable of builders and manufacturers to discuss issues of mutual interest. The HomeBase Hotline, operated by the Research Center with manufacturer support, serves as an information source for builders. The Pennsylvania Housing Research Center has been holding two-day sessions for builders and manufacturers for the past five years at the Pennsylvania State University. Other universities that are members of the 18-member Consortium of Housing Research Centers have similar programs. NIST also operates several related programs.
Available Expertise	The NAHB Research Center and the Consortium of Housing Research Centers can build on considerable experience. NES, CERF, HUD, NIST, and DOE all have programs and expertise in this area.
Resources Needed	Staff would be required to manage the program. Activities would include organizing seminars, researching topics, analyzing the value of seminars to the building community, and disseminating information. An estimated $300,000 per year would be required to support a staff of two or three persons and to provide facilities.
Potential Support	Manufacturers, DOE, NIST, and state governments are among potential sources of funding. The most logical location for the staff would be the NAHB Research Center.
Impediments	The major impediment to this project is likely to be funding. With corporate downsizing and reduction of government spending, the program may be difficult to sell. Additional problems relate to the challenge of enticing builders to attend seminars. A large percentage of builders are small business owners who are reluctant to take time away from their business operations. In addition, information on innovative products is often poorly disseminated to builders.
Next Steps	Next steps are to identify individuals who would be willing to explore sources of funding and to write proposals.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #7	**Investigate and publicize opportunities to achieve energy savings while reducing costs and/or improving durability. Consider the relationship of energy conservation to the building's structural integrity, indoor air quality, and moisture control.** This task involves identifying existing energy-saving technologies, products, and construction techniques; creating a methodology for assessing impact; and determining the costs/energy-savings relationship and each technology's relationship to durability. The activities under this task are interrelated and based on the same information. In many areas, the information already exists but must be brought together in usable form.
Time Frame	The project will require three years. Year 1 activities would include extensive roundtable reviews among builders, manufacturers, and industry experts. Year 2 and 3 activities would include disseminating information on energy-saving technologies to builders, with some level of adoption into construction practices.
Related Work	Related work includes DOE's Building America initiative, which is a several-year research project; NAHB Research Center publications such as the *Manual of Lumber and Plywood Saving Techniques for Residential Construction, Alternatives to Lumber and Plywood in Home Construction*, *Cost Effective Home Building: A Design and Construction Handbook*, and *The 21st Century Townhouses: An Illustrated Guide*. Other sources include the National Fenestration Rating Council (NFRC); research conducted by product manufacturers and associations; the joint NAHB and HUD Housing Affordability through Design Efficiency Program; energy-savings strategies advanced by the national laboratories; and the NIBS Building Envelope and Thermal Environmental Council.
Available Expertise	Sources of expertise include DOE, the NAHB Research Center, NAHB, the National Fenestration Rating Council, HUD, ICC, DOE, and the CABO Model Energy Code.
Resources Needed	To evaluate energy savings, cost savings, and durability properly and fully, the project requires a sufficiently large representation of manufacturers, builders, and technology experts in collaboration with representatives of federal programs.
Potential Support	Potential supporters include DOE and product manufacturers.
Impediments	Significant impediment may be insufficient funding to achieve effective compilation, analysis, and dissemination of information on energy savings, payback on investment, life-cycle cost versus first cost, and effects of products on system performance and long-term durability.
Next Steps	Next steps call for forming a committee to outline the opportunities to be reviewed with builders; determining through roundtable discussions the practicality and savings for each product and technology; and using current field research projects, where necessary, to develop accurate cost accounting, energy audits, and durability verifications.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #8	**Investigate and assess the feasibility of an insurance/warranty coverage program for innovative products through federal sponsorship, reinsurance, or other means that provides similar protection.** An insurance/warranty program that covers innovative products would reduce home builder risk in adopting such products. This action item proposes the investigation of practical means for making such protection available through federal sponsorship, reinsurance, or another mechanism. This item is linked to other action items that seek an improved evaluation process for new technology and that could serve as a prerequisite to insurance. Specific steps include conducting a study of the mechanisms, features, and costs and benefits of domestic and international warranty programs in the construction field and other fields of innovation; conducting a survey and/or holding meetings and workshops to develop a series of options; conducting a feasibility study of the costs and potential benefits of the various options; developing recommendations for a specific program and implementation organization; and pilot testing the recommended program.
Time Frame	The first four steps would require one year; the fifth step would require two years.
Related Work	Related work includes HUD's ExTech 233 program, the programs of the World Federation of Technical Assessment Organizations, and international work in countries such as Belgium.
Available Expertise	Sources of expertise include the insurance industry, HUD, private sector organizations including developers such as SONY and Disney, and manufacturers such as USG and Armstrong with international markets.
Resources Needed	The first four steps would require $150,000. Costs of a pilot program will be assessed at a later date.
Potential Support	Potential supporters include HUD, the insurance industry, CERF, and NAHB.
Impediments	Impediments will be determined in the feasibility study.
Next Steps	Next steps call for development of a specific proposal and formation of a stakeholder task force to plan the program.

National Construction Goals Task Group 6

Foster Development of Innovative Products and Systems

Priority #9	**Expand opportunities to reduce production costs through the use of recycled materials as substitutes for current products or as inputs into the manufacture of conventional products.** This task includes the following subtasks: • Identifying existing processes for recycling materials for construction purposes; • Surveying manufacturers that use recycled materials to produce their products; • Determining the economics and cost-effectiveness of producing construction products from recycled materials versus producing construction materials from new stock; • Establishing test procedures and specifications to provide the basis for developing building code provisions and other requirements for proper and safe use of recycled materials; and • After completing the first three items above and assuming that cost or energy advantages have been established, begin promotion of use of recycled materials through NAHB publications and other trade and manufacturing organizations.
Time Frame	The first two subtasks could begin as soon as appropriate funding is secured. If manufacturers of a particular recycled material do not have the capabilities, establishment of testing procedures could begin within a year of completion of the first two subtasks.
Related Work	The NAHB Research Center tests and certifies some materials. Oak Ridge National Laboratory performs testing. NIST plans to take an active role in recycled materials research.
Available Expertise	Sources of expertise include DOE's Oak Ridge National Laboratory, the NAHB Research Center, the National Institute of Standards and Technology, and various manufacturers.
Resources Needed	Funding would be required for surveys, testing, standards development, and promotional programs. Annual funding should be at least $1 million in addition to cost sharing by the industry. Prototype whole-building construction research should be conducted on a government/private sector partnership basis and could probably fit into the second generation of the Building America or Buildings for the 21st Century projects.
Potential Support	Potential supporters include public and private organizations advocating environmentally sustainable building construction, manufacturers of recycled materials, the federal government, and the NAHB Research Center.
Impediments	Potential impediments include resistance by the building industry and manufacturers until the economic and/or social advantages of recycled materials can be demonstrated.
Next Steps	NIST, DOE, and HUD should seek additional Fiscal Year 1998 funding for the first three subtasks.

National Construction Goals Task Group 7

Expand Markets and Marketability

Priority #1	**Recognize, document, and promote the practices of builders who are successfully marketing innovative cost-reducing products and systems and/or durability features in their homes.** The majority of builders adopt new technologies only if they observe that other builders use the technologies successfully; they believe that the innovations have been successfully applied in the field under market conditions; and they perceive a financial advantage in using the technologies. Both structured and unstructured demonstrations are needed if innovative technologies are to achieve market penetration. Experience with the technologies should be monitored and the information disseminated. Information gathered in carrying out this action item will reinforce action item #1, Establishing a New Information Structure, and action item #4, Improving the Product Approval Process.
Time Frame	This action process will be a continuing activity. Many elements are already in place informally. Establishing a formal mechanism for both demonstrations and an expanded information feedback system will take approximately two years.
Related Work	Builders rely on several different information sources to learn about new technologies and their successes and failures, including trade publications, company marketing activities, exhibits, and word of mouth. HUD and, to a lesser extent, DOE are carrying out some structured demonstrations with innovators.
Available Expertise	The NAHB Research Center, through its HomeBase system, has extensive experience in collecting and disseminating information on builder experiences. HUD has long-time extensive experience with demonstrations, particularly Operation Breakthrough, the Joint Venture for Affordable Housing, and similar efforts.
Resources Needed	A comprehensive demonstration program of identifying, assisting, and monitoring innovative builders will require approximately $5 million per year in federal support. An expanded information system on all market experiences will require $1 million annually.
Potential Support	Under its existing programs, the Department of Commerce can support some information collection and dissemination, although a more fully developed program will require additional funding. For demonstrations, HUD and DOE may be able to supply a small amount of support under current appropriations, though far less than needed.
Impediments	The greatest impediment to these activities is lack of resources. Nonproprietary activities receive little support from industry. The collection and dissemination of information must be broad-based, objective, and address many nonproprietary systems and products. For this reason, public support will be necessary.
Next Steps	The next step is to develop a strategy to obtain public support.

National Construction Goals Task Group 7

Expand Markets and Marketability

Priority #2	**Identify and evaluate durable products and types of construction that can reduce insurance losses and possibly provide economically based discounts.** While the insurance industry hesitates to promote discounts on premiums because of heavy industry regulation, product failures such as EIFS and the recent losses caused by natural disasters such as hurricanes, earthquakes, and fires have highlighted the important role of durable products in reducing insurance losses. The costs of product failures have been passed on from homeowner to builder to manufacturer. This program would set up a working group comprised of insurance company representatives and others to examine how to approach the issue; evaluate current building practices and products to identify the most fruitful areas of concentration; contact product trade associations to elicit their support; develop a research proposal to demonstrate the ideal new home, featuring improved construction techniques and building products; and conduct a series of seminars around the country to gain regional input and recommendations**.**
Time Frame	This action item would be a multiyear program.
Related Work	The Housing Affordability through Design Efficiency (HATDE) program initiated by NAHB in conjunction with the NAHB Research Center focuses on a range of issues related to the performance of residential buildings. It involves financial and technical support from a broad cross-section of interests, including the insurance industry. The insurance industry and various organizations such as NFPA, NIST and others also have information related to product performance and durability.
Available Expertise	Expert resources are available in the groups and associations listed above. Jay Crandell of the NAHB Research Center is the key contact on the HATDE program (301) 249-4000, x540).
Resources Needed	The HATDE program has developed a research agenda that incorporates input from a broad cross-section of stakeholder groups, including the insurance industry, code officials, NAHB, product manufacturers, and government officials.
Potential Support	Support should be available from federal agencies, manufacturers, NAHB, and the insurance industry.
Impediments	Funding is a major problem, as is the need for creating a consolidated effort involving government, the insurance industry, code officials, research organizations, and the home building industry.
Next Steps	Next steps involve initiating work on the subtasks noted above.

National Construction Goals Task Group 7

Expand Markets and Marketability

Priority #3	**Provide builders and consumers with nontechnical information on the performance advantages and other benefits of innovative cost-reducing products and construction methods.** Builders, consumers, and real estate professionals are unsure about the benefits of innovative cost-reducing products and construction methods. A concerted effort to provide accurate technical information in a nontechnical format is required, as outlined in the following subtasks: • Perform evaluations of innovative materials and systems; • Analyze and document results; • Determine appropriate methods for reaching audiences; • Develop information materials; and • Identify emerging new technologies on an ongoing basis and repeat the above subtasks.
Time Frame	This is a multiyear program.
Related Work	The NAHB Research Center's HomeBase program focuses on delivery of technical information to builders and contractors in a variety of formats, including a toll-free hotline, fax-on-demand, a CD-ROM product catalog, a website, and a newsletter. The program does not focus on consumers. Consumers receive some of their information from publications such as *Good Housekeeping* and *Consumer Reports*. Manufacturers reach the trades and consumers through advertising. A consortium of government and industry interests could synthesize objective research results into information targeted to consumers. The consumer-oriented information would complement the objective information provided to the trades through the HomeBase program. Perhaps *Consumer Reports* could focus on building products and materials.
Available Expertise	The NAHB Research Center possesses expertise through the HomeBase program, including its product manufacturer sponsorship base. HUD, DOE, and the U.S. Environmental Protection Agency (EPA) operate programs targeted to consumers. Product manufacturers and trade associations command expertise in targeting communications to consumers.
Resources Needed	Public service advertisements have limited impact in reaching consumers, but they are less expensive to develop than commercial advertising campaigns. Funding would be needed to develop the program and deliver it to *Consumer Reports* or similar groups.
Potential Support	Support could come from a public/private partnership.
Impediments	The major impediment is defining a clear path that attracts buy-in from the building industry and the public sector. Financial support is the important next step.
Next Steps	Next steps call for focusing on products and systems that meet the requirements of the National Construction Goals in improving first cost and product durability and for developing a program to communicate results to consumers.

National Construction Goals Task Group 7

Expand Markets and Marketability

Priority #4	**Develop or expand recycling markets for all major construction waste products, particularly scrap lumber, plywood/OSB, drywall, and vinyl siding.** Even though material recycling is feasible and often cost-effective, many builders and haulers do not attempt to recover recyclables. In some instances, channels of distribution and markets are unavailable. In other instances, builders and haulers are unaware of existing recycling techniques and outlets. In addition, builders and homebuyers need to demand or use resource-efficient or recycled-content building products. Education of home builders and homebuyers is central to developing and expanding recycling markets. Three major opportunities that require further study are green builder programs, including the potential for a national green builder program that can foster a market advantage for builders who adopt more resource-efficient techniques and materials; cleanup services that can better serve builders and recover construction waste materials; and take-back policies for material distributors that include back-hauling of construction waste as part of product delivery systems.
Time Frame	This is a multiyear program.
Related Work	The NAHB Research Center, with funding from EPA, has just completed a detailed study of construction waste and recovery opportunities. A builder's field guide with how-to information for the industry is available to builders at no charge. In addition, informational brochures for other key players in construction and renovation waste management are under development and will encourage the development of waste reduction and recycling opportunities.
Available Expertise	The NAHB Research Center expertise on construction waste recycling can be used in the development and conduct of pilot projects and in dissemination efforts. Through programs such as Jobs Through Recycling and WasteWise, EPA has established networks to promote recycling that can be used for developing and expanding construction recycling markets.
Resources Needed	Approximately $2 million would be required to conduct pilot projects demonstrating the cost-effectiveness of new approaches to recycling; develop a national green builder program; and integrate the results of the pilots into HomeBase outreach.
Potential Support	The best vehicle is a public/private partnership.
Impediments	In the new field of construction waste recycling, information on techniques, outlets for recyclable materials, and examples of successful operations must be disseminated as a prerequisite to increasing participation. New approaches to waste management as described above must be examined. Infrastructure specific to construction recyclables is lacking and must be supplied.
Next Steps	Next steps call for conducting green builder and recycling pilots as described above and linking other government efforts in recycling market development to these pilots and the HomeBase program.

National Construction Goals Task Group 7

Expand Markets and Marketability

Priority #5	**Quantify the impediments created by large home centers to the introduction of new products.** Manufacturers are not able to use home centers to educate builders and consumers on the performance of their products. While home centers undertake cooperative advertising, they direct it primarily to increasing traffic at the home center rather than introducing consumers to new products or technologies. With the declining influence of independent lumber dealers, manufacturers are losing the communication channel they traditionally relied on to educate their customers.
Time Frame	This action could be completed in 12 months by a market research firm.
Related Work	Several manufacturers and builders have been confronted with this challenge and have taken some actions.
Available Expertise	Most of the expertise in this area resides in the marketing departments of manufacturers. Seminars and "how-to" books can help consumers and builders.
Resources Needed	The marketing research resources required to collect information and establish trends would involve a one-time cost of about $50,000. A team should be formed to determine what actions should be taken on the basis of the research.
Potential Support	An NAHB-industry team could provide financial support.
Impediments	Interest on the part of industrial sponsors may be insufficient.
Next Steps	Next steps call for determining the value of the proposed effort, seeking sponsorship, implementing market research, assembling a team to plan strategy, and forming a task force on marketing information.