PATH Roundtable on Codes:

Removing Building Regulatory Barriers

Prepared by the
International Code Council

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About the International Code Council

The International Code Council (ICC) is a 50,000 member non-profit association dedicated to building safety. The ICC oversees a process in which model codes used to design, construct and operate buildings are developed and made available for adoption. The ICC code development process is controlled by financially disinterested representatives of federal, state and local government agencies. While anyone can participate in the ICC code development process, only public safety officials designated by federal, state and local agencies vote on final code content.

The ICC also develops standards for selected subjects, including accessibility for persons with disabilities, bleachers, manufactured housing construction, and storm shelters. In addition, the ICC provides a range of services to support the implementation and use of its codes and standards. The aggregate of these efforts is intended to assist government agencies in operating more effectively and efficiently by providing a firm foundation for building safety issues.

The ICC has three separate subsidiaries: the ICC Evaluation Service (ICC-ES); the International Accreditation Service (IAS) and the ICC Foundation. The ICC-ES conducts evaluations of building products, materials and systems with respect to their compliance with the ICC codes. Those evaluations are then made available to facilitate the acceptance and use of the technology covered by the ICC-ES report. Many of these reports cover new building technology that might not be specifically covered in codes and standards and would need to be considered on the basis of equivalent performance to the specific provisions in codes and standards.

The IAS conducts a program focused on the accreditation of testing laboratories and quality assurance agencies. As laboratory testing results and third-party quality assurance activities are a part of the building regulatory process, the efforts by the IAS facilitate the acceptance and use of these entities by the building industry and building regulators. The ICC Foundation conducts programs for the public good in the areas of building safety.

Preface

The Partnership for Advancing Technology in Housing (PATH) addresses issues that are perceived to be the primary technological barriers for the homebuilding industry. The 2002 assessment of the PATH program by the National Research Council (NRC) recommended, in part, that PATH activities increase their focus on identifying, understanding and removing barriers to the development and diffusion of new technologies in housing. Barriers to acceptance and implementation of construction innovation due to regulatory processes and requirements (i.e., the "building code") represent such an issue.

To address the above recommendation, the NRC and the International Code Council (ICC), with support from and on behalf of the PATH program through the U.S. Department of Housing and Urban Development (HUD) conceived a one-day Roundtable to address this issue. Participants in the Roundtable were experts who fully understand the building regulatory process and issues associated with technology development and deployment. These experts identified and clarified barriers and opportunities associated with the building regulatory process, as well as provided suggestions to stimulate innovation, in advance of and during the Roundtable. The expected outcome of the Roundtable was research and policy action recommendations that could be circulated to a wider audience for comment and enhancement. These recommendations were also intended to serve as the basis for a follow-up conference on policy decisions to stimulate acceptance of housing innovations.

This report provides information on the planning, execution and outcome of the Roundtable held on December 3, 2003. Most importantly, the report provides information on barriers to technology acceptance associated with building regulatory programs as well as initial recommendations to address those barriers. The difficulty in acquiring and presenting uniform information about issues related to acceptance of innovation (e.g., testing, certification, regulatory criteria and their interpretation, processes for acceptance of new technology, etc.) to all relevant parties (manufacturers, builders, contractors, and code officials) throughout the homebuilding supply chain was seen as a core problem. Consequently, potential solutions focused on the need to develop centralized, standardized, and binding criteria associated with innovation testing and acceptance.

The Roundtable and this report should not be considered an end, but a means to a better understanding of regulatory barriers to technology acceptance.

Acknowledgements

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Contents

Introduction

As part of its strategic goal to increase the availability of decent, safe, and affordable housing in American communities, the U.S. Department of Housing and Urban Development (HUD) has been involved in efforts to advance housing technology through its administration of the Partnership for Advancing Technology in Housing (PATH). This Federal initiative works to accelerate the creation and widespread use of new building products and technologies to improve the quality, durability, environmental performance, energy efficiency, disaster-resistance, and affordability of our nation's housing.

Building regulatory activities directly and indirectly affect new building technology research, development and deployment. For instance, a building technology developer may devote resources to research and development of a building technology, discovering too late in the process that the technology does not meet building regulatory criteria. As a consequence the technology must then be tested, retested, redesigned or significant documentation developed indicating it meets the intent but not the specific criteria of adopted codes. Similarly, local code officials may be reluctant to approve a technology submitted in a homebuilding permit application unless sufficient documentation showing code compliance on the basis of performance equivalency with the code is provided or there is specific guidance in their codes and regulations pertaining to the new technology to minimize the need for such documentation. Builders may also not want to assume the liability for a non-traditional technology or invest the time necessary to secure approval; consequently more traditional technology is used. These and other situations impact the ability for new building technology to contribute to the PATH objectives.

Since its initiation, PATH has developed and implemented a number of programs related to housing. Many of these programs have been associated with development of new building technology and construction practices. Others seek to insure that builders have relevant information to facilitate technology adoption and use. The 2002 assessment of the PATH program by the National Research Council (NRC) recommended, in part, that PATH activities be increased to identify, understand and remove barriers to development and diffusion of new technologies in housing. For this reason, the Roundtable was conducted. This report presents and summarizes discussions held prior to, during, and after the Roundtable.

Roundtable Synopsis

The ICC and NRC, with support from HUD and on behalf of PATH, sponsored a one-day Roundtable on the subject of building regulations as a barrier to building technology acceptance on December 3, 2003, with the hope that key recommendations for new research projects and policy decisions would be made. The agenda for the Roundtable is provided in Appendix A.

While different approaches to designing and implementing the Roundtable were seriously considered, it was decided that a one-day event in Washington, D.C. without a registration fee for a small number of invited experts was the most appropriate way to identify and discuss issues and formulate initial research and policy action recommendations. Experts were to represent code officials, builders, subcontractors,

manufacturers, codes and standards developers, academia, architects, engineers and insurance interests. Individuals associated with each group were contacted, and with the exception of subcontractors and standards developers, representatives from all fields listed above participated. The 24 participants invited to the Roundtable were experts in their field who fully understand the building regulatory process and issues associated with technology development and deployment. (See Appendix B). The Roundtable was intended to channel their expertise so that barriers or opportunities associated with the building regulatory process could be identified, better understood, and addressed so as to stimulate innovation and acceptance of building technology.

Additionally, it was decided that an open discussion prior to the Roundtable would provide preliminary discussion topics, as well as an opportunity to initiate a dialogue on the subject. Consequently all interested parties were provided an Internet address in advance of the Roundtable for reporting problems associated with building regulations or regulatory programs they had experienced with getting building technology accepted or approved. This site was open to public participation and communications about its availability and the desire for input on and experiences related to the subject were disseminated to facilitate public participation. All input received was compiled and circulated to Roundtable participants prior to the Roundtable. (See Appendix C).

Roundtable participants were also given an ICC-developed guide to the technology research, development and deployment process and various problems that could be encountered in securing building technology acceptance to help them focus their input prior to and at the Roundtable (See Appendix D).

Input received pursuant to the Roundtable is summarized below. Detailed transcripts and input on draft materials provided to the participants on the Roundtable results are provided for both problems identification (See Appendix E) and potential solutions (See Appendix F).

Problems

As previously noted, experiences submitted in advance of the Roundtable and experiences and problems raised by participants during the Roundtable are included in the appendices. This section attempts to organize and summarize that information.

As one contributor to the pre-Roundtable discussion summarized:

> *"The effect of this barrier (demonstrating compliance for new housing technology and securing approval) is the lack of innovation in new residential construction. This increases the cost of homes, causes problems with quality and durability, and results in the continued use of antiquated construction processes, methods and materials. This fosters reduced profit for businesses, failure of new businesses, loss of employment, and lower value of homes at higher cost rather than higher value homes at lower cost."*

Problems associated with getting new housing technology more readily accepted can be categorized into a number of areas. Each of these has their own separate and unique issues and entities that can facilitate change. Collectively they impact the ability to implement building technology and achieve the goals of the PATH program with the result as described in the quotation above.

For instance, manufacturers may not be aware of the problems or if they are, they may not be convinced they need to deal with them. Information upon which to base decisions may not be available or what is available may not be targeted to address the needs of key decision-makers. There may be a simple lack of resources to address development and deployment of the information or those needing the information may not have time to adequately consider the information available. What information is available may be misused, creating a credibility dilemma and lack of confidence by decision-makers. Liability for technology performance is a concern for those wishing to deploy as well as approve building technology. In lagging technology development and deployment, building regulations may not provide adequate guidance to facilitate technology acceptance or can even directly or indirectly preclude technology use. If building regulations do provide adequate guidance, the task of documenting conformance and conducting the work needed to validate compliance must still be undertaken, which is dependent upon information that as noted above may not be readily available.

The following is a summary of the problems associated with each of these issues as presented and discussed pursuant to the Roundtable.

Lack of Recognition

For any number of reasons, manufacturers and proponents of building technology may not be aware of the need to address barriers until they encounter them and at that time it may be too late to secure a timely and positive outcome. Alternatively, they may be aware of barriers and choose to ignore them or they simply don't know what steps they need to take to facilitate acceptance. In either case they do not build a basis for technology acceptance, resulting in those being asked to specify, use or approve the technology with little or no information upon which to act. As such users are hard pressed to support the technology. If they do initially support the technology they soon

find out that the lack of needed information is adversely affecting their ability to succeed and they move on to other more traditional technology or new technology that is adequately supported.

Lack of Resources

Time, manpower, money and other resources are needed to conduct the work necessary to facilitate technology acceptance and approval. This includes development and deployment of the information needed to document technology performance and work to develop standards and codes and secure their adoption. It also includes efforts to educate those decision-makers who specify, approve and use technology, and all the other related activities that are needed to ensure a supportive and receptive building construction and regulatory infrastructure. Because many of these activities occur on a specific schedule, they cannot be hurried, even if additional resources and money are available.

Lack of Information

Assuming the manufacturer or proponent of a technology is aware of the need to address barriers to acceptance, the information that is made available to all involved in the process needs to address their informational needs and be readily available. This includes those such as distributors that are affiliated with the manufacturer, as they must carry this information to others in the building industry. Information needs relate to testing and certification, the building regulatory development, adoption and approval process, the performance of the technology alone and as part of the complete building, and how to install and service the technology. Once information is developed it must be effectively and uniformly communicated. Both activities, developing the information and disseminating it, require resources and time.

Misuse of Information

Incorrect information is also a problem, possibly larger than having no information at all. Incorrect information can come from different industries trying to gain an advantage over competing industries. It can also come from within an industry where one proponent of a particular technology presents incorrect or misleading information to the detriment of all other proponents of similar technology. In addition one proponent can take information applicable to one technology and inappropriately apply it to another technology they are attempting to implement or continue to use outdated and incorrect information.

Liability

Fear of failure of a new technology and the associated liability is a problem that causes those who specify, approve or use technology to make sure they do not create future problems for themselves. Even with appropriate information and minimal misinformation there is a fear of blame and the resultant exposure and liability should something unforeseen go wrong. This also extends to insurance interests who may not be inclined to provide coverage. Given technology options, it is clearly an advantage to choose a technology that has proven itself and has a clear record.

Codes and Standards Development and Adoption

Criteria in codes and standards that are prescriptive in nature may not specifically address the new technology, or the paths available in those documents to validate compliance may not readily apply to the new technology. In addition the depth and breadth of prescriptive provisions available for more traditional technology can be a disincentive to using a new technology. The time needed to develop new codes and standards or revise existing ones is also an issue, as is the availability of documentation to support codes and standards criteria and their differing schedules for revision. Developing codes and standards provisions takes time and resources. In many instances it requires information about technology installations that may not exist for a number of the reasons presented above. Technology proponents that are fully prepared to participate in this process may also hesitate to take the lead because they do not want to expend resources that, while creating an opportunity for them, creates an opportunity for their competition.

The inability of decision-makers at the federal, state and local levels to accept changes in codes or adopt newer codes and standards results in continued use of older documents that may not recognize new technology. When new codes and standards are considered for adoption it is also likely that competitors of the new technology will work to have their adoption defeated or have them amended to eliminate consideration of the new technology.

Conformity Assessment

Conformity assessment is focused on determining if some established criteria are satisfied. It includes testing of technology and certification such that continued production of the technology conforms to specified standards. As noted above, standards are critical to this process and, if not available, the basis for acceptance may need to be developed through other means. Such means include an evaluation of the technology to determine its acceptability for use on the basis it provides equivalent performance to other technology that has already been accepted as meeting specific codes and standards. Such evaluations are performed by evaluation services and design professionals.

Evaluation services are sometimes considered difficult to work with because of scheduling conflicts and time sensitivities, costs, credibility, fear of reprisal and lack of an independent mediator. Such services have also been criticized as not being proactive enough in working with technology developers and local officials. Alternatively a registered design professional can conduct an evaluation and prepare the necessary documentation but its acceptance may be limited to the states in which the design professional is registered.

Testing laboratories that conduct testing used as a basis for technology assessment are hired by the technology proponents. To ensure objectivity they are required to be accredited for each particular test, as opposed to their general capabilities and expertise. This adds time and expense to the process of testing.

The lack of standardized criteria for testing complete homes also affects the ability to measure and express how the technology will perform when integrated with other components and systems associated with the building.

Administrative Processes

The administrative process for demonstrating compliance with the codes can be a barrier to the use of new technology. One problem is the difficulty in understanding the code requirements and securing approval when the codes are administered by multiple agencies. Other problems occur when local officials are not familiar with the provisions in the codes (both prescriptive or the use of performance equivalency), offer differing interpretations or have differing documentation requirements. In not having sufficient resources or support for building code enforcement from local government, code officials may not have the time or resources needed to consider approval of new technology or it can cause them to accept only technology that can be readily evaluated for compliance.

Recommendations

The problems, experiences and discussions during the Roundtable, as summarized above and presented in the Appendices, support the following recommendations.

Recognition

Technology developers need to consider building regulatory issues much sooner in the research, development and deployment (RD&D) process. Decision-makers associated with those developers need compelling information that shows the economic, social, visibility and other benefits that will accrue in proactively addressing and managing building regulatory issues and the downside of not acting. Availability of data that show the benefits of addressing these issues reinforced with case studies of successes and failures will be critical to getting the attention of decision-makers and having them develop and implement appropriate actions. The delivery of such information can occur from outside experts and/or internal advocates through various media; the most effective considered one-on-one presentations to management that are tailored to their particular technology and business. Education of those who specify or approve technology as well as consumers who purchase and use technology can also cause an increased demand that will cause decision-makers to allocate the necessary resources to address technology acceptance issues.

Resources

Once a decision to act has been made, resources will be needed to undertake the activities necessary to foster technology acceptance and approval. Advanced planning to identify activities and resource needs in relation to RD&D activities (technology acceptance planning) can enhance the relevance and impact of resource investments. Funding will be needed to underwrite those resources. That funding can be ensured through the availability of a comprehensive cost/benefit message as suggested above coupled with a listing of creative ways to tap into federal, state and local government resources, tax incentives and other funding mechanisms. Qualified professionals with adequate resources to perform will also be needed. Educational programs on codes, standards, conformity assessment, etc., in business and engineering degree programs can ensure the future knowledge base to understand and address technology acceptance barriers. Where resources are limited, partnerships with others in a

particular industry and/or the building industry at large can help build the critical mass of resources needed.

Information

Technology developers and proponents should provide more training on their products. In addition they should provide more thorough installation instructions and information on the technology and its integration and relation with other products and building systems. This can be done on an individual basis or through partnerships with others in industry or the building community at large. It will be critical that technology developers have evidence that testing, quality assurance, codes, standards and other requirements have been satisfied. Industries can work together to facilitate the acceptance of their collective products, and their trade associations should be proactive in working with the building regulatory community and others early on in technology development. Technology developers should also work more closely with progressive building regulators who can provide guidance on technology approval issues. In addition they should generally be more inclusive of the building design, construction and regulatory communities early in technology development. Tracking of codes and standards development activities, meetings and conferences and other external activities that impact technology acceptance or provide a venue for communication are also important considerations.

Liability

The issue of liability must be addressed in a manner that facilitates new technology development, application and use while protecting those who specify, apply, use and approve the technology. For instance, when using a performance code, insurance interests should be involved as part of the review process. Consideration should also be given to providing warranties for all new products and mechanisms established to secure warranty enforcement under state consumer laws and removal and replacement of new technology should it fail. Federal programs or bonds to establish resources to address replacement of new technology are also a consideration. The use of limited field testing of technology prototypes could advance key information on the technology and act as an information resource while limiting exposure. Where the technology is heavily dependent on installation for correct performance, requirements for trained and licensed installers and contractors can also limit problems and, as such, reduce the incidence of failure.

Codes and Standards Development and Adoption

All involved in the building community should become more involved in the development of codes and standards and the development of research, testing, documentation, and other information necessary to foster the changes and system enhancements needed to address new technology. Federal, state and local interests should become more involved in and use the results of the model code and standards development process and limit their amendments to the resultant documents when they are adopted to yield a fully adopted national, uniform and coordinated set of codes and standards. Ideally states should establish statewide requirements that are as consistent as possible with national codes and standards. To foster increased consideration of new technology, an increased emphasis should be placed on the use of performance codes and tools such as evaluation reports. In addition U.S. codes and standards should be brought more in line with international provisions. Emerging issues such as durability should be

addressed through the development of criteria to ensure uniformity with respect to measuring and expressing technology performance.

Conformity Assessment

The conformity assessment system needs to become: more efficient; readily recognized; and relied upon on a uniform basis by building regulators. Evaluation services should establish guidelines and other criteria that outline documentation needed to facilitate evaluation and acceptance, review and accept information and issue reports in a more timely manner; and be held accountable for their actions. Separating life-safety issues from other issues could possibly hasten the consideration of some technologies, as could the issuance of conditional or limited acceptance. Testing, quality assurance and evaluation service efforts should also be enhanced to address systems integration issues. The importance of testing and quality assurance agency involvement in this process also supports the development of ways to accredit such agencies in a timely manner that also recognizes as many of their capabilities as possible with the least number of accreditations.

Administrative Processes

Code officials need to have clear and timely information on what products have been tested and certified to help them in uniformly reviewing and approving technology installations. As noted above, education of code officials on new technology and the basis for evaluation and acceptance will enhance their willingness to consider new technology. Education of the building community on all aspects of the process will ensure that they are adequately prepared when seeking approvals from building regulators.

Providing the state with the authority to override local decisions related to acceptance of new technology in states where there is a statewide code can facilitate uniform acceptance of technology. To the degree that code officials are willing to delegate authority for consideration of new technology, reliance on conformity assessment activities conducted by private-sector interests could be increased.

Appendix A

PATH Roundtable

December 3, 2003
National Research Council
500 Fifth Street, NW
Washington, D.C.

Purpose - to identify ways the building approval (e.g., the code implementation and enforcement) process and related activities can be enhanced to stimulate or support technology innovation in housing.

Expected outcome - recommendations in the form of an action plan that PATH and others can implement to facilitate more timely and informed regulatory approval of new building technology in housing.

Agenda

8:00 to 8:30 a.m.	Registration (coffee, rolls and fruit)
8:30 to 8:45 a.m.	Introduction and overview to PATH (Bres), NRC (Little) and ICC (Conover)
8:45 to 9:15 a.m.	Presentation of relevant background information and overview of the building technology development and deployment process (Bres and Conover)
9:15 to 9:30 a.m.	Technical and social value integration (Little)
9:30 to 10:00 a.m.	Presentation of and discussion on specific experiences from participants
10:00 to 10:20 a.m.	Break (refresh coffee and rolls)
10:30 to 11:30 a.m.	Presentation of and discussion on specific experiences from participants (continued)
11:30 to 12:00 p.m.	Moderated discussion to identify issues and problems
12:00 to 1:00 p.m.	Lunch (tickets provided for atrium lunch area)
1:00 to 2:00 p.m.	Moderated discussion to identify issues and problems (continued)
2:00 to 2:15 p.m.	Break (soda, coffee and cookies)
2:15 to 3:45 p.m.	Moderated discussion to agree on recommended actions that address issues and problems
3:45 to 4:00 p.m.	Wrap up and identification of next steps (Bres)

Appendix B

Attendees - Technology and Building Code Roundtable

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Appendix C

Experiences with the Building Process Prior to the Roundtable

This document presents information received from individuals involved in the building industry with respect to their experiences with approval and use of new technology in housing. This information was provided to ICC via a notice on the ICC website during October and November 2003 requesting such information. The document also includes relevant information on barriers to technology acceptance and approval from two other resources.

This information is important background information for the Roundtable that was conducted December 3, 2003 to address barriers to acceptance and approval of new housing technology and to recommend actions the PATH Program may take to minimize those barriers.

A summary of the barriers or problems submitted in advance of the Roundtable is included in the list below. The term "conformity assessment" has a broad scope and includes any and all actions (e.g., testing, quality assurance, assessment, evaluation, etc.) that are related to determining if a particular item satisfies certain criteria and conditions. The terms "evaluation" or "evaluation services" are also used and refer to one aspect of conformity assessment that is focused on the review of test data, calculations and other supporting information to determine compliance with building regulatory provisions.

- The process for demonstrating compliance with building codes is overly burdensome.
- Provisions in the model codes directly or indirectly prohibit or preclude new or innovative designs (e.g., solar).
- Prescriptive provisions in the codes tend to focus on certain materials (such as wood) to the exclusion of others. The availability of such provisions adversely affects the desire or ability to use other products in a home.
- State and local political forces cause revisions to model codes to address cost or construction issues, and this makes it more difficult to apply the outcome of national conformity assessment activities to state and local codes.
- When making changes to the model codes at the state or local level, limit the changes and involve code enforcement personnel.
- When codes (i.e., electric, plumbing, fire, etc.) are controlled by multiple agencies it creates additional complexity.
- The members from the building industry on a committee developing a state or local building code seem to be unable to accept the newer edition of a model code and want to make modifications to that code creating differing state and local requirements throughout the U.S.
- There is a lack of complete information on products, technical requirements, the approval process and an understanding of information available.
- New technology is usually not in the code and there is a significant lag time to include the new technologies in the code.
- If new technology is not specifically addressed by the code text, then an engineer is needed to approve the new technology, which increases costs.

- The time involved to approve and secure a permit to use non-traditional products needs to be addressed.
- There is a cost for innovating and a lack of incentive for investing in innovation.
- There is a lack of resources to properly design and manufacture a new product and pay for services of engineers, testing services, metallurgists and others in the product development process.
- There is a lack of standardized testing for complete structures.
- Having to test to ASCE 7 and then conduct more tests for individual state requirements creates problems.
- Manufacturers fear reprisal by an evaluation service if they were to dare to report their opinion.
- Responsiveness of evaluation services needs to be addressed.
- The evaluation service process is difficult, inefficient, arbitrary, and costly and evaluation services suffer from a mistaken view of their role.
- There is a lack of independent appeal to others when conformity assessment work bogs down.
- There is a lack of "openness" in the conformity assessment process and ability of the process to control technology acceptance without being held accountable for lack of timely action.
- Disagreements between those in the conformity assessment arena and proponents of new housing technology need to be addressed.
- Large retailers try to sell products in all states without knowing whether the products are approved or not.
- Users or purchasers of products believe that a retailer would not be selling a product unless it is approved (and then may find out later during the permit or inspection process that it is not approved).
- The building community does not know how building systems work.
- Many are used to doing things one way and refuse to learn new techniques or to instill quality in their work.
- Too many only look at the bottom line and fail to realize that defects in construction, are far more costly and stressful that just doing things correctly the first time.
- The contractor requirements for licensing and continuing education are minimal or non-existent, yet inspectors must be licensed and conversant in the codes they enforce.
- The average construction worker knows remarkably little about what they should do and even less about why they need to do it.
- The quality of workmanship overall has not kept up with the improvement in quality of homes (due to improvement in materials and products).

A summary of recommended solutions or actions to address those barriers or problems submitted includes the following:

- Get the technology developer to work more closely with the building regulatory environment (early on and through the stages of technology development and deployment).
- Develop a relationship with a progressive building official who can help the technology developer understand and work through the codes (and approval process).

- Utilize available evaluation services.
- Secure necessary evidence that the technology has satisfied required testing and quality assurance criteria.
- Develop design guides that show how to build solar homes and comply with the model codes or exceed them and express the level of "excess compliance".
- Have the evaluation service establish the requirements for the evaluation of product review and accept the information submitted by the manufacturer in response to the evaluation service requirements, and then promptly issue the evaluation report.

The actual responses received are provided below and are separated by dotted lines (-------)

The most important factor is for the innovation developer to work closely with and embrace the regulatory environment. This works best if they can initially develop a relationship with a progressive building official to guide them through the codes.

The evaluation services process is particularly suited for wide range acceptance of new products and design methods. Staff is accustomed to innovation. The Evaluation Services Committee is made up of building officials that have demonstrated an interest in innovation by applying for service on the committee. This collection also has the benefit of diverse experience and working environments.

Obtaining an evaluation report demonstrates a minimum level of competence and acceptance and approval by a segment of the regulatory community. It is also easier for a less sophisticated building official to review the documentation and feel comfortable that experts in innovative technology have determined that there is some merit to the proposed innovation. An evaluation report is also evidence that the proposed technology has passed a minimum test regimen and that there is a quality control process in place.

I am a solar thermal home designer frustrated by the International Building Code (IBC) code restriction placed on type 5 constructions. The IBC code forbids a third floor of living space regardless of the height of the house *(This was determined upon review of the IBC to be an incorrect statement as the IBC does allow a third floor of living space)*. This code restriction stands in the way of practical solar home designs. The reason for this problem has to do with the cost of using the entire surface area of a roof for solar heat gain and the lack of incentive for doing so. A third floor is a natural consequence of a well-designed solar thermal house. That floor could be a tax exempt attic or it could be tax exempt living space. If the solar thermal home third floor could be tax-exempt living space I believe more residential homebuyers would be motivated invest in solar applications.

Having invented a new method of building affordable housing I have encountered many times the belief that the only type of structure that would meet codes is made of wood, because that is what is featured in the code books. Plus, the lack of standardized testing for complete structures creates market entry problems. Investors are turned off by having to test for FL, then CA, this is on top of many thousands of dollars in ASCE 7 related testing. And, the problem in providing housing is not a structure problem, but a mortgage problem. Our mortgage system is broken and no one is trying to fix it.

The context of the remark is in reference to this particular company's experience in obtaining evaluation reports, which flows to the entire issue of code compliance verification. The crux of the mater can be expressed as an attitude of "them versus us", and the barrier can be stated as the difficulty of obtaining code acceptance/approval of innovative new products. It is most unsettling to find fear of reprisal on the part of a manufacturer if they were to dare to report their opinion.

From a business and manufacturer's point of view, the function of a code evaluation service should be to facilitate and expedite the evaluation and subsequent issuance of evaluation reports. The manufacturer recognizes that an evaluation report is critical for market acceptance of new and innovative products, and the manufacturer is anxious to demonstrate compliance with code requirements for numerous reasons. The evaluation service should establish the requirements for the evaluation of products, review and accept the information submitted by the manufacturer in response to the evaluation service requirements, and then promptly issue the evaluation report. In the manufacturer's view, the manufacturer has spent substantial resources to properly design and manufacture a new product, and has paid for the services of professionals such as engineers, testing services, metallurgists and others in the product development process.

This manufacturer has experience that leads them to believe the evaluation service views itself as a hurdle over which those with new and innovative products must jump. The following journals of events, which have been purposefully stripped of identifying information, are offered to demonstrate how this opinion has been reached:

Journal 1

1. Evaluation report application submitted
2. Application review did not begin until four months after submission.
3. Applicant did not receive a response and request for more information until 13 months after submission.

Journal 2

1. A technical revision to a report required 17 months and a fee in excess of $22,000. The technical revision did not require submission of any new technical information.

Journal 3

1. An effort to obtain a report was abandoned after spending more than 4 years and close to $50,000.

One of the major aggravations is the lack of an independent appeal process. In business, if customers are not properly served, the customers can go elsewhere. In this case, there is no where else to go. The process is not conducted "in the light of the sun". There are few institutions in the US that exert so much control over businesses and citizens without accountability. The role of the evaluation service should be to set evaluation protocol, and then to insure the applicant follows the protocol. The evaluation services should be enthusiastic, helpful, and timely in moving new technologies and

manufactured products through the evaluation process. This process should take days or weeks, not years.

In summary, the process for demonstrating compliance with building codes is a substantial barrier to the use of new and innovative technology innovation in the residential building industry. In particular, the evaluation service process is difficult, not efficient, arbitrary, costly, has little sense of fairness, and the evaluation services suffer from a mistaken view of their role.

The effect of this barrier is the lack of innovation in new residential construction, which increases the cost of homes, causes problems with quality and durability, and results in the continued use of antiquated construction processes, methods and materials, reduced profit for businesses, failure of new businesses, loss of employment, and lower value homes at higher cost, rather than higher value homes at lower cost.

Large retailers purchase products and try to sell them in all states not knowing if they are approved or not, which if not approved will cause friction between the inspector and installer. They believe that the retailer would not be selling the product unless it is approved.

In South Carolina we have adopted the I-Codes yet state and local politics and elected officials seem to be determined to rewrite them. This is based on cost as you can guess. We keep asking them (those responsible for state code adoption) to limit their changes and involve code enforcement as much as possible. It is getting better as it goes but there is much room for improvement.

The primary problem with implementing new regulations and technology is the ignorance of the building community in understanding how building systems work. Far too many are used to doing things only one way (even if it wrong) and refuse to learn new techniques, or instill quality control in their procedures so that every project they do from the minor remodel to large new construction consistently applies the right products and techniques to produce a lasting result. Too many only look at the bottom line and fail to realize that defects in construction, lengthy punch lists at substantial completion, etc. are far more costly and stressful that just doing it right the first time.

The contractor requirements for licensing and continuing education are minimal or non-existent. We require inspectors to be licensed and conversant in the codes they enforce; yet the average construction worker knows remarkable little about what they should do and even less about why they need to do it.

I am convinced that the quality of homes have improved over the past two decades primarily due to the improvement of materials and products, yet the quality of the workmanship overall has not kept up with this improvement--even declined in some cases.

New technology is usually not in the codebook and there is a great lag time to get some of the new technologies in there. If it is not in the codebook, then great expense is occurred with engineer cost to sign off on them.

I am currently working with the MA State BBRS in developing a new 7th edition State Building Code and I find a number of the members on our committee from the building

industry seem to be unable to accept changes that are in the International Residential Code (IRC) and IBC such as egress window size and riser and tread depths. Here in MA we have a big problem because all of the codes (i.e. electric, plumbing and fire codes) are not under the control of one regulatory agency.

Relevant information from two other sources is provided below.

PATH Technology Inventory - Insulating Concrete Forms

Model Code or Local Code Issues/Barriers

Potential issues or barriers to use of insulating concrete forms (ICFs) may be encountered. Among these include the following items which discussed with in more detail below:

- General unfamiliarity of code officials and inspectors with the product
- Fire issues due to the use of foam
- Termites and the use of foam below-grade
- Structural concerns, especially for high loads due to backfilling, wind, earthquake; special constructions; attachment/integration of walls, floors, roofs; and proper filling of forms with concrete
- Moisture protection
- Attachment of finishes

General Unfamiliarity with Product/ Builder Experiences

A builder in Iowa has experienced problems with code acceptance of ICFs in the past. For example, after using the product for three years, his local building department required that the unfinished basement walls be dry-walled and taped. After complying with this fire-related requirement, the electrical inspector determined that there were an insufficient number of receptacles in the "finished" basement. The problem was resolved. However, problems like these can occur until inspectors are familiar with the product.

Another builder in Florida mentions that they have problems periodically with acceptance of ICFs by local code officials. Whenever they go to build in a new municipality, one in which ICFs have not been used previously, he has to educate the code officials. His company does this by presenting a video, manufacturer installation manuals, information on acceptance in other areas, and structural calculations performed by the manufacturer’s structural engineer. If the code official is unfamiliar with ICFs, they will hear, "Huh? What is that? You can't build out of foam!" and, "Why are you putting all that steel in there?" When these questions are addressed in a clear concise manner in terms the code officials can understand, acceptance typically follows.

Fire-related Codes Provisions

While building separation, protection, and flammability requirements of building codes vary between jurisdictions and the different model codes, there is typically a requirement that foam in the interior of a house (or other building) be covered with a minimum 15-

minute fire-rated assembly to prevent smoke development or combustion. For houses using ICFs in normally unfinished areas such as basements and habitable attics, this would typically require placing drywall or another 15-minute fire-rated material over the foam.

Building officials have expressed some concern about how floor joists are integrated with ICFs. The *Prescriptive Method* (a set of criteria added to the International Residential Code to facilitate review and approval of ICFs) should be consulted for details of floor construction with ICFs.

Foams used in construction contain additives that retard combustion in order to meet surface burning requirements of many codes. ICFs are treated so they will not support combustion. Tests show that the flame-spread rating for foams is better than for most wood products.

PATH: Roadmapping Group Seeks to Improve Houses With Advanced Panelized Systems (selected excerpts)

On the technical side, the industry faces issues such as transportation economics, change order flexibility, and labor training (rough carpenters often are not familiar with the assembling of panels). In addition, most panels are shipped as "open" panels so inspectors may view the installation of plumbing and mechanical systems. The need for this visibility may limit innovation in "closed" panels that have fully integrated wall and floor systems.

Following that initial discussion and planning meeting at the NAHB Research Center, sub-groups of the larger group are continuing to define specific, time-phased research and development activities required to implement these technologies. The roadmap for the advanced panelized-type system is scheduled for completion by mid-2001. The PATH Roadmaps are intended to help coordinate and leverage private sector and public sector research and development for maximum benefits. The completed roadmaps will, among others, facilitate or encourage joint private/public sector activities that will reduce or eliminate barriers to achieving the vision—e.g., development of connection and panel standards to speed construction.

Appendix D

Overview of the Research Development and Deployment Process

The purpose of this document is to provide a "template" to facilitate advance thought as well as framing the discussions and recommendations at the PATH Roundtable on December 3, 2003. It identifies and describes a number of activities that occur in the product development, deployment and implementation process and provides "seed" problems associated with acceptance and approval for each activity and a "placeholder" (blank bulleted line) for inclusion of others during the Roundtable.

The manufacturer or proponent of housing technology performs many of the activities that are listed. Along the way, other parties become involved with the technology and may therefore impact the process. As users of the technology, builders will relate to issues associated with the ability to readily apply for and secure approval for the technology. Building officials focused on building and regulatory approval will likely be more involved than others during deployment and approval processes. Conversely, a testing lab or quality assurance agency will be involved prior to and during market entry. Architects, like builders, may want to specify the technology and see a practical application of the technology and will then focus on securing timely acceptance and approval.

In reviewing the suggested activities and descriptions below, thought should be given to particular problems that could be encountered regarding technology acceptance and approval. This "template" will be used during the Roundtable to facilitate reporting of problems and solutions relevant to the product development and deployment processes.

Activity	Description	Problems Related to Technology Acceptance and Approval
Research		
Idea generation and brainstorming.	Describe the vision of the technology, what it accomplishes, how it works, etc.	• Existing codes and standards provisions adversely affect technology. • Relevance of codes and standards may not be known. • Testing requirements unknown. • Problems unknown or impossible to determine. •
Conceptualization.	Begin to put “pencil to paper”.	• Funding to support identification and resolution of problems may not be available. •

Business assessment and early investment development.	Review the product's business potential and start to garner internal and/or external financial support.	• Those controlling the business and finances are not told about acceptance and approval issues and resources needed to address them. •
Research and design.	Begin to conduct research that will support product development and initiate conceptual design work.	• Need for testing and documentation unknown. • Need for codes and standards conformance and documentation unknown. • Those doing research and design are not interested in regulatory approval issues. •
In-house lab testing and validation.	Conduct internal testing to confirm product development can continue and will pay off.	• Don't know what testing to do to support codes and standards compliance. • Focus is on performance of product rather than on code compliance. •
Development		
Prototype.	Develop, engineer, and build a working model of product or building technology.	• Need to document and verify compliance with codes and standards. • Lack of financial resources or knowledge of the regulatory process. •
Field testing.	Install prototype and gather data on its performance.	• Don't know how to communicate about code compliance or who to work with. • Lack of resources and support. •
Revisions.	Revise the prototype based on field testing results.	• Lack of time and resources to develop codes and standards. • Reluctance to make changes and support "free riders" who would compete. • Critical focus is product development, not code changes. •
Continued testing.	Continue prototype testing leading to product design finalization.	• Needed direction for product revision unknown. •
Manufacturing process development.	Design process that will govern product production.	• Don't know how to conduct quality assurance to foster code approval. •
Advanced investment and business organization.	Develop product introduction, marketing and deployment.	• The product can be readily deployed. • No one addressed code compliance issues. •

Institutional feasibility assessment and coordination.	Review how product development and deployment will be integrated in product developer's infrastructure.	• Resources needed to address conformity assessment activities. •
Industrial Preparation		
Manufacturing processes.	Determine how product will be manufactured.	• Costs and time needed to address testing and certification. • Code compliance not a priority. •
Actual product manufacturing.	Make product.	• Ensuring quality assurance is acceptable. • Changing the product after the fact to address code issues. •
Shipping and delivery.	Label, package and ship product.	• Make sure the product does not get damaged. •
Development of customer support.	Develop an infrastructure to support product's sale, use and service.	• How to educate marketing, sales, service and product distribution personnel about codes and standards. •
Marketing		
Marketing materials.	Develop and deploy marketing message.	• Getting installation instructions and other communication materials to appropriately address code compliance. • No acceptable marks or other approvals. •
Sales staff and distributor education.	Educate sales staff and distributor network about product to ensure support in deployment.	• Developing and implementing educational programs for internal and external audiences. • Compiling and simply presenting test reports, evaluations, listings and other approval-relevant materials. •
Deployment		
Marketing materials.	Develop and deploy the marketing message.	• Installation instructions and other communication materials don't address code compliance. •
Sales staff and distributor education.	Educate sales staff and distributor network about product to ensure support in deployment.	• Lack of approval-focused educational programs for internal and external audiences. • Lack of test reports, evaluations, listings and other approval-relevant materials. •

Approval		
Documentation.	Prepare documentation that will support and verify code compliance.	• Lack of clear and timely specifications, test data, calculations, reports, plans, etc. •
Permit application.	Submit documentation and make case for compliance.	• Incomplete or missing test reports, evaluations, listings and other approval-relevant materials. • No education or outreach to builders, code officials, etc. efforts with code enforcement staff. •
Plan review.	Review plans and specifications for code compliance.	• Incomplete test reports, evaluations, listings and other approval-relevant materials. • No codes and standards provisions to guide approval. •
Construction inspection.	Review construction for compliance with plans, installation instructions, etc.	• Lack of clear specifications, installation instructions, listings, etc. • No one to contact for help with field-related problems or questions. •
Certificate of use.	Confirmation that compliance is achieved.	• Relevant data on products and their as built and installed condition are unavailable. •
Use		
Owner registration and commissioning of building.	Commission the building and confirm proper operation of systems.	• No operating instructions, certifications and related product and systems data. •
Periodic inspections.	Inspect building systems and equipment and update and maintain systems and equipment.	• No operating instructions, certifications and related product and systems data. •
Product failure and liability.	Address product failure and associated liability.	• No warranties, certifications, etc. • No one to contact to address the problem. • No code provisions to provide remedies. •
Field feedback.	Secure information from the field and make available throughout entire product RD&D infrastructure.	• No mechanism to secure and use feedback on product performance, code acceptance, approvals, etc.

Appendix E

Experiences and Recommendations

The following is a compilation of experiences and recommendations provided by participants during the Roundtable. These are listed in the order presented by participants. Concepts (bold Italics) related to technology acceptance barriers were added subsequent to the Roundtable.

- Liability for the specifier and user of building technology must be addressed. There is a greater fear of specifying a new product compared to specifying a more traditional product or design. Recognition by and approval of the product by the code official still does not address concerns about liability. ***Liability***
- Performance codes are generally ignored for residential construction but could be used as a basis for approval of new products. Builders and others may not fully understand the performance code and may be wary of the performance code due to liability. Such a code allows for a specific "code" to be is written for a specific project and all involved in the project can write the code in advance together using the performance code as a basis for acceptance. This increases use of new products by allowing them to be considered as alternate methods and materials to those prescribed in the code. If and when liability issues arise, those involved would be judged on the specifications and code developed based on the performance approach and, assuming the performance goals and objectives are correctly stated, the liability issue would be minimized. ***Performance codes***
- Even if addressed through a performance code compliance must be proven. The group writing the prescriptive specification or code that provides a "menu" for satisfying the performance code must find an outside agency to review the design or product against that process and not the traditional prescriptive code. ***Performance codes***
- There is additional trouble for the building owner to secure insurance when the product or building is designed and approved via a performance code. To address this, the insurance entity needs to be involved as part of the process. ***Insurance***
- Mixing performance codes and liability with respect to a new material can pose a problem. If the product fails, what protection is provided to the designer/specifier? This suggests that liability and performance codes are not exactly connected. ***Liability and use of performance codes***
- Mixing and matching performance and prescriptive codes is a third option (the others being pure performance and pure prescriptive). ***Combining prescriptive and performance codes***
- A state housing study commission in Virginia has looked at the issue with respect to certain housing types. Localities oppose state legislation to accept industrialized housing as a matter of course by right or by site plans through zoning ordinances. The power of states overriding the decisions of local government to accept or not accept new housing technology needs to be addressed. ***Statewide acceptance, preemption of local authority***
- The use of American standards compared to standards used by the rest of the world impacts acceptance of new technology. ***Global standardization***
- Some feel there is a lack of reference to new standards in the codes. ***Timely updating of codes and standards***

- There are numerous industry "battles" that are focused on keeping new technology from being accepted by keeping it out of the codes. ***Competition between and within industries***
- Air admittance valves are an example of a new building technology that has received considerable discussion. Some codes allow them and others do not. They are acceptable for use but from an indoor air quality standpoint they may be less desirable than more traditional plumbing venting systems. ***New plumbing products***
- There was a liability issue with exterior insulation finish systems (EIFS) and one bad version adversely affected other good versions (EIFS products). Sometimes one negative experience in a particular product area may make code officials reluctant to approve new materials in general and/or other types of the new technology. ***Assuming one product represents the rest of an industry.***
- The existence of three separate evaluation services was a problem because it supported a lack of national uniformity (e.g., one-stop evaluation). ***Product evaluation***
- The lack of appeals process use to secure approval of new products. For example, Virginia, with a statewide building code enforced by local government, receives 24 appeals on average per year. This is low because of the fear that if one appeals the decision of a local building official to the state, the building official will get even or the builder simply feels it is less costly and burdensome to forgo the appeals process and simply use a more traditional product. ***Appeals, approval time, retribution***
- The glazing industry provides an example of how an industry addresses product acceptance. The National Fenestration Rating Council (NFRC) has produced a listing but regional manufacturers may not have the budget for national certification and listing. This pits the small manufacturer with fewer resources against the larger manufacturer. ***Resources of small versus large manufacturers***
- Sunrooms are an example of how prescriptive energy criteria in the code can facilitate new technology acceptance. For years it was difficult to get sunroom approval due to lack of prescriptive criteria, so many individuals lied about products in order to secure approval. Now, due to the increase of prescriptive provisions in the code, it is much easier to review and approve sunroom products. ***Availability of specific prescriptive criteria***
- It is questionable whether provisions in the codes to facilitate acceptance of new products (alternative methods and materials) are effective with all code officials. It is felt those provisions do not work with all code officials since every state is different and has varying enforcement mechanisms. These provisions appear in Chapter 1 of the code and many state and local governments delete or revise Chapter 1, eliminating the provisions allowing alternative methods and materials. Non-uniformity through the U.S. on this issue poses a problem. Some state and local officials are comfortable with alternatives and others are not. The prescriptive provisions in the codes are understood but the performance approach is not. ***Elimination of performance, lack of understanding of the performance approach to product approval***
- Code officials are not familiar with, trained about or asked to support, adopt and use the performance approach in current codes or a stand-alone performance code. Too many officials may be stuck using the prescriptive code. Code officials may be afraid of liability if they use a performance approach as a basis for approval. ***Education of code officials, performance versus prescriptive codes, liability***

- The alternative methods provisions (design) work, but the alternative materials provisions do not (material properties, testing, etc.). The code official needs additional education to understand and accept the performance approach to product approval. ***Education of code officials***
- When using alternative methods provisions in the codes there must be a performance standard for the local community. The International Residential Code (IRC) does not work well for a 32,000 sq.ft. home, but such a large home is not a prime candidate for the IRC.
- When a new alternative material is presented to a local official, there are problems associated with the lack of standards for durability. ***Durability validation***
- Every code official can ask for and review the same information as evaluation services but frequently code officials do not have the time to do so. Testing is also a problem because many new products are being imported. It is also hard to determine who is qualified to test imported products and how to approach acceptance of foreign products in the United States. ***Acceptance of test data, testing agencies, time to review and approve documentation***
- Durability and lack of direction on this on the durability issue with respect to code compliance. An architect can find a product may work in the building but UV degradation prior to installation may pose a problem once installed. How does one ensure that the product is shielded from UV prior to installation? The manufacturer may not address subtleties associated with the performance of the product (e.g. use by carpenters can impact delivered performance of the product). As an example a manufacturer importing pool enclosures indicated in their installation instructions that a particular mechanical joint must be replaced every 5 years. How can the code official approve this knowing that delivered performance may not be achieved during the life of the product (or is dependent upon human intervention later)? Where is the guidance and what does the building official do, especially since other prescriptive code provisions may not address durability (e.g. once the building is completed continued performance is not considered). The end result of the pool enclosure issue was to approve the installation under the condition that the manufacturer provide a 10 year structural warranty. ***Durability over time, impact of others downstream of the manufacturing process to impact delivered performance***
- An example of Brazilian pressed wood for non-structural issues was provided. It is difficult to determine the structural and durability issues for such a product. This is an example of assessing alternative materials and products versus methods (like alternative egress means). ***Basis for evaluation and assessment of alternative materials***
- The code change cycle poses problems for acceptance of new products. The longer the cycle, the longer it takes to revise the codes. Some want a shorter cycle. Others, like structural engineers, want a longer cycle so one can gain experience before the code changes. ***Timeframe, updates to the code***
- The building official is not worried about liability but does struggle with the alternative materials provisions. The issue of durability is not always thoroughly addressed in the codes. The proven record for certain materials helps address the durability issue but in other products there may not be such a record. ***Durability, availability of field data and experiences, liability***
- The alternative methods and materials provisions in the codes are not used to approve new materials or methods but are instead used to cover a mistake after approvals have already been granted. ***Performance alternatives***

- OSB board was approved because it was recognized by codes and standards, not because there were data available to the building official. ***Prescriptive codes***
- Whether the alternative materials and methods (performance) provisions of the code work depend on the scope of the alternative. The performance equivalency approach works best when alternative methods closely adhere to the code, because this makes comparison easy. If a product looks less traditional, there is a perception it cannot satisfy the specifications in the code. This is further complicated when the product is integral to an assembly because it gets much harder to test and document compliance. The time it takes to complete testing and secure approval is also a consideration. If the traditional approach is being used (e.g., prescriptive code, test, list, etc.) it may be harder to secure approval under alternative materials and methods. ***Performance equivalency, time to test and validate, hesitancy to approve new products, product integration as part of a building system***
- The lumber industry does have standards, testing and a singular critical mass as an industry to address change. ***Industry leadership to facilitate change***
- An example of outdated code provisions is found in the moisture barriers required by code. Although the code specifies use of 15 lb. felt as a basis for moisture barriers, such products are not available... ***Prescriptive codes, disconnect between code criteria and available technology***
- Durability is difficult to define and is the subject of an ongoing discussion within ASTM. Durability or perceived durability is a barrier to innovation. ***Durability***
- If there were a warranty for the durability of the product the concern about durability would be removed from code consideration. In Japan a warranty for buildings is mandatory for five years. The code official may wear many hats but warranties may not be a part of the building code enforcement process and are more related to state consumer laws. ***Durability, warranties***
- The product manufacturer will sometimes examine differences between the U.S. and other countries when considering importing products to the U.S., and that analysis can be provided to the code official. ***Performance equivalency, application of foreign documentation***
- There are many tests done on a particular product but those tests may not address the assembly of the parts in the field as an assembly. Testing must also consider the use of the product. For instance EIFS were applied in Europe to mass walls of masonry construction but that experience was not directly transferable to wood assemblies in the U.S. These were different applications. In addition poor training of installers of EIFS and poor installations compounded the problems. ***Testing of assemblies, relevance of specific tests for one application to another, training and quality control***
- There are many new materials and products but it takes significant marketing effort to get products considered and used due to the cost of new products as compared to more traditional materials. For instance, spray foam needed to be reviewed under performance equivalency provisions in the codes. Initially, no testing was done but then the manufacturer secured tests and a product evaluation. The manufacturer, however, had never considered the impacts of fire on the product and had to re-test to address this issue. This suggests a need to identify issues the code and code officials must consider and a program to help manufacturers address code issues and documentation needs earlier in the testing process. ***Lack of knowledge by the manufacturer of code implications and needed testing to secure product acceptance, availability of assistance to manufacturers***

- A code official relayed his experience with one of the legacy evaluation services. The product he encountered was an alternative material (columns with a fiberglass shell around a wood base). The product was new on the market. Later, the columns changed from having a fiberglass shell to having the full column made of fiberglass. This changed the situation in that the column was now a structural element. Then the columns were moved from outside homes to inside homes, resulting in non-compliance with the codes. The code official spoke with the manufacturer and indicated that the product does not comply with code. The manufacturer knew nothing about the code and refused to do anything about it. The local code official would not approve the columns unless the manufacturer demonstrated code compliance. The manufacturer resisted and then eventually came to the table after the business was essentially shut down. The code official recommended they change the product as well as get an evaluation. The code official agreed that once the product was changed and testing was done to address smoke development of the product, the code official would accept the product based on performance equivalency with the code (e.g., alternative methods and materials). The manufacturer applied to two separate evaluation services. It took about one year for the first application for an evaluation to get through one of the evaluation services process. Eventually the manufacturer received different requirements from each evaluation service. The lack of coordination between regional evaluation services created a problem for the manufacturer. Now through the consolidation of the legacy evaluation services as the ICC-ES, there is recognition of standard procedures through the use of ICC-ES acceptance criteria. ***Performance equivalency, evaluation services, timely product acceptance***
- ICC-ES is evolving. Code officials are familiar with their respective regional (legacy) evaluation services. ICC-ES needs to be refined to be usable from a timeliness and accountability standpoint. The education process is also an issue. Educating the code official regarding evaluation services, performance codes and new technology may be of value. Timeliness is likewise an issue and at times, the process borders on code writing via the use of acceptance criteria. Some manufacturers or industries may choose an acceptance criteria and evaluation using the performance equivalency route while others proceed to make changes to the prescriptive code via the code change route. There is a need to legitimize the evaluation service process to solve these issues. ***Timeliness, performance equivalency, evaluation services, education and training***
- The code official needs an evaluation protocol to assist in making an assessment of alternative methods and materials. An example of a fast food robotic kiosk was provided. In order to approve the test "product" (there were only two being deployed as prototypes) via alternative methods and materials, the code official had to create a set of criteria to guide their own evaluation. ***Performance equivalency, acceptance criteria***
- There is a need for educating code officials on new building technology based on evaluation service findings. ***Evaluation service, education***
- There is a need to distribute and present evaluation service information to code officials and others in a meaningful way. ***Evaluation service, communications***
- The liability issue is a concern for builders. Builders may not want to be the first to use new technology. The federal government may be able to provide some umbrella for the builder, architect, code official, etc. such as flood insurance for trying new technology. ***Liability, indemnification, federal support***

- A key in the new building technology process is figuring out what existing codes contain with respect to new technology. An example of an NAHB RC home and compliance with the IRC was raised. The code officials questioned fire-stopping of an insulated concrete form, and the manufacturer did have an evaluation service report, which helped the approval process. One could compare an evaluation service to the Food and Drug Administration (FDA) with respect to what the FDA has done to speed up the approval of drugs and address their misuse. ***Evaluation services, performance equivalency, timely acceptance***
- There is a quality problem with labor that can be addressed through additional training. The NAHB RC Quality Contractor Program is an example of helping to provide the best building quality with the work force available. Training must accompany new materials. ***Education and training, labor force***
- Federal coverage for liability wherein a limited warranty is provided for a certain number of applications of a new product conditional on a product evaluation report being available. There is a concern about this being associated with more testing and increasing the initial costs for a technology. To get a warranty, the tests and issues needing to be addressed by the manufacturer would have to be specified. ***Warranties, liability, testing***
- A provisional or limited test period could be considered to allow a trial of installations. It may be helpful to secure a probational evaluation service report in this instance. If this had been done with EIFS there may have been fewer issues with an increased scope of the product assessment. ***Evaluation services, prototype and probational assessment***
- Lab and true tests of assemblies are conducted with extra care so the results may not transfer to the real world. Federal liability protection may be a solution for the problem of potential product failure in the test home. The FDA has different stages in the liability protection process that might be a model for building product approval. ***Laboratory tests versus real world installations, products as part of a field assembly, liability protection***
- When the U.S. Department of Housing and Urban Development had the Technical Suitability of Products program and Minimum Property Standards (MPS) many homes were built under the Federal Housing Authority (FHA) Section 234 program (operation breakthrough). The mortgage permitted the builder to vary from the MPS. If the product failed during the life of the mortgage, FHA would use its insurance fund to reconstruct the home to the MPS using traditional materials. Right now, FHA is not used but this could be a template for Freddie Mac or Fannie Mae to facilitate trial of innovation and minimize consumer exposure should a failure occur. ***Liability protection, Federal program support, coverage by the mortgage industry***
- The problem is not the builder. The consumer may not make well-informed choices and some products may be installed without permits. For instance, code officials went to assist in outreach on codes and safety at a local home improvement store by setting up a help desk and found 9 of 10 plumbing products from the store they were asked about did not comply with code. The code may not catch all products. For instance, some columns have a label and some do not. ***Education and outreach, lack of code compliance by products, difficulty telling compliant from non-compliant products, consumer awareness***
- The problem for a code official is to tell which products are tested and listed and which ones are not. ***Testing, listing and labeling, uniformity across a product line with respect to code compliance***

- Testing from Canada, Europe, etc. needs to be addressed with respect to the global market. The International Accreditation Service (IAS) of the ICC is working on that issue for testing and certification agencies. Another issue is the mutual acceptance of different standards. It has not been determined whether foreign standards are equivalent to U.S. standards. ***Conformity assessment, mutual recognition, global uniformity***
- Laboratories are accredited to just a specific test. It would be preferable for accreditation to cover the procedures followed by the lab for any test rather than having to be assessed for each test. Doing the latter is burdensome and costly for the lab and those costs are passed on to manufacturers who use the lab. Many labs are not accredited. It would be helpful to know whether testing agencies in other countries are different from those in the U.S. ***Laboratory accreditation, "one standard - one test" globally***
- ICC-ES requires a quality control component for products as part of the product evaluation process. ***Evaluation services, quality control***
- We need to find a way to better meld the global situation and accept testing and documentation from other countries. Need global acceptance. More work is occurring with memoranda of understanding with other countries on mutual recognition for labs and certification agencies. ***Conformity assessment, global acceptance***
- Education needs to be addressed and communication between all involved needs to occur. Paths to facilitate communication need to be developed. The life safety issue is paramount to some consumers. Other concerns with homeowners are energy consumption, durability, maintenance and appearance, all of which are tied in some way to economics. Life safety issues must be separated from non-life safety issues (e.g., fire versus water consumption). ***Education and communication, treatment of life safety versus non-life safety issues***
- It is unclear as to why there is a limited linkage between the evaluation service and the code. An evaluation report is advisory and not required. For instance, structural insulated panels (SIPS) sometimes are evaluated, but code officials will not accept that evaluation or performance equivalency because they want a prescriptive section in the code on which to base approval. The general lack of understanding of evaluations by code officials is one possible reason for non-acceptance of SIPS having an evaluation report. There is also a perception regarding evaluation reports which holds that, to receive approval for an alternative material, all you need to do is pay for it via an evaluation report. A general protocol about how to conduct an evaluation is needed so those enforcing the code can undertake this activity if they so choose. There is also a perception that tests used to get an evaluation report are designed and conceived by the manufacturer rather than the building regulatory community. ***Evaluation services, education and communication***
- Prescriptive code and performance/evaluation services are two systems that need to meld together more effectively. The evaluation report provides the necessary data for acceptance by building officials and Chapter 1 of the ICC codes could be modified to require acceptance of evaluation reports from an approved entity. Currently there is no requirement to accept evaluation reports in the model code, and if this were required it could be considered a conflict of interest... ***Performance equivalency, evaluation services***
- The building industry is not using evaluation services or where they are the covered product may not be readily accepted. For instance, SIPS cannot be readily used in seismic areas without test data. While there are data and evaluation reports on SIPS some code officials will not accept SIPS suggesting that the ICC-ES needs to work

on the recognition of ICC-ES. ***Evaluation services, education, variability of local code enforcement***

- The large builder looks at the cost of a new product. If a new product is costly, the builder determines if the consumer will buy it, if it will help them build faster or if the code will require its use. Once these checkpoints are successfully passed, marketing addresses the issue by looking at potential sales. Marketing will find out what people will buy and/or create a market demand and only then will the large builder move forward to implement a new product. PATH needs to have a complete understanding of what people desire in their homes. ***Consideration of new product use by builders***
- The builder's legal department may have concerns about liability. For instance, the builder will be likely to avoid public relations problems that may result from new technology gone awry. The federal government may need to provide protection in this instance, and the insurance industry may not want to provide protection. ***Legal and liability issues, federal protection for use of new technology***
- From a marketing standpoint, if the new product is hidden the consumer may not care whether new technology is involved or not. This is not necessarily the case, though. For example, air bags, although mandated, are hidden but consumers are well aware of them and would likely request air bags even if not mandated. Consumers will place value on products if: a product has a rating, is simple, risk can be communicated and performance/durability are known. Consumers will value products as described above whether the product is hidden or not. We must strive to communicate risk and durability to the consumer. ***Consumer information, durability, creating a market pull for new technology***
- Building "green" and the issue of energy conservation are successful ventures due to rating systems. Builders can use these as marketing tools. ***Consumer information, market pull***
- Diffusion of technology studies - custom builders could educate buyers. ***Consumer education***
- Communicate and educate - consumers do not demand or know about energy, sustainable design, safety, etc. There is a need to educate the general public. The custom builder has much more interaction with the buyer. The buyer wants to save money and wants to know if something they might consider will look good. If you cannot sell new technology to the consumer, you may need to look to codes to require the technology. ***Consumer education, market pull versus minimum codes***
- The market drives technology use as much as codes push technology use. Certain products in housing perform in fire conditions differently than non-fire conditions. The product is a total house and the user is the citizen. ***Consumer education, market pull versus minimum codes***
- The problem is with the lack of education. The misapplication of products can be the problem, which falls back on education and training for a solution. ***Education of those applying new technology to buildings***
- The car industry provides an example of testing and wrecking cars to secure data. We need to develop some empirical data to rate homes. Consumers might relate to this, resulting in market stimulation. ***Performance data, consumer information to drive the market***
- Systems integration is an issue not just for labor but also for the designer, general contractor and others. There is a need for someone to act as the integrator of all

product-related information. Evaluation services need to be enhanced to address systems integration issues. ***Systems integration, evaluation services***

- Certification of installers and contractors could help. We need to teach the consumer to demand protection. ***Certification of those applying new technology to buildings, consumer demand creating a market pull***
- There needs to be protection for first adopters. ***Liability and indemnification***
- Everyone needs to agree on testing, metrics and how to measure and express information. ***Testing and presentation of information***
- The builder must deal with a significant amount of technology in housing as well as a large amount of information. The builder uses products because people want them, the code requires the products or the products make sense to use. ***Builders and amount of information, drivers for technology use***
- Panelized construction is an example of a decision to use innovation driven by the homebuilder, increased quality control and ability to control labor. ***Factory versus on-site construction techniques to spur technology acceptance***
- Sales staff may not yet be able to respond to technology questions but that may be due to consumers not asking. ***Consumer demand for information, education***
- The producer does not provide good installation instructions and they instead rely on the building code to cover installation issues. For example, a parking garage recently collapsed because it lacked detailed installation instructions for the pre-cast materials provided by the manufacturer. ***Availability of robust installation instructions***
- Mechanical and plumbing officials want less specific code provisions so unions and trades can do what they want to do. ***Use of performance codes to obviate the intent of the prescriptive code***
- Politicians affect how the code is written, applied and enforced. Political and financial reality impacts the process of establishing codes. ***Technical versus political forces in establishing codes***
- In some localities, the inspector may require what they want regardless of plans. Enforcement is a policing activity and there is no guarantee that no one will violate the code. ***Variability in code enforcement and inspection***
- There is a need to get code officials to recognize evaluation reports. ***Evaluation reports***
- Education is a problem because elected and appointed officials are taking money away from building departments. Local officials need to be educated so they will better understand the needs of code departments. ***Allocation of funding for code enforcement, education of local officials***
- The code needs to reference or recognize evaluation reports. ***Evaluation reports***
- Dealing with a culture in the code community that makes people inclined to deny rather than approve new technology. Change will occur through education and funding. ***Education and funding for code officials***
- The cost for certification exams is prohibitive, so many jurisdictions will opt out of certification and in so doing people will not get educated. Need to make it easy for building officials to reach their potential. Need to do public relations and education for local officials. ***Education of local officials, costs for certification of building officials***
- Code officials do not have a political constituency so they are typically affected when budgets are tight. Policy makers have paid attention to the Insurance Services Office (ISO) ratings due to insurance ratings and costs. Many of the problems will be solved

with a total package to local officials, etc. The insurance industry could help foster increased emphasis on the building departments. Maybe ISO could be used by consumers to demand better codes and secure build public support for code enforcement. It will take time for the use of the ratings to occur as many consumers think that code compliance gives them a perfect building, not just the standard minimum safe building. ***Insurance ratings, education of policy makers, financial resources***

- The consumer does not examine details and assumes the building has satisfied the codes. ***Consumer education and demand***
- The new ICC-ES can facilitate innovation by setting up a preliminary meeting with the manufacturer to establish ground rules. Manufacturers should be made aware of evaluation service help up front. Even though such services are available, some companies will not invest the money to work with the evaluation service early in the process. ***Evaluation services, more timely treatment of code acceptance issues by the manufacturer***
- Sit down with the code official early in the process rather than at the end. ***More timely treatment of code acceptance issues by the manufacturer***
- There is an opportunity with the evaluation service consolidation. The different answer from each of the regional (legacy) evaluation services was a problem. A singular evaluation service will help but a binding evaluation service at the national level may not be the answer. The evaluation service should educate the code official with respect to tests, criteria, etc. that can be used to accept a new product and make this presentation to manufacturers as well. ***Evaluation service, education***
- The key problem, assuming an evaluation service is a key tool to product acceptance, is due to the passive nature of the evaluation service. Code officials must understand evaluation relevance and appropriate officials of the product manufacturer must be advised of costs and benefits of an evaluation. The passivity of evaluation services is a barrier to innovation, but they are not the only way to get acceptance. If the code official had a protocol then they could readily address approval themselves. For national products the evaluation service can help, but the time it requires to get a report and the cost of such a report are an issue. One way to tie evaluation services into building codes would be to put criteria in Chapter 1 of the codes stating that code officials "should consider" evaluation reports as a mechanism for approving alternate methods and materials. ***Evaluation service, educating officials of the product manufacturer***
- The manufacturer should bring peer review into the process. ***Peer review of new technology***
- Trade associations should be proactive in showing code officials and others what technology is coming up in the future. ***Education of code officials***
- Need to determine the best format to preview new technologies to code officials and others. Maybe arrange a presentation at regional chapter meetings of code officials. ***Education of code officials***
- The training provided on the code in New Jersey and New York through each state is acceptable. A good inspector is preferred by the builder and an experienced building department is a good ally for the builder. Bring builders and code officials together for training. HUD and PATH should strongly recommend and support manufacturers, builders, etc. in instituting new training programs on new technologies for everyone. ***Education, builder and code official partnerships***

- Building departments are not as well recognized, as they should be. ***Communications, building department recognition***
- The quality of ICC education needs to be addressed. ***Education quality***
- Separate MPS and IRC codes create problems. The HUD MPS should be moved into the mainframe. As long as there are different federal, state and local codes for homes, tension and lack of coordination will persist. ***Uniformity in hosing codes between Federal agencies and state and local government***
- Big companies versus the little guy and resources available to them to address the code and acceptance process. There needs to be a mechanism to tell the little guy about the problems and have them team up with larger entities that can help, although the little guy may not want to share their idea. ***Resources available to and education on the process for manufacturers***
- The nature of this industry suggests that market share is so small that venture money will not come to the home technology market. A consortium of supporters that would support one new technology is a possible solution and small business research grants could be an avenue for financial support. ***Financing of innovation, consortia***

Input provided by Roundtable participants following the Roundtable is provided below.

- The Performance Code (PC) can serve as a facilitator/solution for many of the scenarios that were presented in the Roundtable discussion. However, many code officials are not familiar with the PC or perhaps they are intimidated by the performance concept and are therefore apprehensive to adopt it. The ICC should make a concerted effort to educate the code enforcement departments about the merits of the PC. For instance, the PC has a guide already built into the text concerning how to use the code and to set up an approval committee for each submittal being considered under the PC. It is felt there will have to be a number of successes with the PC in commercial applications before residential applications will be considered.

- There needs to be better communication between the manufacturer and the code industry at the development stage of a technology. If the manufacturer could include the code industry during this phase many problems could be solved. This should occur at a national level with the help of the private sector/consultants and the ICC could bring about a greater awareness to the manufacturing industry via education/information that highlights the benefits to the manufacturer by including the code industry as part of their research.

- The accreditation process between the U.S. and other countries for new technology needs to be improved. This could expedite the acceptance procedure for new technology in American cities.

Appendix F

Solutions Proposed at the Roundtable

This document presents the input provided at the PATH Roundtable on December 3, 2003, using the document in Appendix D as a starting point. It identifies and describes a number of activities that occur in the product development, deployment and implementation process and identifies problems associated with acceptance and approval for each activity as well as identifies possible solutions to these problems.

To facilitate a comparison with Appendix D, those problems added at the Roundtable in addition to the solutions (all recommended at the Roundtable) are underlined. Those problems or solutions shown in Italics were added based on the information presented at the Roundtable as captured in Appendix E.

Research

Activity	Problems	Solutions
Idea generation and brainstorming. Describe vision of technology, what it accomplishes, how it works, etc. There are no specific code problems in the research stage.	• Existing codes and standards provisions adversely affect technology. • Relevance of codes and standards may not be known. • Testing requirements are unknown. • Barriers not known or impossible to determine. • Knowing true performance of product. • Knowing and understanding requirements (code, etc.) for product.	• Get individuals who understand relevant issues involved. • Educate management on need to address acceptance and regulatory barriers throughout process.
Conceptualization. *Begin to put "pencil to paper."*	• Funding to support identification and resolution of problems may not be available.	
Business assessment /market research and early investment development (first stage to address code barriers). *Review product's business potential and start to garner internal and/or external financial support.*	• Those controlling business and finances are uninformed about acceptance and approval problems and resources needed to address them. • Not forecasting effort, timing and costs associated with addressing barriers and acceptance issues (time to market is affected). • Having regulatory compliance not seen as a financial advantage (by management and decision-	• Educate engineering and other university students on codes and standards (mandated in ABET standard but still having difficulty implementing). • Educate manufacturer decision-makers about regulations. • Work with technology advocates to educate those needing training.

	makers). • *Larger manufacturers tend to have resources available to address acceptance issues while smaller manufacturers may not.*	
Research and design. *Begin to conduct research that will support product development and initiate conceptual design work.*	• Testing and documentation needs unknown. • Codes and standards conformance documentation needs unknown. • Those researching and designing are not interested in regulatory approval issues. • Integrating systems with other products is not considered. • Identify who will be using the product, their skill level, who will be installing the product, scheduling of trades, etc. • Lack of knowledge about international issues. • *Existence of multiple codes for housing (e.g., IRC and HUD MPS).* • *Lack of communication between manufacturer and code industry at early stages of product development.*	• Need to integrate systems and involve others. • Need tools and methods to address systems integration issues. • Get experts to outline "watch out" items. • Address conformity assessment in U.S. and globally via information and education. • *Have trade associations provide education on what technologies are anticipated.* • *Secure uniform adoption of a code for housing throughout the U.S.* • *Manufacturers should include code industry during early stages of technology development.*
In-house lab testing and validation. *Conduct internal testing to confirm product development can continue and that doing so can pay off.*	• Don't know what testing to do to support codes and standards compliance. • Focus is on performance of product and not code compliance. • Determine need for an accredited lab. Some manufacturers do not understand need for an accredited laboratory. • Wrong test methodology or missing the point. • Need to understand why codes require what they do. • Lack of true performance requirements (e.g., prescriptive criteria may provide limiting factors).	• Education of manufacturer is critical.

Development

Activity	Problems	Solutions
Prototype. *Develop, engineer, and build a working model of product or building technology.* There should be no problems at this stage. Need to continue market research update.	• Need to document and verify compliance with codes and standards. • Lack of standard or protocol on which to base performance evaluation. • Lack of financial resources or knowledge of regulatory process. • Code changes impact what has been done and in turn impact prototype design. • Understanding how changes to prototype will impact acceptance and approval rates. • Knowing what portions of codes or which standards are applicable (e.g., if you make windows can you get a summary of what is important, the applicable standards and the sections of the codes?) • *Use of U.S. standards compared to those around the world.* • *Ability of larger manufacturers to fund certification and listing for products while smaller regional manufacturers may not have necessary resources.* • *Not all needed tests are known, leading to a later problem necessitating "last minute" testing.*	• Track codes and standards revisions and modify prototype as warranted. • Pilot program targeting small business innovator to help with code approval and related issues. • Develop a testing guide to get approval. • Develop needed standards • *Global uniformity in standards development, application and use.* • *Assistance to manufacturers in understanding all testing and required documentation early in the process.* • *Facilitate meetings between technology developers and evaluation/ testing entities early in technology development process.* • *Meet code official early in process.* • *Consider pursuing needed code changes.*
Field testing/full scale testing. *Install prototype and gather data on performance.* *Install in field or test in lab, simulation, or at manufacturer's facility.*	• Don't know how to communicate code compliance or who to work with. • Lack of resources and support. • How to get code approval for prototype. • Need to develop data to secure code approval. • Find out whether third-party testing and backup on that entity will be required or whether self-testing and certification will be accepted.	• Get conditional permit for field test applications for technology that can easily be removed and replaced. • Other means must be found to replace and remove technology that is not easily replaced and removed for liability and protection purposes. • Develop a protocol to support testing and evaluation.

	• Lack of standardized method to address prototype installations • Need waiver of liability. • Convince builder to participate in field test. • Lack of test protocols and standards that replicate real world situations. • *Competition from others in industry.* • *Competing product evaluation entities/lack of national uniformity.* • *Determining which testing labs have been accredited for specific tests.* • *Metrics for full-scale home testing may not exist.* • *Systems integration issues are not fully addressed.*	• Demolition bond to remove product if warranted. • *Provide provisional or limited test period and/or probational evaluation service report.* • *Accredit testing labs based on qualifications to perform procedures rather than on specific tests.* • *Global "one test - one approval".* • *Enhance testing and evaluation efforts to address systems integration issues.*
Revisions. *Revise prototype based on field testing results.*	• Lack of time and resources to develop codes and standards. • Reluctance to make changes and support "free riders" who would compete. • Critical issue is product development rather than code changes. • *Evolution of product in such a way that what was acceptable is rendered unacceptable due to changes in product composition and/or intended use.*	
Continued testing. *Continue prototype testing leading to product design finalization.*	• Needed direction for product revision unknown.	
Manufacturing process development. *Design process governing production of product.*	• Don't know how to conduct or see need for quality assurance to guarantee code approval. • Need to recheck everything if changes are made to prototype. • Need to secure validation of manufacturing process with respect to quality assurance. • Assess product, installation and	• Re-validate conformance. • Get quality assurance agency on board. • Secure needed code changes.

	interaction with other products that may be impacted or impact the new product. • Determine whether product needs code change to make acceptance work. • If a quality system is present, make sure it examines correct product characteristics.	
Advanced investment and business organization. *Develop product introduction, marketing and deployment.*	• Product can be readily deployed. • No one addressed code compliance issues. • Availability of financing for testing. • Ability of margin on product to cover testing costs. • Lack of grants to support innovative products. • Testing slows down production and inventory is in place before testing is completed (i.e., testing starts too late in process).	
Institutional feasibility assessment and coordination. *Review how product development and deployment will be integrated in product developer's infrastructure.*	• Securing resources to address needed conformity assessment activities.	

Industrial Preparation

Activity	Problems	Solutions
Manufacturing processes. *Determine how product will be manufactured.*	• Costs and time needed to address testing and certification. • Code compliance not a priority.	
Actual product manufacturing. *Make product.*	• Guaranteeing quality assurance is acceptable. • Changing product that does not comply with codes after development to address code issues. • Consumer inability to know whether they are buying a code complying product. • Manufacturer did not go through required testing and applicable approval processes.	• Labeling, education, etc. of consumers. • Address consumers though agencies such as Consumer Products Safety Commission.
Shipping and delivery *Label, package and ship the product.*	• Making sure no damage is done that would impact product acceptance.	
Development of customer support *Develop an infrastructure to support product's sale, use and service.*	• How to educate marketing, sales, service and product distribution personnel about address codes and standards. • Lack of data on new products such as exotic woods and knowledge of data location. • Manufacturer must convince architect there is no problem specifying product and manufacturer needs data to convince specifier. • *Lack of certified installers and contractors.*	• Planned training programs provide builder with reliable information. • Reference codes satisfied (specific code requirements). • *Educate consumers to demand certified installers and licensed contractors.*

MARKETING

Activity	Problems	Solutions
Marketing materials. *Develop and deploy marketing message.*	• Getting installation instructions and other communications materials to appropriately address code compliance. • No acceptable marks and other approvals. • Lack of data from manufacturer and from reliable sources to satisfy various needs of architects, engineers, specifers and code officials. • Lack of public demand for information and data related to code compliance. • Knowing what issues to address.	• Educate manufacturer, consumer, architect, engineer, code official, etc. • An educated buying public.
Sales staff and distributor education. *Educate sales staff and distributor network about product to ensure they can support its deployment.*	• Developing and implementing educational programs for internal and external audiences on approval. • Compiling and simply presenting test reports, evaluations, listings, and other approval-relevant materials. • Buying public does not care about code-related safety, etc. issues and needs education. • Understanding why code requirements are important. • Knowing what safety requirements are applicable. • *Consumers are not informed enough to assess risk and durability associated with new technology.*	• Educate public and create demand for safety and compliance-related information. • Educational collaboration - suppliers should work with code official, builder, architect, engineer, etc. to educate consumer at point of sale (first convince builder of technical and marketing side to use technology). • Participate in (builder) all trade shows. • *Create market pull programs like "green" and energy efficiency that drive consumers to demand new technology.* • *Educate consumers.*

Deployment

Activity	Problems	Solutions
Marketing materials. *Develop and deploy marketing message.*	• Installation instructions and other communications. Materials don't address code compliance. • Lack of reliable information on which builders can rely. • Materials are developed and deployed by the wrong people (i.e., marketing who may not understand code and approval issues). • Code compliance is less important than basic safety (real or perceived problem). • Knowing what performance is required of subject product.	
Sales staff, code official and distributor education *Educate sales staff and distributor network (as well as code officials, builders, etc.) about product to ensure support and successful deployment...*	• Lack of approval-focused educational programs for internal and external audiences. • Lack of test reports, evaluations, listings and other approval-relevant materials. • Test reports, evaluations, listings, etc. are not written so a builder or homeowner can understand and apply them. • All involved are not fully informed or educated about new housing technology. • Permit fees are supposed to support education for code officials but are not available for such efforts because elected officials use the fees for other state or local programs having political budget problems. • Lack of required continuing education for certification. • *Builder may have concerns about liability and negative public relations from a new technology gone bad*. • *Lack of good installation instructions.*	• Need to identify funding sources. • Need to create partnerships of builders, manufacturers, code officials, etc. to develop and implement educational programs. • Get U.S. HUD and code personnel, etc., to use clout to convince everyone to help with, support and to implement education. • State programs should specifically designate fees towards training.

Approval

Activity	Problems	Solutions
Documentation. *Prepare documentation that will support and verify code compliance.*	• Lack of clear and timely specifications, test data, calculations, reports, plans, etc. • Need for witnessing samples. • Need for third-party testing. • Testing agencies or test houses do not understand performance requirements. • Lack of statewide codes that facilitate statewide acceptance of technology. • No warranty information or lack of viable warranty. • *Lack of references to new standards in the code.* • *Bad experiences with one technology carry over to other similar technologies or the same technology by different manufacturers.* • *Lack of uniformity by local officials in adopting and applying provisions for acceptance of alternative materials and methods of construction.* • *Who does testing and acceptance of tests by regulatory authorities.* • *Lack of data availability to manufacturer for certain materials.* • *Relative ease of documenting conformance for a stand-alone product as opposed to something that is part of a building assembly.* • *Materials prescribed by code are outdated and do not provide a good foundation for performance equivalency.* • *Testing may not address assembly of parts in field and how miss-assembly may affect*	• Political pressure to get states to adopt statewide codes. • *Increased use of performance codes.* • *Involve insurance entity so they are comfortable with any use of performance codes and/or new technology.* • *Ability for states to override local government with respect to acceptance of new technology.* • *Acceptance of new standards when codes have not yet been updated to reference the standards.* • *Refine evaluation services from a timeliness and accountability standpoint.* • *Educate code officials about the evaluation service process and what is provided by an evaluation service.* • *Get information from an evaluation service to code officials in a timely and meaningful way.*

	performance of technology.	
Permit application. *Submit documentation and make case for compliance.*	• Incomplete or missing test reports, evaluations, listings, and other approval-relevant materials. • No education or outreach to builders, code officials, etc. efforts with code enforcement staff. • Lack of basic understanding of safety requirements. • *Minimal use of appeals process for fear of upsetting local officials.* • *Lack of connection between evaluation reports and code.* • *Funding is not available from permit fees for education and training of code officials.*	• Peer review as a basis for approval of new products and housing technology. • *Reference and require evaluation service reports in code.* • *Educate local elected officials to better understand public safety and need for trained code official.*
Plan review. *Review plans and specifications for code compliance.*	• Incomplete test reports, evaluations, listings and other approval-relevant materials • No codes and standards provisions to guide approval • *Lack of prescriptive code requirements to guide approval.* • *Fear by code officials of liability if they approve a technology based on performance in absence of prescriptive code provisions.* • *Those on ICC committees may not be the "best of the best".* • *Lack of standards for durability.* • *Length of code change cycle in providing timely codes while also allowing enough time to gain experience with new codes.* • *Difficulty telling which products have been tested and which ones have not.* • *Certification exams for code officials are cost prohibitive, resulting in code officials not becoming trained.*	• *Develop prescriptive code provisions early on and have provisions approved and available in code when technology is brought to market.* • *Education of code officials on performance approach to technology acceptance.* • *Provide a protocol that will help code officials make their own evaluation of new technology rather than relying on an evaluation service for evaluation (one participant commented that he and other participants felt reliance on local officials is the core problem. If we strengthen the evaluation services and insure the quality of their reports, and then require local officials to accept, we could solve much of the problem. This suggests the solution may be to strengthen the evaluation services and secure greater reliance on them by code officials as opposed to*

	• *Code officials lack a political constituency.* • *Training for code officials by ICC leaves much to be desired.*	*assisting code officials in doing their own separate evaluations.*
Construction inspection. *Review construction for compliance with plans, installation instructions, etc.*	• Lack of clear specifications, installation instructions, listings, etc. • No one to contact for help with field-related problems or questions. • Approval based on an individual code official's interpretation of code (e.g., as many interpretations as code officials). • *Buildings do not fall apart just because there is no code official involved (e.g., inspection by local official is not necessarily the answer)* • *Lack of qualified labor.* • *Difficulty in telling which products have been listed and the appropriate installation guidelines.*	• *Provide additional training for labor force such as the NAHB RC.*
Certificate of use. *Confirmation that compliance is achieved.*	• Relevant data on products and the built and installed condition of the products are not available. • *Warranties for products are not part of code enforcement process and are more related to state consumer product laws.*	• *Extend or clarify state law related to consumer goods to provide for warranties for new building technology quality contractor program.*

Use

Activity	Problems	Solutions
Owner registration and commissioning of building. *Commission the building and confirm proper operation of all systems.*	• No operating instructions, certifications or related product and systems data.	
Periodic inspections. *Inspect building systems and equipment and update and maintain.*	• No operating instructions, certifications and related product and systems data. • *Lack of information on product durability may necessitate scheduled inspections and replacement as necessary as a condition for approval.*	
Product failure and liability. *Address product failure and associated liability.*	• No warranties, certifications, etc. • No one to contact to address the problem. • No code provisions to provide remedies. • *Lack of protection for specifier or designer.* • *Lack of protection for builder.*	• *Use of performance codes with stated goals and objectives.* • *Have federal government provide some blanket protection (like flood insurance) for builder, specifier, architect, code official, etc.* • *Provide an insurance fund through Freddie Mac of Fannie Mae to cover rebuilding a home after product failure.*
Field feedback. *Secure information from the field and make available throughout entire product RD&D infrastructure.*	• No mechanism to secure and use feedback on product performance, code acceptance, approvals, etc.	