



Information Technology to Accelerate and Streamline Home Building

February 2005 Status Report

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PREFACE

The evolution of information technology (IT) has led consumers to expect better value for their dollar and higher quality from their homes, while builders expect shorter cycle times and immediate access to current information for a wide variety of products and services. Housing is experiencing unprecedented demand, and the housing industry is beginning to feel market pressure from more knowledgeable consumers and builders. In the same way that IT plays a role in competitiveness, it can also help the industry deliver higher quality at lower prices by reducing the administrative costs of building and increasing the efficiency of the supply chain.

The Partnership for Advancing Technology in Housing (PATH) has an opportunity to advance IT in the home building industry in ways that increase efficiencies and cut costs. Due largely to rapid changes in the IT sector, the means to achieve these goals have changed since PATH first examined IT issues in its *Year One Progress Report* (June 2002). This report discusses the knowledge that PATH has gained since 2002, and recommends an updated strategy to achieve PATH's IT goals. This strategy will not be published in paper, but will be available on the Internet so that the information can be updated frequently.

PATH PROGRAM GOALS

PATH advances technology in the home building industry to improve the affordability and value of new and existing homes. Through public and private efforts in technology research, information dissemination, and barrier analysis, PATH focuses on promoting the following qualities in the nation's housing:

- Affordability
- Energy efficiency
- Environmental impact
- Quality
- Durability and maintenance
- Hazard mitigation
- Labor safety

PATH has the following four strategies for promoting these qualities in housing.

Remove barriers that impede innovation, and facilitate technology development and adoption

PATH investigates the barriers that impede innovation, and proposes and develops programs to overcome those barriers. This work guides the other goals and efforts.

Improve technology transfer, development, and adoption through information dissemination

PATH coordinates dissemination of innovation information to the housing industry and consumers.

Advance housing technologies research and foster development of new technologies

PATH supports background and applied research as well as technology development in the housing industry. This research is complemented by short-term and long-term assessments of specific technologies on the market.

Support the program through appropriate management and resource allocations

Partners in the PATH program recognize the importance of injecting current and emerging technologies into home building. Together, these partners—the U.S. Department of Housing and Urban Development (HUD), U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), U.S. Department of Commerce, Federal Emergency Management Agency (FEMA), home builders, researchers, and manufacturers of building materials and products—have identified many of the relevant technologies and facilitated the implementation of research, pilot demonstrations, and evaluation projects across the United States. In addition, PATH program partners set priorities for technology development that help the housing industry work toward the PATH mission. This priority-setting is known as “roadmapping.”

ROADMAPPING PROCESS

The roadmaps dictate the main areas for research and development in PATH’s research portfolio, guiding investment by government and industry. The roadmaps also provide the home building industry with a strategic plan for future technology development. The PATH Industry Committee (IC), comprised of builders and manufacturers of building products and materials, oversaw the initiation of the roadmapping process in early 2000. The most first of these for Information Technology (IT), the *Year One Progress Report*, is described in the adjacent sidebar.

Vision: Year One Progress Report June 2002

PATH envisions that IT will make information available on demand, helping builders perform their jobs more accurately, efficiently, and quickly.

At the heart of this vision is the common language of “interoperability”—the ability for different systems and software to communicate across the supply chain. Achieving interoperability will permit designers, specifiers, and consumers rapid access to comparative data on product costs, features, limitations, and availability in formats that can easily be compared, selected, and incorporated into computer-aided design (CAD) plans.

IT tools could speed the regulatory process. Applications and plans could be submitted electronically without traveling to the permit office or waiting in line. Builders and developers would know their application status at all times, and approvals could be returned electronically. Using regulatory tools, all required inspections for regulatory approvals or loans could be performed on demand, without suspending work or scheduling a site inspection.

Developing new Web portals will allow the construction community to access accurate, up-to-date design details, manufacturer instructions, safety data, and component specifications onsite and in real time.

Finally, the systems builders use to communicate and track processes can be improved and expanded. With the proper IT solutions, change orders, customer option choices, plan revisions, and unforeseen delays could be entered once, then accommodated seamlessly into revisions of working documents and process schedules. This updated information would then be available to all parties through the Internet.

A group of 40 builders, material and product suppliers, academicians, researchers, and other stakeholders identified and prioritized technologies that hold promise for achieving PATH's goals. IC members then helped divide the technologies with the greatest potential benefits into three groups, which became the basis for the first three technology roadmaps for new home construction. The manufactured housing and remodeling industries developed additional roadmaps to address PATH goals for these sectors. As a result, five roadmapping activities are currently in different stages of development:

1. Information Technology to Accelerate and Streamline Home Building
2. Whole-House and Building Process Redesign
3. Energy Efficiency in Existing Homes
4. Technology Roadmapping for Manufactured Housing
5. Advanced Panelized Construction

Unlike the other four areas, the IT field has changed so dramatically since the first IT roadmap was released that research priorities have changed fairly dramatically as well. This report revises several of the recommendations made in 2002, and outlines the role PATH should play to achieve the greatest results. A list of the most urgent recommendations appears at the end of this document in Appendix B.

INFORMATION TECHNOLOGY ACTIVITIES UPDATE

The first IT Roadmap recommended four strategies for using IT to accelerate and streamline the home building process:

- Developing a “common language”
- Streamlining the regulatory process
- Building a non-commercial information portal
- Creating production management systems

In December 2002, PATH sponsored a meeting of the Technology Roadmap Working Group (TRWG), which discussed progress on these strategies. Participants in the Information Technology Breakout Session (shown on the right) discussed each of these strategies. Their views, progress on each strategy to date, and recommendations for future action by PATH, are discussed below.

1. Develop a Common Language

Year One Progress Report, page 9—“Large national building firms, such as K. Hovnanian and Beazer, are implementing IT in their building processes. However, these companies have significant IT expertise and hire consultants and software companies to implement integrated systems. These are not solutions for small- and medium-sized builder who have fewer than 10 employees, yet build the majority of homes in the nation. These builders need software that can interoperate, and that can exchange, interpret, and use information without integration experts.

A common language would span, integrate, and be embedded in each of the current major areas of home building. An appropriate digital environment would allow every activity across those areas to cost-effectively create, store, access, collaborate, manipulate, and exchange data digitally.”

Developing a common language is the basis for interoperability. This effort has four components:

- *Synchronizing product data among manufacturers, wholesalers, and resellers through uniform information language standards such as the UCCnet Global Registry.* These industry media convert business processes into data flow systems, thereby making this conversion the first requirement for subsequently exchanging data throughout the supply chain.
- *Implementing technology and systems for inventory control, ordering procedures, and radio frequency identity device (RFID) tools to set prices of products on the shelves.* The data resides in a database that can be accessed by a variety of analysis tools. Many industry associations are in various stages of implementing such technology and systems, while vendors of business/supply

Breakout Session Participants December 9 – 10, 2002 Baltimore, Maryland

- Bill Asdal, Asdal & Co. Builders
- Liza Bowles, Newport Partners LLC
- Patrick Bridges, Bridges and Associates
- Wayne Ciccolo, Newport Partners LLC
- Mike Crosbie, Steven Winter Associates
- David Dacquisto, Newport Partners LLC
- Michael Dickens, Build IQ
- Gerry Eid, Eid-Co
- Tom Leete, Builders FirstSource
- Carlos Martín, U.S. Department of Housing and Urban Development
- Brad Oberg, IBACOS
- Wayne Pignolet, EBuild
- Michael Strong, Brothers Strong
- Steve Thorsell, BOCA International
- Michael Turner, The Home Service Store
- Ron Wakefield, Virginia Polytechnic and State University

chain management, customer relationship management (CRM/eCRM), and e-commerce tools are customizing them for the lumber and hardware sectors.

- *Analyzing data and using software-supported business tools for effective supply chain management.* Using tools that robustly provide specific managements services (e.g., estimating, scheduling, purchasing, accounting) certainly assists builders, but insuring that these tools can transfer information between them is critical to expediting production. Planners can understand sales, products can be ordered, pricing can be adjusted, and logistics can be fine-tuned. One example of this process is direct delivery from the manufacturer to the store aisles, eliminating warehousing.
- *Introducing Builder-to-Consumer services (B2C).* B2C holds particular promise for the building sector if it can provide efficient delivery of large, complex orders of building supplies and satisfy the logistical requirements of construction plans.

The breakout participants discussed the need to continue activities to develop a common language and a thesaurus. The building industry can benefit particularly from efforts to create a common language among suppliers, leading to supply chain efficiencies.

A PATH-funded project to support product descriptions for the wood industry is an example of how PATH can play a constructive role in standards development by lending its name and federal presence. In 2001, the lumber products industry, under the leadership of ProDealer Exchange (PDX), considered the development of these documents sufficiently important that they formed an ad hoc working group to initiate development of a standard. Since its inception and through 2002, the group has, with assistance from the NAHB Research Center and under PATH funding, made exceptional progress in developing an XML standard for the lumber supply chain.

The rapid and successful development of XML standards for the lumber supply chain serves as a sound foundation for incrementally evolving the standard to include other vertical sectors.

PATH is likely to contribute most effectively in this area by continuing to determine home building and product manufacturing industry needs for technology services, and ensuring that these needs are voiced to the IT software and hardware development community.

In this area, the Technology Roadmap Working Group made the following recommendations:

The Voluntary Inter-Industry Commerce Standards Association

The Voluntary Inter-Industry Commerce Standards Association (VICS) is an international organization working to establish cross-industry standards that increase supply-chain efficiency in the general merchandising retail industry. In the United States, VICS and its member organizations (including Home Depot, Black & Decker, Lowe's, 3M, and Ace Hardware) have identified data synchronization as a priority for North America. A VICS committee was established to conduct further research.

In 2002-2003, the building/lumber and hardware sectors committed to the VICS initiative, dovetailing parallel efforts for interoperability in the architectural/construction sector that focus on design and logistics. Experiences in other industries demonstrate that the considerable effort and expense involved in interoperability efforts will have a quick return on investment through better efficiencies in product selection, logistics, and labor, leading to less waste and better service.

Recommendation: Attend the meetings of the relevant standards bodies in construction interoperability to ensure adequate representation of residential construction needs.

Recommendation: Investigate efforts of the Voluntary Inter-industry Commerce Standards Association, an international organization working to establish cross-industry standards that increase supply-chain efficiency in the general merchandising retail industry.

Recommendation: Carefully evaluate the wood industry project and use the results to identify the best role for PATH in supporting a common language.

2. Streamline the Regulatory Process

Year One Progress Report, page 14—“Fundamentally, streamlining the regulatory process is about increasing the efficiency of permitting, plan review, inspection, and new product approval. Achieving increases in efficiency calls for making the regulatory processes faster and more convenient, consistent, and reliable for all affected parties while providing a higher level of protection to the public.”

This second strategy suggests the need for information and communication technologies to address one of the most critical impediments to housing production: the regulatory approval process. While inroads in streamlining regulations have been made in many progressive cities (see the sidebar discussing a project in San Jose), there are two persistent and overwhelming barriers to overcome.

The first is dealing with the technology of electronically processing permits, inspections, and code enactment while maintaining the legal and ethical requirements of building codes and code departments. More specifically, the inadequacy of current computer processing to handle the complexity of information involved in these processes must be overcome. As interoperability advances the IT capabilities of the building community, it also becomes more acceptable to the regulators that review, inspect, and approve building safety. However, the pace of implementing such changes in the regulatory process is controlled by local code authorities, and not by builders or manufacturers.

As such, the second hurdle is current building code department procedures. Many building code departments are reluctant to relinquish authority for interpreting the codes and often do not have the resources to adequately streamline them, although these jurisdictions are often those that need streamlining most. Many jurisdictions have embraced a variety of IT capabilities, but many others are unable to accept electronic applications for building permits over the Internet. Local amendments to model codes—as well as the complexity of dealing with a variety of electronic plan formats—impede the development of expert systems for plan review. The use of geographic information systems (GIS) and remote sensing for inspections is still just a vision in housing agencies, although it is becoming an accepted tool for planners and other sectors of the government.

Among the issues that concerned the code officials and code software designers that participated in the Roadmap sessions were:

- Electronic seals of plans
- Large file sizes and comparatively small monitors
- Lack of funding to support IT
- Uniformity in the nation's construction codes
- Lack of interoperability among hardware and software in the marketplace

Online Permitting Pilot Underway in San Jose By Patrick L. O'Toole, Senior Editor

Source: <http://www.housingzone.com/topics/pb/build/pb00ca621.asp>

The idea makes so much sense that it is universally met with enthusiasm. Making the idea a reality, however, is a lot more complicated and has taken years of cooperative effort to launch.

That said, late last month the city of San Jose, the largest municipality in the fast-growing Silicon Valley began offering builders and contractors a way to apply for permits and to track their applications through various approval stages.

Called "Smart Permits," the program employs Internet technology to streamline and reduce costs in the building permitting process. When fully implemented, the program will allow computer-aided graphic design (CAD) files and specifications to be submitted electronically to the city, and for corrections or modifications to be submitted within hours, without requiring new printed plans. Anyone who has ever rushed blue prints to city hall sees the benefit. A key focus of the pilot is to implement complete online systems that handle everything from submission review, fee payment and inspection scheduling.

At first simple permits—re-roofing a building or replacing a furnace or water heater—will be available online. Gradually, by April of next year, San Jose will consolidate all development review activities into one comprehensive system accounting for 50,000 permits of all types per year, a release from the public/private partnership called Joint Venture: Silicon Valley Network said.

The City of San Jose is the biggest jurisdiction to get on board a three-year-old program stewarded by Joint Venture, but not the first. Pilot permitting projects are also underway in the Silicon Valley communities of Fremont, Milpitas, Mountain View, Palo Alto, San Carlos, Santa Clara and Sunnyvale. With the San Jose launch, the program is close to its goal of solidifying a core group of community-users in the region, says Randy Tsuda, the Smart Permit project manager.



The e-permit Web site operated by the city of Sunnyvale, California, as part of an intergovernmental pilot project in the Silicon Valley.

”When online permitting in Silicon Valley reaches a critical mass, further incubation by Joint Venture will not be required,” says Tsuda. Eventually, builders, developers and contractors will be able to fill out a universal online form for submittal to any of 10 Silicon Valley communities. The hard part was getting to this point. There were numerous committee meetings among government planners and information technology officials with each jurisdiction. The structure of existing permitting systems varied greatly from town to town and many ended up streamlining their permit processes to get with the Smart Permit program, says Tsuda. Then there were long committee meetings before agreement could be reached on issues like technical formats, and what requisite amount of information is needed for each type of permit application.

In the end the intergovernmental online permitting system among Silicon Valley communities may serve as model for simplifying the approval process around the country. Ultimately it can remove many of the approval-related inefficiencies that have traditionally existed in the construction business—a goal that is hoped for by San Jose Mayor Ron Gonzales. “Smart Permit systems will help businesses meet their critical schedules and let cities become more efficient.”

Several large cities have been implementing sophisticated “Enterprise Management” applications that integrate planning, governance, revenue collection, public service, and building safety tasks from plan review, inspections, and approvals. Some of these applications are for huge, multimillion-dollar implementations, such as those in Los Angeles; others are adaptable to small and medium-size municipalities and counties.

Separately, HUD has created a new initiative on Regulatory Barriers to Development that may contribute to this effort by determining data collection instruments, needs, and gaps that are evident among building departments.

In this area, the Technology Roadmap Working Group made the following recommendations:

Recommendation: From a practical standpoint, the highest priorities for streamlining the regulatory process may be documenting best practices and cost-saving potential for code authorities to use in making their case for greater automation, and developing a simple toolkit to help jurisdictions adopt electronic operations.

3. Build a Non-Commercial Information Portal

Year One Progress Report, page 20—“The Internet already offers many Internet portals, including several targeted to the home building industry. They vary in design and function, and they are all commercial sites.... Usually these sites feature manufacturer’s advertising literature and do not provide quick, easy access to the full range of objective information required to compare and select products or materials. Other ‘commercial’ services compile product information from manufacturers, but the much needed objective information is often difficult to locate through a profusion of advertising. Builders and homeowners favor a non-commercial approach, but such an approach has little support from product manufacturers.”

As search engines such as Google have become increasingly popular, the usefulness of additional, specialized portals has declined. Maintaining a portal with sufficient information to compete with the search engines in today’s world is probably unnecessary. However, improving or expanding PATH’s

existing portals, such as ToolBase, evaluating the analytical tools that now exist (particularly those that provide easy and immediate feedback for builder and consumer decision-making like PATH's Energy Efficient Rehab Advisor or NIST's Durability Doctor), and inventorying existing tools for Web-based training, would be of great value

In this area, the Technology Roadmap Working Group made the following recommendations:

Recommendation: Evaluate the effectiveness of current home building industry portals technically, as well as the industry's use and reliance on Web-based information to determine the best technical approach to non-commercial information delivery.

Recommendation: Expand ToolBase (currently, the only non-commercial housing technology portal) through links with industry and governmental portals such as Builder OnLine and HousingZone. Use that linkage to visitor demographics and psychographics to improve the ToolBase site itself.

Recommendation: Catalog the IT-based analytical tools that now exist and evaluate their potential value. Government-sponsored tools that should be considered exist within EPA, DOE, and NIST. Appropriate tools could be made available directly or indirectly through ToolBase.

4. Create Production Management Systems

Year One Progress Report, pages 25, 26—"The development of IT in production management requires a general project-planning framework tailored to the construction of houses. The industry has yet to adopt a generally accepted framework for project planning that defines the functionality to be encompassed with a suite of enhanced tools and the opportunities needed to improve overall integrations....

Implementation of effective, end-to-end production management systems [will require]:

- State-of-the Art and Benchmarking Studies
- IT in the Management of Change Orders
- Development of an Interactive Supply Chain
- IT for Pre-Construction Activities"

Home building is both dynamic and unpredictable. Activities are often difficult to anticipate, and construction project plans, drawings, schedules, and budgets are often modified. Information technology offers a way to integrate the construction processes and make them more efficient.

An Interactive Supply Chain speeds the logistics of construction from the drawing board and the customer's last-minute decisions to the loading docks and building sites. PATH-sponsored research at Virginia Tech developed a strategy for production management that would assist building participants in obtaining the benefits of real-time data flow between all members of the construction process, including manufacturers; builders; architects and designers; and realtors, developers, and cities.

Scanning activity by PATH uncovered work on mobile communications for site-based construction Production Management Systems. Substantial work is being undertaken on supply chain management in PATH's "Industrialization" and "Whole House Calculator" research agendas, in other industries,

and by such construction-specific groups as the Lean Construction Institute. Several efforts are underway to improve the supply chain, including a project at the Joint Center for Housing Studies described below. However, other areas of the work identified in the earlier roadmap need to be refocused due to the significant changes that have occurred in the IT industry as it affects home building.

While this fourth strategy originally called for a review of the state-of-the-art and benchmarking of successful programs, the dot.com bust that started in 2000 created a wave of transformations in the builder software industry. This shakeup and period of uncertainty has led to concern throughout the industry about the viability of construction-specific IT vendors. In fact, many of the builders that had invested in software by early vending companies (and who subsequently became dependent on those vendors' technical assistance and maintenance) were forced to develop internal IT resources after the vendors went bankrupt. BuildTopia founder and CEO, Stephen Porten, is quoted by *Builder Magazine* as cautioning, "The challenge is to know what is happening in the back-office market to better guess which systems will survive before spending time, money and effort to ensure your system can communicate with theirs." As such, many builders remain cautious towards IT purchases and decisions. A list of current major vendors and involved home building participants is provided in Appendix A.

In this area, the Technology Roadmap Working Group made the following recommendations:

Recommendation: To address the strategy of IT in the Management of Change Orders, undertake a survey before designing new projects.

Specific recommendations were also made for each of the relevant parties involved in the production management systems.

4.1. Manufacturers

Production management systems are of great interest to product manufacturers. Technology advancement in RFID is one area where low-cost chips containing

Arizona State University's Pervasive Production Space: Funded through a PATH-NSF Grant Award

Arizona State University's (ASU) Pervasive Production Space (PPS) is an innovative IT framework for home building. The goal of the project is to make building information available anywhere, anytime through the use of innovative IT tools. The project focuses on developing and identifying pervasive computing paradigms, methodologies, design tools, and technologies to meet this vision for the U.S. home building industry.

ASU envisions that the PPS will use a multitude of networked computing devices, including radio frequency identification tags. The idea is to transport data directly to the work site. Using RFID tags, the PPS can automate common tasks in the home building process such as tracking location, broadcasting identification information, and recording the status of events. Current and future enabling technologies such as Wi-Fi and WiMAX will provide wireless connectivity needed to connect devices in the production space.

Initially, the PPS will be tested for building code compliance inspection through real-time sharing of information among the City of Mesa, Arizona; Pulte Homes; and its trade contractors. Ultimately, the designers hope that PPS will be applicable in all phases of the home building process, including land development, house design, pre-construction, building construction, and post-construction.

Contact: Anil Sawhney, Ph.D., Del E. Webb School of Construction,
<http://construction.asu.edu>

embedded product codes could have a significant influence on distribution systems. (See sidebar on an RFID project at Arizona State University funded by PATH and NSF). Although well known to manufacturers, builders have not yet widely adopted them.

Several related projects are underway that PATH should continue to track and evaluate. Two strategies are described here: Tracking models of IT-based supply chain management in other industries, and improving the supply chain in the home building industry in particular.

An example of the former is the Massachusetts Institute of Technology's Integrated Supply Chain Management Program (ISCM)—a consortium of non-competing companies started in 1995 by faculty and staff from the Sloan School of Management and the Center for Transportation & Logistics. The purpose of the program is to accelerate the implementation of supply chain management principles within the sponsor companies, and to advance the state of the art of supply chain management. Company participants pay a fee, which gives them input into defining the research agenda on supply chain initiatives and best practice information to share among participants. A list of research projects completed and a current research agenda is posted at <http://web.mit.edu/supplychain/index.html>.

A significant effort down the road from MIT addresses the second project. Unlike the more technology-focused effort at MIT, the Joint Center for Housing Studies at Harvard is examining changes in the housing supply chain from the vantage point of changes within the industry, some of which may be accelerated through adoption of IT. The objective of this research is to understand the changes occurring in the supply chain, from the manufacturer and material suppliers to distributors to the final customers of residential building products. Additional information on the Joint Center initiative can be found at <http://www.jchs.harvard.edu/research/distribution/index.htm>.

For manufacturers, the Technology Roadmap Working Group made the following recommendations:

Recommendation: Track efforts by other research groups in developing supply-chain management systems in other industries and in documenting the supply chain for the home building industry.

Recommendation: Tie efforts in developing common languages for IT in home building (Strategy 1) with supply-chain documentation.

4.2. Builders

The original strategy specified the investigation into change-order management systems for builders. As such, much discussion focused around the distinction between tracking change orders for internal purposes and propagating updated information reflecting changes to third parties. The greatest interest focused on the internal tracking. While software does exist allowing change order processing within larger production management systems, it isn't clear how good the software is or how it is used. This dilemma brought about a much bigger issue regarding builders' need and use of production systems.

PATH has already generated significant amount of research on IT systems for builders. Industry-developed systems, however, have surpassed these efforts and are increasingly pervasive, though only for production builders. Rather than continue with basic research efforts, the group recommended that PATH survey builders to determine what types of systems are currently being used or considered by

builders of various sizes. Results might vary by region and size of company. Of particular interest to builders are systems used for estimating, buying/ordering, and getting feedback from suppliers about the fulfillment and tracking of pending orders. This activity might later be followed with field evaluations to better understand the potential for efficiency improvements.

For builders, the Technology Roadmap Working Group made the following recommendations:

Recommendation: Assess the financial implications for adoption of IT-based approaches by home builders and industry players. This assessment should examine IT solutions, not just for large production builders, but also for small and medium-sized builders and specialty trade contractors who are much slower to adopt computerized systems for managing various aspects of their businesses.

Recommendation: Document cases where builders have tied elements of their production process to the software management of their key suppliers, and benchmark successful software collaborations between builders and their key trade contractors.

4.3. Architects and Designers

The use of computers and software to support the housing design and land development industry is more pervasive than ever before. Approximately eight to ten vendors of CAD software programs sell to architects, building designers, builders, and remodelers. Since these programs are now better able to conceptualize in three dimensions a project under design, builders can use them in presentations to potential customers. Until now, most architects would design a house, then give the plans to a technician, who would create an electronic drawing. CAD software offers a more efficient manner of preparing plans for approval and making revisions under the supervision of an architect. Land development software systems have become readily available as well.

Despite these advances, several major issues still need to be addressed:

- Technical consultants make large investments in software but the software can become obsolete even while it is still functional. New software applications often drive users to invest in expensive hardware upgrades.
- Training investments are enormous, yet many software programs are not compatible across platforms. Many engineering programs, for example, do not work well on Microsoft Windows platforms. CAD software in particular does not link into other construction business management software very easily.
- IT does not speed the initial process of analysis and design, although it does save a great deal of time in the revision process.
- Consolidation in the software industry leads to greater compatibility in “suites” of programs, but there are some software applications that are neglected during the mergers of firms that still need to be re-integrated into the larger suites.
- Many firms do not have the capability to integrate various full software packages into a coherent business offering, and their clients are unwilling to pay extra for this integration.
- Historic project data must be re-keyed into current software so that it is accessible in a format that allows analysis between projects. This process is time-intensive and raises concerns about compatibility with future software releases.

- Some of the software technologies technical professionals use could be used directly by builders and developers. However, they are often inexperienced with such software and do not have the confidence to make these investments in software and training.
- Software for home design is not especially user-friendly for builders and is not a useful creative tool for architects.

For architects, the Technology Roadmap Working Group made the following recommendations:

Recommendation: Document the impact on construction cycle time of CAD software for plan development, revisions, and permitting. Issue a bill of materials for small to medium-sized builders and their trade contractors. This should also include an evaluation of how well the technology connects into builder software tools for estimating, scheduling, and project management, and whether it ties into builders' accounting programs and sales and marketing functions.

4.4. Developers, Real Estate Brokers, and Cities

Strategy four defines each of the IT steps that lead up to breaking ground for construction of a new home, from land acquisition through zoning and planning to approval to proceed. When looking at pre-construction alone, the benefits of IT are apparent: zoning and planning can take several years if it moves smoothly and longer if delayed by regulatory issues. Using IT could help expedite this process both for developers and with cities—and even homebuyers.

Yet, there is uncertainty about the extent to which developers rely on computer software to lay out subdivisions, estimate development costs, develop schedules, or track work in progress. There are also large opportunities to use IT in the land development process, particularly in using global positioning systems (GPS) and computerized topographical mapping data to generate maps, evaluate environmental factors related to development, and optimize solutions.

A review of the software offerings of major vendors suggests that land developers are well served across a wide range of specialty areas relating to land development. The software falls into three categories: (1) property; (2) land use; (3) and zoning decision-making and monitoring software.

Property Acquisition

One of the principal areas where IT tools are used in land development is in property acquisition. Developers hire professional services firms who conduct due diligence assessments of land before acquisition. They conduct environmental assessments and soils analysis, and investigate for pre-existing structures or easements—all factors that could impact the viability of a land development project. GIS analysis is commonly conducted by accessing known databases. This information is critical to making a go/no-go decision, and could be tied into the IT services for regulatory approvals discussed in the Roadmap Strategy 2.

Financial Analysis Software

Financial analysis software is designed to assist land developers in evaluating a property for its return on investment and net present value. This software allows a user to quickly analyze the profit potential

of any land parcel appropriate for residential development. The software works by entering data on the prices of land, the cost to develop it, and the effect of time on unit sales profit. With these inputs, the software generates monthly and annual Pro Forma income statements. It measures the worth of an investment in terms of rates of return and net present value. A financial analysis tool like this is only as accurate as the assumptions upon which the analysis is based. Unforeseen delays in obtaining clear title to land or in meeting regulatory requirements could significantly affect financial returns. Some of these software programs include sensitivity analysis to show the effect on these measures should an assumption change. Risk analysis allows the user to investigate how these measures vary with a change in assumptions. Two vendors offering financial analysis software for land developers are Land Value Analysis and PlanEASe.

Financial management software also depends on accurate assumptions in order to produce realistic assessments of return on investment and net present value. Technical consultants can now produce dozens of layers of mapping on any given site that expose each of the assumptions critical to investment decision making and the approval process. These include location of pre-existing easements, pre-existing structures, and springs; soils analysis; vegetation indices; and other site water characteristics, including the presence of designated wetlands, contaminants analysis, and topography, to name a few. All of these are critical pieces of information when the developer makes financial and strategic decisions.

Software for Civil Engineering and Landscaping

Software for civil engineering and landscaping is widely available to support the technical side of land development. Two of the major vendors are Eagle Point and Autodesk. The software provided by these two organizations supports activities such as surveying, mapping and infrastructure management, civil engineering design and analysis, land planning, GIS and digital design data management, online collaboration and project management services, and transportation and infrastructure analysis and design. This should also tie into the development of CAD-software “suites” described in the previous section.

For this wide group of land and engineering professionals, the Technology Roadmap Working Group made the following recommendations:

Recommendation: Survey state and local governments to assess their capabilities to use land planning IT and electronic plans.

Recommendation: Identify large government databases that could be useful to the development community and make its data accessible in GIS software applications.

Recommendation: Evaluate the utility of software tools for land developers, particularly in small to medium-sized operations, and identify technology gaps in available software.

POTENTIAL AND RECOMMENDATIONS FOR PATH

As a continuation to the concepts, topics, and priorities described in the original IT Technology Roadmap, this update both reviewed their status and suggested ways in which PATH, as a public-private association, could assist. This IT effort, more than all the other PATH Technology Roadmaps, has been particularly difficult to grasp because of the changing nature of the information technology industry and its products over the last five years. Indeed, if PATH laments the fact that technology does not innovate quickly enough in the home building industry, it is awed by the rate of change in computer and information services today.

As such, the IT Technology Roadmap participants encouraged PATH to be observant of changes in the industry to assist in updating the Roadmap and developing short-term strategies for its implementation. Just as importantly, however, the participants stressed the critical need for PATH to draw clear lines between the public and private roles in this industry's evolution. In an industry undergoing such flux and speed in innovation as IT/computer services, this clear vision of the government's role is paramount and, indeed, ethical. This role can be described as creating an equal playing field—both for IT vendors and researchers, but also in terms of access for home builders, designers, developers, and, ultimately, homebuyers.

In addition to the specific recommendations for follow-up (summarized in Appendix B), the IT Technology Roadmap participants affirmed this clarification in roles.

Appendix A Housing Supply Chain Production Companies: Sample List

BUILDING SECTOR COMPANIES INVOLVED WITH SUPPLY CHAIN INITIATIVES		
Company	Contact	System Vendor
ACE Hardware	Greg Lenard Lynda Moriarity	Microstrategy EagleVision POS System; Terradata data warehouse; JDH Software Group Portfolio 2003.5 (collaborative planning and inventory replacement system with hosted accounting applications, RF inventory control, POS data collection and management)
Black & Decker	Ed Sofia Bruce Twery	Collaborating with Home Depot
Georgia-Pacific Corp	Terrell Ivey Charlotte Wood, 404-652-3709 re Builder Connection	Online transportation exchange service; Builder Connection, a supply chain tool for managing delivery of more than 28,000 products to over 50,000 customer locations.
Home Depot	Mark Healey	Terradata data warehouse; Mobile Ordering technology for item replenishment
TruServ Corp.		Business Objects SA; Data warehouse

SOFTWARE/HARDWARE VENDORS OF SUPPLY CHAIN SYSTEMS	
Company	System
JD Edwards & Co.	Supply Chain Management 9.0
JDH Software Group	Portfolio 2003.5 (collaborative planning and inventory replacement system)
Retek, Inc.	Java-based POS systems and tools for product replacement planning
SAP	Staffware (labor management)
NCR Corp.	Electronic/RF shelf labeling and price optimization tools
Cognos	GERS merchandising system including sales and inventory reports, sales trends, inventory management, gross profit margin calculator
Hyperion Solutions Corp.	Essbase

Appendix B

IT Technology Roadmap Update – Summary of Recommendations

Strategy 1

Recommendation: Attend the meetings of the relevant standards bodies in construction interoperability to ensure adequate representation of residential construction needs.

Recommendation: Investigate efforts of the Voluntary Inter-industry Commerce Standards Association, an international organization working to establish cross-industry standards that increase supply-chain efficiency in the general merchandising retail industry.

Recommendation: Carefully evaluate the wood industry project and use the results to identify the best role for PATH in supporting a common language.

Strategy 2

Recommendation: From a practical standpoint, the highest priorities for streamlining the regulatory process may be documenting best practices and cost-saving potential for code authorities to use in making their case for greater automation, and developing a simple toolkit to help jurisdictions adopt electronic operations.

Strategy 3

Recommendation: Evaluate the effectiveness of current home building industry portals technically, as well as the industry's use and reliance on Web-based information to determine the best technical approach to non-commercial information delivery.

Recommendation: Expanding ToolBase (currently, the only non-commercial housing technology portal) through links with industry and governmental portals such as Builder OnLine and HousingZone. Use that linkage to visitor demographics and psychographics to improve the ToolBase site itself.

Recommendation: Catalog the IT-based analytical tools that now exist and evaluate their potential value. Government-sponsored tools that should be considered exist within EPA, DOE, and NIST. Appropriate tools could be made available directly or indirectly through ToolBase.

Strategy 4

Recommendation: To address the strategy of IT in the Management of Change Orders, undertake a survey before designing new projects.

Recommendation: Track efforts by other research groups in developing supply-chain management systems in other industries and in documenting the supply chain for the home building industry.

Recommendation: Tie efforts in developing IT common languages for home building (Strategy 1) with supply-chain documentation.

Recommendation: Assess the financial implications for adoption of IT-based approaches by home builders and industry players. This assessment should examine IT solutions, not just for large production builders, but also for small and medium-sized builders and specialty trade contractors who are much slower to adopt computerized systems for managing various aspects of their businesses.

Recommendation: Document cases where builders have tied elements of their production process to the software management of their key suppliers and benchmark successful software collaborations between builders and their key trade contractors.

Recommendation: Document the impact on construction cycle time of CAD software for plan development, revisions, and permitting. Issue a bill of materials for small to medium-sized builders and their trade contractors. This should also include an evaluation of how well the technology connects into builder software tools for estimating, scheduling, and project management, and whether it ties into builders' accounting programs and sales and marketing functions.

Recommendation: Survey state and local governments to assess their capabilities to use land planning IT and electronic plans.

Recommendation: Identify large government databases that could be useful to the development community and make its data accessible in GIS software applications.

Recommendation: Evaluate the utility of software tools for land developers, particularly in small to medium-sized operations, and identify technology gaps in available software.