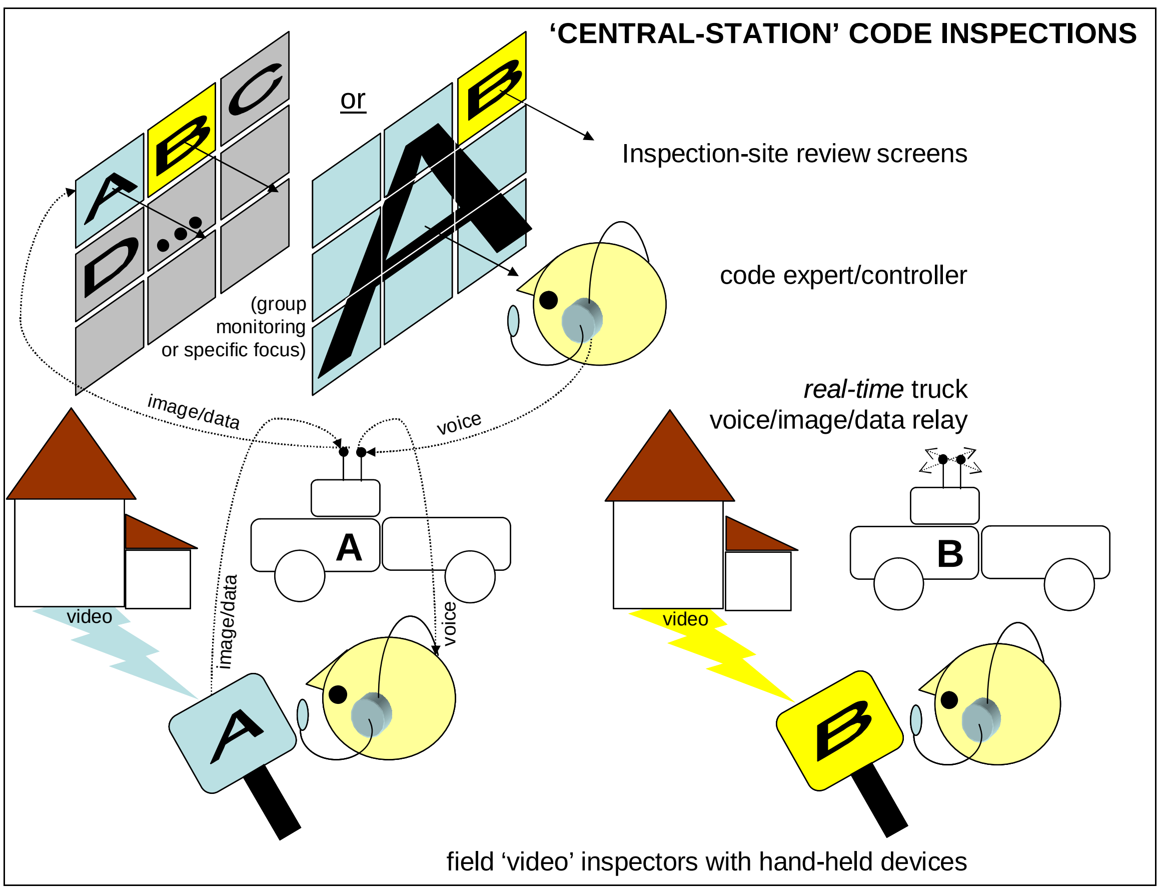
TOOLS FOR STREAMLINING CODE ENFORCEMENT DOCUMENTATION AND COMMUNICATION PROCESSES



PATH
PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING
PD&R
Office of Policy Development and Research

TOOLS FOR STREAMLINING CODE ENFORCEMENT DOCUMENTATION AND COMMUNICATION PROCESSES

PREPARED FOR THE
U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
OFFICE OF POLICY DEVELOPMENT AND RESEARCH

by Building Technology Incorporated, Silver Spring, MD
under Contract C-CHI-00710

September 2004

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FOREWORD

Residential code inspection is an important aspect of homebuilding in the United States. This publication is designed to help America's builiding code jurisdictions recognize emerging technologies and devices that can improve the efficiency, cost-effectiveness, and quality of code inspection services. Benefiting from this look ahead at emerging capabilities, jurisdictions can identify and implement strategies for improving inspection services to the homebuilding industry and consumers. Through its Partnership for Advancing Technology in Housing (PATH) program, HUD is pleased to provide this publication on tools for streamlining code enforcement documentation and communication processes.

Dennis C. Shea
Assistant Secretary for Policy Development and Research

ACKNOWLEDGMENTS

This publication is based on interviews of building code inspectors, leading firms in other industries, and manufacturers of electronic equipment for commercial industry use. Particular thanks are extended to the following individuals who contributed substantial time and shared their wealth of knowledge and experience:

S, G. Chung, InnoTeleTek
Marvin Goldstein, Building Inspection Services, Inc.
Zophia Zager, Fairfax County, VA

G. Kimball Hart, Hart, McMurphy & Parks, Inc., Joseph Sherman, Sherman and Associates, and David B. Hattis and William I. Whiddon, Building Technology Incorporated, conducted the interviews and prepared the findings herein. G. K. Hart and W. I. Whiddon were the principal authors of this report. W. I. Whiddon directed the project for Building Technology Incorporated. Dana Bres served as the Department of Housing and Urban Development's program manager.

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Introduction

This report addresses code inspections for residential buildings including single-family attached and detached housing. The report focuses solely on the site inspection and does not cover permitting or plan checking. Addressing the use of either traditional specialized inspectors of different building systems or combined inspectors trained in building, electrical, mechanical, and plumbing trades, the report covers both new construction and rehabilitation.

The goal was to examine whether new technologies, from a variety of commercial and industrial settings, could be applied to the building inspection process to make it more efficient and less costly for code jurisdictions, builders and, ultimately homeowners. The potential for savings could be significant. Inspection related activities can account for as much as 3/5ths of total code enforcement costs for a given jurisdiction, millions of dollars annually in many locales.

No single solution (hardware, software, or management) will work for all code jurisdictions. It is important to avoid suggesting too much for small jurisdictions or over-promising impacts for large jurisdictions.

These findings are based on a series of in-depth interviews with county and community building code inspectors and independent home inspectors. The study focused on highly populated, urban/suburban code enforcement jurisdictions where high volume and budget reduction pressures have made the search for high efficiency imperative. The practices adopted by these leaders tend to be adopted by others, if first costs can be brought down.

This section begins with a brief look at how residential code inspectors allocate their time each day to provide some perspective on where time is currently being spent in the code inspection process and thus where opportunities may exist for new technology. The potential to improve efficiency by saving time is one of the key criteria to be used in assessing any new technology.

Inspection quality and customer satisfaction cannot be compromised in the process of looking for efficiencies. This is a criterion that must be considered in assessing the potential for new technologies.

The Code Inspector's Day

The amount of time spent per inspection varies widely across jurisdictions. In a smaller jurisdiction, like Hillsborough Township, NJ—with a population of approximately 40,000 and an area of about 55 square miles—the average inspection takes about an hour. A foundation inspection can take up to two hours and a framing inspection up to three hours. In Arlington County, VA—with a population of over 198,000 and an area of 26 square miles—the average inspection has been reduced to about 30 minutes. Inspectors average 8-10 inspections per day for an average of 4.5 hours per day spent actually inspecting buildings.

In a very busy inspection office like Fairfax County, VA—with a population of 991,000 and an area of 395 square miles—the average interim residential code inspection is now about 6 minutes (on site and excluding travel time). The average for a final inspection is about 8 minutes, which is also the average inspection time for Montgomery County, MD. Even with inspectors achieving a high rate of 16-20 inspections per day, this still works out to only about 2.5 hours per day spent actually on site inspecting buildings.

Figure 1
Time Allocation of an Inspector's Typical Day

Compact Urban (Arlington County)

Scheduling 0.5 hours / 6%	**Travel and Locating Jobsite 1.5 hours 19%**	**Inspection (Onsite Plan Review, Measurement, Judgment) 4.5 hours 56%**	**Document 1.5 hours 19%**

Large Suburban (Fairfax County)

Scheduling 0.5 hours / 6%	**Travel and Locating Jobsite 3.5 hours 44%**	**Inspection 2.5 hours 31%**	**Document 1.5 hours 19%**

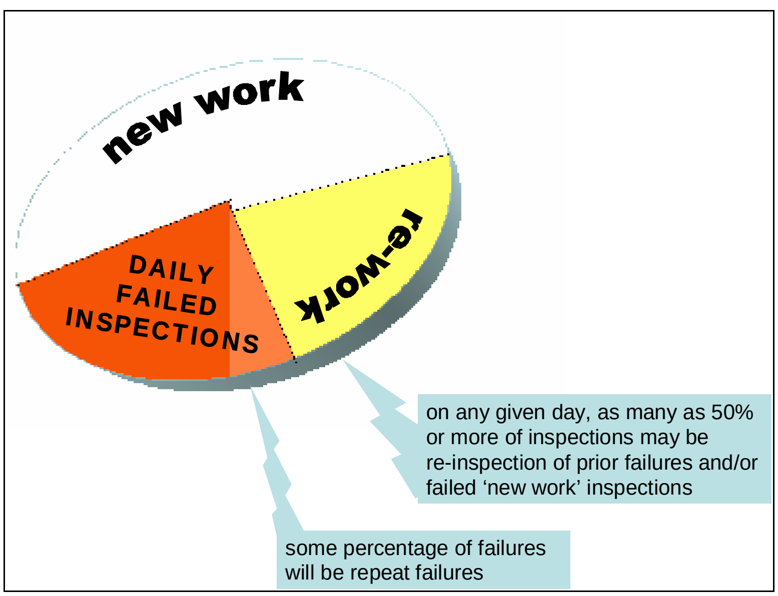
As illustrated in Figure 1, one of the principal differences between Arlington and Fairfax Counties is the amount of time inspectors must spend traveling between sites. In a small and compressed urban jurisdiction like Arlington County, travel time can be as little as an hour a day with the average being about 1.5 hours. In a large, suburban jurisdiction like Fairfax County, VA, longer travel distances on clogged suburban roads can easily lead to travel times of 3.5 hours per day. In short, inspector travel for urban/suburban jurisdictions is approaching an irreducible minimum level that will be difficult to decrease. And, increasing traffic congestion in urban/suburban areas may increase travel time regardless of how efficient code offices have become.

The Potential to Save Time

A great deal has already been done to find efficiencies and cut costs in the busiest code inspection offices. For example, the use of combined inspectors—those trained to do structural, electrical, plumbing, and mechanical inspections—has reduced the number of plumbing-only inspectors in Fairfax County from 27 to 3. For many efficient code offices, the number of minutes left to be saved by the application of new technology may be small.

No matter how efficient on-site inspections might become, it is still wasted time if the residence doesn't pass. All surveyed jurisdictions reported "30% to 40% inspection failure rates," indicating that a significant amount of inspection resources must be spent on re-inspections. If ways could be found to verify corrective action without a follow-up site visit (in all but the most egregious or complex situations), perhaps as much of 20% of total inspection resources could be saved or redirected to improved first-time inspections.

Figure 2
Inspector Time Lost to Re-Inspections



Educating homeowners and builders could have a substantial affect on increasing efficiency and reducing cost. The role of technology in educating builders and consumers may be a fruitful area of inquiry in the future.

The Potential to Increase Inspection Quality or Customer Service

An important dimension to be considered in assessing possible improvements to the residential inspection process is the potential for new tools to have an impact on inspection quality such as: responsiveness/timeliness of scheduling; consistency and accuracy of observation; improving judgment on site; thoroughness of observation and reporting; and clarity of reporting.

- Responsiveness/Timeliness—Most jurisdictions now provide “next day” response to a request for an inspection. What is the potential to provide “same day” or even “on-call” inspection services for the consumer? Time is money at both ends of the inspection “transaction.” Inspection backlogs create substantial overhead on the government side and idles progress in the field.

- Consistency—A high priority is making consistent judgments or interpretations of building related codes and standards. Observations and conclusions must be uniform and repeatable over time and circumstances.

- Accuracy—Achieve the lowest attainable error rates in observations and judgments.

- Thoroughness—Time pressure invariably leads to the risk of cutting corners, an especially troubling tendency in areas of public safety. The ultimate consequence of a missed observation or hasty judgment may be quite serious (for example, a recent experience in Chicago where the failure to check lag bolts on a new deck resulted in multiple deaths).

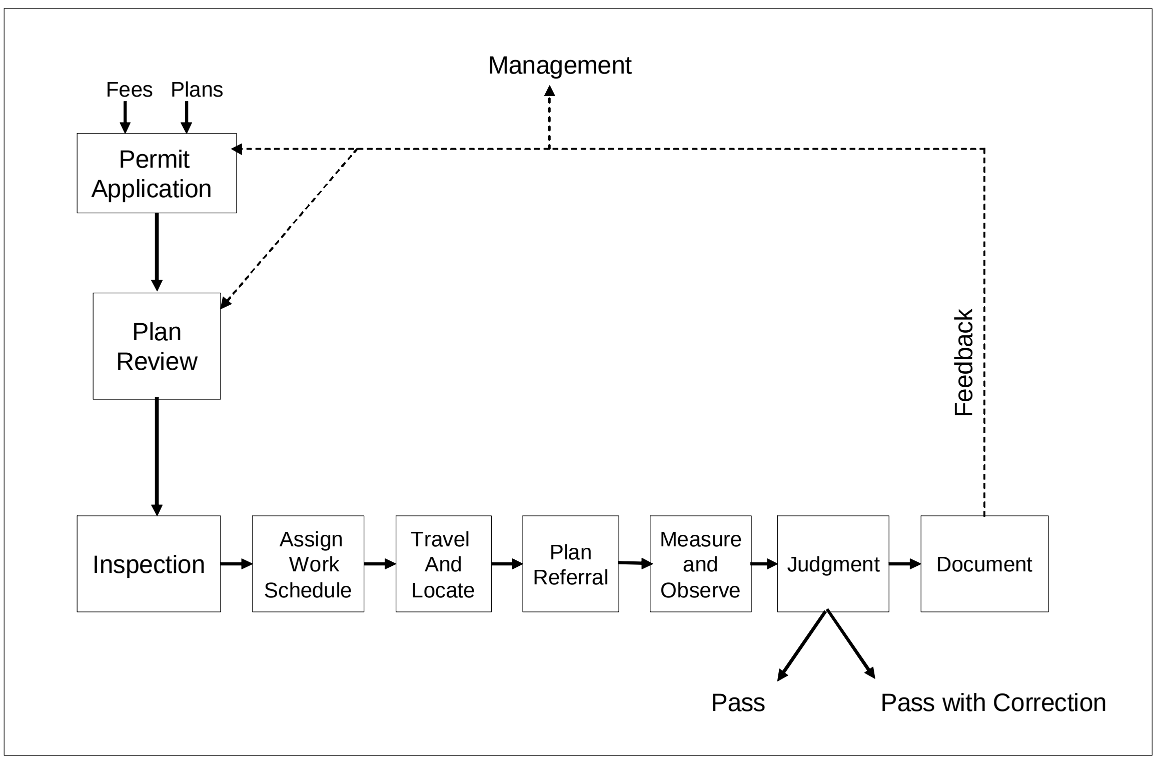
- Clarity—In the end, clarity is critical to consumer satisfaction, public safety, and governmental protection from potential liability. Clear communication of required actions or next steps to complete is essential. The more clear the communication, the more likely a satisfactory outcome.

In the balance of this chapter, both the potential to save time and the potential to improve customer service are qualitatively assessed for each stage of the code inspection process. The assessments rate the potential for management and or technology changes to reduce time requirements as ‘low,’ meaning that there is little time to be saved or that savings are not likely, ‘moderate,’ meaning that savings may be worth pursuing, or ‘high,’ indicating that substantial time and resources may be saved and opportunities should be investigated further. The potential to improve inspection quality is similarly rated as ‘low,’ not likely or of marginal value, ‘moderate,’ may be worth pursuing, or ‘high,’ opportunities should be investigated further, for each of the inspection quality dimensions described above.

A Closer Look at the Inspection Process

A simplified illustration of the permitting and inspection process is shown in Figure 3. Permitting and Plan Review are not part of this study. However a brief introduction is necessary to describe activities in these two steps that affects the inspection process.

Figure 3
The Code Inspection Process for New Construction and Alteration



To start the process, an owner or a contractor applies for a permit by filling out a form, supplying a set of plans, and paying a fee. In new construction, the permit is typically applied for by the builder and includes a full set of plans. Over time most builders become well educated about local code requirements so that there is a better chance that plans coming from them will be in compliance with code. Because code requirements can vary widely from jurisdiction to jurisdiction, a builder new to an area might have code violations on the original plans until they get up the learning curve. Many jurisdictions offer voluntary educational opportunities for builders—often through the local homebuilders' association. Unless there is a really hot issue caused by a recent code change, these educational sessions are not highly attended. Most builder education about local codes continues to be on the job and is a hidden cost to local code offices due to lost inspection efficiency.

In many jurisdictions, alterations of existing housing (called "rehab" in some locales) is becoming equal to or greater than *new construction*. For alteration work to an existing residence, there is a much higher likelihood that the permit will be applied for by either a specialized vendor or the homeowner. In either case, it is likely that the permit applicant will be less familiar with local code requirements and building plans will be less sophisticated and less complete than for a new residence. There is also the matter of interpreting what portion of the existing structure must be brought up to current code as part of the alteration or addition.

In the next step, Plan Review, in-house, code-office staff reviews the submitted plans to confirm that they meet local code requirements. If they do not, they are returned, with comments, for revision. This process continues through as many iterations as necessary until staff approve the plans as meeting code. Once approved, site work, and the inspection process, can begin.

Typically, more than a dozen distinct inspections may be required for new construction or substantial residential rehabilitation work. (For example, Fairfax County requires: Footing; Sewer/Water; Plumbing Ground Work; Basement Wall; Slab; Waterproofing (backfilling); Masonry Chimney Hearth; Fireplace Throat; Electrical Service; Close-in and 1st Gas; Framing; Mechanical Close-in; Final; and Residential Use Permit inspections.)

As noted, the inspection process begins from a set of plans that meet local code. The primary job of the code inspector is to certify that the construction matches the building as designed and complies with the code using appropriate and properly tested materials. It is not the job of an inspector to comment or pass on design or workmanship. For this type of review and comment, a homeowner must hire an independent home inspector. These independent and fee-based inspections are becoming common practice in many areas.

Inspection Step 1: Assigning and Scheduling Work

The Process: The process of assigning an inspection begins with a call from the builder requesting an inspection. It is up to the builder to know when work has been sufficiently completed so that an inspection is warranted. Most jurisdictions set a deadline—some as late as midnight—for an inspection to be done the following day. Entering the request, which may be more or less automated, starts both assigning and tracking the request. In larger code offices, the request is entered into a computer and the next day's assignments are a computer printout.

Each morning requests are sorted and assigned. Considerations in sorting the workload include: pre-existing, geography-based "territories" or areas of responsibility; easier inspections (for "good" builders) versus harder inspections (for homeowners or "problematic" builders); or travel time considerations like bad traffic areas or times.

Today's Tools: Computer-based logging and tracking systems are now very common in code offices. In more sophisticated offices, like the Fairfax, VA, code office, all permit applications are tracked by computer. A computer printout is provided each morning as the initial working document to make all of the day's assignments for inspections. The other most commonly used tool related to scheduling is the cellular telephone. Throughout the day, inspectors can call in to report scheduling problems or to make schedule revision given the reality of what is happening in the area. The cell phone has already had a very large impact on improving scheduling efficiency in all code offices, regardless of size.

Potential for New Tools to: Save Time—**Low to Moderate**.
Improve 'Timeliness' Dimension of Inspection Quality—**Moderate**.

An assessment of current logging and tracking software was completed in an earlier study by HUD. (Electronic Permitting Systems and How to Implement Them, April 2002.) Initial feedback from those interviewed for this study suggests that current systems—especially as they have been customized to fit particular code office needs—appear to be working well. The Fairfax code office has recently examined an enhanced system to improve logging and tracking by integrating information and status reports from officials of other county agencies such as Public Health and Fire.

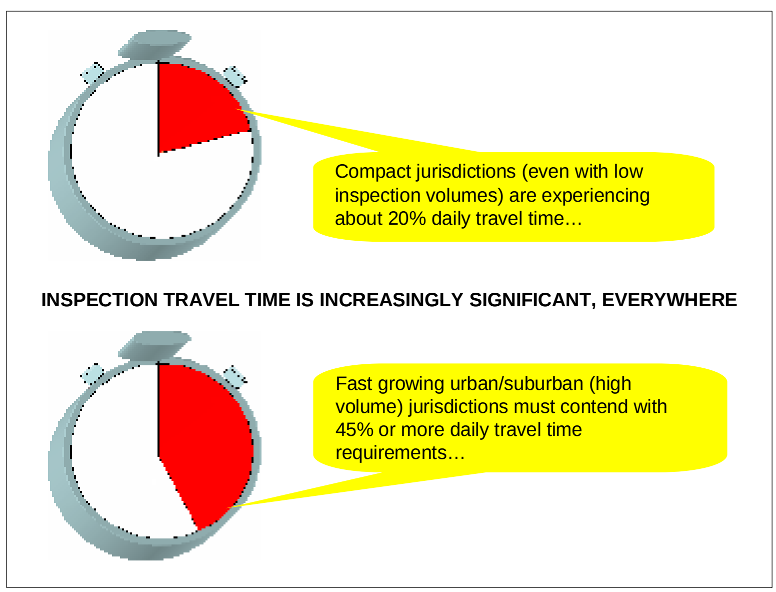
The actual time spent on this function is relatively low compared to the overall inspection time budget (see Figure 1). However, it is critical in setting up the likely success or "efficiency" that individual inspectors will have each day. If limited to streamlining the logging and scheduling function itself, the potential for new tools to have an impact is low. If new features like access to previous contractor experience or some other sort of pre-screening for inspections can somehow increase the likelihood of more inspections being passed on the first visit, the impact on the overall code inspection process could be significant.

One possible opportunity to save time may arise through the utilization of real-time data entry with wireless devices, enabling direct communication to and from the field. Such a capability would allow inspector reassignment as workloads fluctuated throughout the day. Other impacts might include more effective inspections as managers could directly monitor and analyze actual time-on-the-job information.

Inspection Step 2: Travel and Locating Jobsite

The Process: Having been given a set of inspections to perform, the inspector must sequence them, get into the truck, and go. The goal is to avoid traffic as much as possible, find the jobsite, and do the inspection. Figure 4 illustrates the significance of this task to overall code inspection operations. Although the description of this task is mundane, travel time can be the single highest allocation of time in the average inspector's day.

Figure 4
Inspection Time Lost to Travel



Increasing the percentage of passed inspections could have a significant effect on reduced travel time—by reducing the total number of visits per site. The role of education in increasing the percentage of successful inspections merits further consideration. As discussed above, active code offices do offer voluntary educational sessions for builders and handout educational materials for homeowners. The role of technology in facilitating the successful transfer of code compliance education to builders and homeowners should remain a consideration in assessing the use of technology in streamlining code compliance.

Today's Tools: A book of local maps and a local commercial radio station with good traffic updates are the two most commonly used tools for this inspection step. The book of maps may be something produced by the County Planning and Zoning Office so that they are significantly more detailed than the gas station variety. How often these maps are updated to include new subdivision roads is an issue. In fact, most inspectors know the territory well.

Potential for New Tools to: Save Time—**Low to High**.
Improve 'Thoroughness' Dimension of Inspection Quality—**High.**

The use of geographical positioning systems (GPS) immediately comes to mind as a likely technology to have an affect on this step in the inspection process. Actually, their impact may be limited for most inspectors, especially in more urban area, who know their territory well. In rural areas or for new inspectors on the job this tool could be more useful.

Various hands-free, voice-activated technologies may also make travel time more productive. Efficiencies to be gained by the ability to speak, record, or communicate while driving have already been proven by the significant penetration of cell phones into automobiles and company vehicles of all sorts. There are, however, significant drawbacks to the widespread use of cellular technology as a regular part of the inspection process. First, there is the ongoing debate about the distraction caused by using such devices while driving. If the jurisdiction were to require the use of these devices while inspectors were driving, it might open the jurisdiction to liability and litigation. Second, there is the problem of ambient road noise. This can be simply an aggravation for voice calls but could be much more important if ambient noise caused voice-recognition equipment malfunctions or improper recording of information during the course of conducting official business. Finally, there is the simple problem of "dead spots" that still exist everywhere on both cell and satellite networks. Again, this is a minor inconvenience on casual calls. The potential for problems in calls concerning official business would have to be assessed as part of the analysis of the potential for voice-activated technologies. However, could these problems be overcome, using travel time could make it possible for inspectors to "dictate" more detailed notes about each inspection and thus, could have a significant affect on thoroughness.

A third technology of interest is the ability to transmit information and data from the inspector's truck back to the office. This is similar to the discussion above but without the voice component. This might be called the "FedEx" model where the driver swipes the bar code on the parcel, thus providing the ability to track a document in real time using the communication technology on the truck. If this were to be used in the inspection realm, it would require the use of bar coding or other devices to speed input by inspectors. It would probably not be acceptable to code inspectors to stop the progress of their day with a time-consuming data entry process at the jobsite simply so that the data could be transmitted back to base instead of doing data entry at day's end as is common now. At first look, the value of this technology by itself appears limited. The builder, or the builder's representative, knows instantly at the job site whether an inspection has passed or not. Having this information in real time doesn't reduce the inspector's time on the road. It might reduce data entry time at the end of the day. It is possible that some variation of this tracking capability might help inspectors and builders communicate so that less time is lost on the job waiting for an inspector to arrive.

Inspection Step 3: Onsite Plan Referral

The Process: A set of plans approved by the local code jurisdiction must be available onsite at all time. These plans are typically looked at on an "as needed" basis. The plans have been approved by the Plan Review section of the jurisdiction but they usually don't have extensive notes, red lines, or other markings to indicate thoughts or concerns of the Plan Review staff. It is up to the inspector to catch and inspect any special exceptions that may be on this job. Inspectors rarely have time to do any pre-site-visit research. If this is the first inspection of a typical unit in a multi-unit development, the inspector might take extra time looking at plans and inspecting the first unit to save inspection preparation time on the rest of the units. Only really big projects would have a pre-construction conference where code related issues might be discussed ahead of time. It is common knowledge that local builders can get known for their level of effort in meeting code requirements. Though not a matter of public record, this "institutional memory" can have a significant impact on the amount of time needed to prepare for an inspection.

Today's Tools: Other than the set of plans required to be on site, the most commonly used tools for onsite plan referral today are a ruler, or scale, and a cell phone. The scale is used to confirm any dimensions on the plans that might not be obvious or correctly labeled. The cell phone can be used to call back to the office for more information, to clarify an issue with a plan reviewer, or to inquire about some new product being installed for which test results or certification might not be clear.

Potential for New Tools to: Save Time—**Low**.
Improve 'Thoroughness' Dimension of Inspection Quality—**Low**.

Little time is spent on this task now so there is really very little time to be saved here as it is the plan reviewer's job to be sure that the design and plans meet code. But, perhaps new technology could make this step more valuable to the inspection process. The inspector's job is to be sure that the building is being constructed as designed and drawn and *is compliant with code requirements as constructed.* The key may be to make more detailed plan, product, and code information available to the inspector in the field. At present, many inspections are rejected simply because the inspector does not have the needed information at hand on the site. More powerful hardware may provide the needed capabilities and reduce the number of inspection failures.

At the present, cell phones do a good job of providing inspectors with the ability to call back to the office for some level of information or direct help. In the near term, photographic or video technology could have an impact by enabling transmission of a picture of an existing situation to others. Because "a picture is worth a thousand words" photographs or video could reduce confusion about the field situation and speed resolution.

Inspection Step 4: Measure and Observe

The Process: The inspector must walk the jobsite, look, measure, open up, or probe. The task is to mentally compare what is built to the plans as drawn and to generally be attuned to any other possible code violations. The inspector will always look for product labels and other certifications to insure that materials are being used that have passed code requirements. This is not a testing procedure nor is it a situation where the inspector is called upon to make judgments about the quality of workmanship or aesthetics of the design.

Today's Tools: As suggested in Figure 5, this step probably calls into play the most tools that will be used by the inspector. A measuring tape and flashlight are always used. A screwdriver and small hand mirror are commonly used. Other tools, typically in the truck, that might be used as needed are: level, electric circuit tester, footing probe rod, or a torque wrench. (the builder is required to have a step ladder on the job that can be used by the inspector.) Occasionally a new code requirement will cause a new tool to be carried in the truck. For example, a new code in Fairfax County will require inspectors to carry an arc fault tester. For all the attention that mold has caused recently, there are currently no code provisions concerning its growth or detection. Thus, code inspectors do not carry moisture detectors.

Potential for New Tools to: Save Time— **Low**.
Improve 'Thoroughness' Dimension of Inspection Quality— **Low**.
Improve 'Consistency and Accuracy'— **Moderate**.

The tools currently used in this step of the inspection process are simple and very rugged. Most can be put into a pocket or hung on a belt, leaving the inspector's hands free to climb a ladder if necessary.

Figure 5
Tools Currently Used By Residential Code Inspectors

Always:
- Measuring Tape
- Electrical Tester
- Flashlight
- Cell Phone
- Form, Sticker, or Document (to record results of inspection).

Sometimes:
- Screwdriver
- Mirror (long handle and articulated)
- Level (often for plumping related items)
- Footing Probe Rod
- Torque Wrench (typically for lag bolts on porch structures)
- Laptop Computer
- Camera
- Book of Local Maps (typically of finer detail than off-the-shelf publications).

Provided by Contractor on the job:
- Approved set of building plans that meet all code requirements.
- Stepladder

Because little time is spent measuring now, except where findings are contested, there is little room for new tools to save time. The accuracy of current measuring tools is generally sufficient for the job. New tools that measure and record automatically could improve consistency and accuracy where needed.

Inspection Step 5: Judgment

The Process: Judgment is the element in the entire inspection process that calls upon the full knowledge of a professionally trained inspector. The inspector must visually and mentally compare the onsite, as-built condition to the approved, code-compliant plan and personal knowledge of code requirements, and then either pass or reject the conditions. Roughly one-third of all inspections fail, according to the agencies interviewed for this report. (Note that the range is broad, however, from as few as one-quarter to as many as one-half.) If requested, the inspector must reference the specific section of the code that is relevant to the rejection. As discussed above, this is limited to code issues only and is not either a design review or an assessment of best construction practices.

Today's Tools: The only tools used in this judgment call are the experience of a highly trained code inspector and the current building code as adopted by the local jurisdiction.

Potential for New Tools to: Improve Inspection Quality—**Very High** or **Very Low**, depending on how inspector expertise is positioned and leveraged.

If the current practice of having a fully-trained code inspector do an inspection onsite remains in effect, there is little that new technology can do to streamline the process. In the case of new or less well trained inspectors or in the case of a new code provision, technology could speed up the process of consulting a reference. This is a relatively rare event and not likely to be the source of great efficiency improvement.

However, if technology could make it possible to relocate the highly-trained inspector off site—just as the military has taken the pilot out of some aircraft—then the impact of technology on the inspection process could be very great. In this scenario, a highly-trained core team of inspectors might remain at a central call-in center while less trained assistants operated high-resolution video equipment in the field with a feed back to the central station. This approach creates the opportunity to use part-time or summer help to expand and contract the workforce to meet seasonal needs while highly leveraging the time (and cost) of the experienced code professionals. (The concept receives further assessment in a review of coming tools later in this report.)

Regardless of the level of experience or location of the inspector, increased access to detailed information through enhanced communication should aid judgment in the field. Inspectors, especially cross-trained inspectors, need continuous training, reinforcement, and updating of skills to maintain proficiency. Having needed reference materials directly available can only help the process. Inspectors armed with the required reference knowledge to back them up will be empowered to resolve issues and problems as they arise.

Inspection Step 6: Documentation

The Process: The first step in documenting the results of a code inspection is to leave a signed form, sticker, or other document at the site indicating the results of the inspection. Next, there is the documentation necessary to continue or complete the file on the project. A passed inspection is easy to record. A failed inspection requires that the reasons for failure be recorded. This may also include reference to the relevant code sections. It may also include photo documentation. Results of the inspection need to be sent back to the office either immediately or at the end of the day. Files must be completed and refilled—either electronically or in hardcopy. There may be some additional communication back to the code office management. For example, there may be some new trend in building practices that needs to be addressed generally or there may be some new product on the market that has not been properly tested and certified or that is being applied incorrectly that all the code inspectors need to watch for. Finally, in the case of failed inspections, there is likely to be further communication with the builder, either onsite or later, concerning why the inspection failed and what is necessary to bring the situation into compliance.

Today's Tools: Although not strictly a "tool," the form or sticker left at the jobsite is part of the inspection process and must be handled by the inspector. In more sophisticated code offices, laptop computers are commonly being used to enter the results of inspections so that they can be uploaded to a central database for processing or storage. This entry process is seldom done on the jobsite because laptop computers are not rugged enough to handle that environment. Data entry on laptops is typically done in the inspector's truck between inspections or in the office at the end of the day. Laptop software currently available can help code inspectors be more efficient by providing easy reference to and importing of code sections (when documenting a failed inspection) and fields within the program for entering notes from the inspection. As discussed above, a cell phone can be used in this step to call in the results of an inspection. GIS systems are coming into more common use as a way to track information about each building.

Potential for New Tools to: Save Time— **High**.
Improve 'Consistency, Thoroughness, and Clarity' of Inspection Quality—**Moderate**.

There is a significant amount of time spent in the inspection process handling forms, documenting problems, communicating with others, and filing. All of these are tasks where technology has a history of being able to help. According to the inspectors interviewed, it is typical to spend one to two hours per day collectively on these tasks. This is enough time spent so that a technical innovation could have significant effect.

The ability of the inspector to leave a paper record of the inspection on site is very important to the discussion here. As attractive as the use of Blackberries or other electronic tablets might be, their application is limited without the ability to provide paper copies on site. For this, a small and lightweight printer must somehow be included in the system used. The hand-held machine used by Hertz staff to check in returning rental cars comes to mind because of the ability of this tool to print out a paper receipt on the spot.

Once the issue of leaving a paper copy on site has been addressed, the rest of the data entry and filing processes discussed above are currently receiving lots of attention from hardware and software developers eager for jurisdiction business. Various systems are currently on the market and they are being improved or modified all the time. The potential to use wireless (WI-FI) connections is the newest technological alternative being discussed.

In this environment, report writing is not a trivial exercise. One agency interviewed prided itself on having its inspectors trained by both the legal department and police detectives. Their view is that time spent on proper documentation can prevent costly and time consuming legal action later.

The issue of communicating with builders and homeowners—to report code inspection failures and to instruct about remedies—might be another area where technology could have an impact. Code inspectors typically communicate with a builder's job superintendent on site. Superintendents universally have sufficient language skills for this interaction. However, the increasing presence of minorities with limited language skills on construction projects can make the job of communicating a code violation remedy beyond the superintendent more difficult. The ability to provide both photographs and information in multiple languages could be facilitated by technology.

Recap of Opportunities to Improve Inspection Efficiency and Quality

Figure 6 summarizes where and how new tools and processes might be applied to inspection operations. Actual impacts on inspection efficiency and quality for individual jurisdictions will vary based on how the improvements are implemented.

Figure 6
Summary of Findings on Potential Improvements to Efficiency and Quality

Inspection Process/Step	New Tools/Processes	Time Reduction	Responsiveness/ Timeliness	Consistency	Accuracy	Thoroughness	Clarity
Assigning and Scheduling Work	Anticipated vendor developments; scheduled or 'real-time' optimization	Low-Moderate	Moderate				
Travel and Locating Jobsite	GPS; GIS; 'hands-free'; 'prompt/response'; automatic data transmission; 'cab-dispatch'	Low-High				High	
Onsite Plan Referral	Wireless, internet-based, access	Low				Low	
Measure and Observe	Visual measurement tools; direct digital input; hands-free' input	Low		Moderate	Moderate	Low	
Judgment	Remote video imaging; coordinated management	Low-High		High	High	High	
Documentation	Hand-held printers; truck-mounted printers; customized documents	High		Moderate		Moderate	Moderate

Criteria for New Tools to be Considered for the Inspection Process

As part of the interview process with code inspectors, desired attributes for future inspection tools were discussed. A summary of inspector comments is provided in Figure 7. It should come as no surprise that any future tools should build upon the strengths of tools used today that have proven effective over years of application.

<u>Rugged</u>: This is the principal criterion for any tool an inspector would consider taking onto a jobsite. This requirement was virtually unanimous among all of the inspectors interviewed. Jobsites can be dusty, dirty, wet, very hot or very cold. Inspectors have little patience with any tool that can't stand up to this environment. For this reason, laptop computers are often left in the truck. The only caveat to the ruggedness requirement was the reluctance among some of inspection jurisdictions to sacrifice technical capability to achieve ruggedness. Many jurisdictions recognize the limited 'shelf-life' of technical advance—electronics can become obsolete within 2 to 3 years—and offset their demand for ruggedness accordingly.

Figure 7
Desired Attributes in Any Future Inspection Tools

Most Called for Attributes for any Tool:

- Rugged – This is far and away the most important attribute, as agreed by virtually all inspectors interviewed.
- Hands-free Operation – Inspectors must be free to climb a ladder. Anything carried must be capable of being worn or clipped to a belt.

Other Attributes Mentioned as Important:

- Easy-to-use
- Light-weight
- Safety—Mounting a phone or laptop in the inspector's truck must consider of the truck and neither the placement nor use of the tool may compromise safe operation of the vehicle.

Specific Attributes of Interest for Input/Output Devices or Communication Tools:

- Image Capture or Video – This is of high interest. Currently inspectors take many photos either to document problems or to facilitate future training sessions. This is a foundation to build on.
- WI-FI/e-mail – The ability to tap inspection results into a "Blackberry" and have those results communicated immediately to headquarters is of interest. The main issue is to accomplish this at both first costs and operating costs that are low enough.
- Hardcopy printing – It is important to leave either a sticker or hardcopy document behind at the job site to indicate whether the inspection has passed or failed. Any attempt to automate the inspection process must account for this hardcopy need without creating extra work.
- GPS – This is a marginal benefit. All permits are tied to a street address. Most code inspectors are so familiar with their "territories" that GPS would not commonly be needed except for new inspectors on the job or for an inspector recently transferred to a new territory.
- Voice Recognition and Recording – This is of interest because it ties to the highly desirable feature of hands-free operation. However, the problem of high-volume ambient noise on the job site or in the inspector's truck suggests potential limitations for this technology.
- Handwriting Recognition – This is of interest because it replicates the current practice of filling out a multi-part form in the field. It is also of interest because it is very important for the inspector to be able to leave a signature in the filed (when combined with printing).
- High-Resolution or Plasma Displays – It is important that any display be large enough and bright enough to be seen in poor light conditions.
- GIS – Now being implemented in many urban jurisdictions like Fairfax. Has the Advantages of storing building data and filing paperlessly.

Hands-Free: This is the second most important criterion mentioned by inspectors. On the jobsite, an inspector must be able to move quickly and to climb a ladder at any point. The fewer tools the better and those that must be taken should fit into a pocket or clip to a belt. Hardened briefcases with padded sections for specialized tools can be brought onto the job as needed for special situations.

The other most commonly mentioned attributes for a future inspection tool are: ease of use, light weight, and—of course—safety. The latter is not trivial when it comes to the inspector's "office"—which is to say the pickup truck. The ergonomics of a pickup truck are designed for driving, not data entry, communications, or other inspection related features. No matter how tempting it is to take advantage of the great amount of time that an inspector spends in the truck, when safety is the first consideration, it is not at all clear that technology can significantly improve the ability to capture a portion of this time.

The balance of Figure 7 presents general comments concerning possible attributes for input/output devices or communication tools. Of the several items discussed, the ability to use video in the future is of great interest. This builds on an increasing use of photography at the present time and might become part of an entirely new strategy for using video technology as a way to leverage the time of inspectors.

Conclusion

Code inspectors today do not use many tools. The few they use on site are simple and very rugged. There do appear to be opportunities for technology to streamline the code inspection process but the extent to which new tools will be used depends on the ability of the tool to adapt to a very rugged worksite or the ability of the inspection process to be adapted to some radically new approaches. The next section of this report deals with an investigation of technologies currently used in other industries or environments that might be adapted to the code inspection process.

II. New Tools or Technologies from Other Industries

Introduction

The purpose of this section is to investigate developing tools or technologies from other industries that could be adopted or adapted by residential code inspectors to save time or improve quality in any aspect of the inspection process. The goal is to "think outside the box." For this initial scan, concerns about cost are largely set aside, though it is fully understood that any future technology will have to be cost effective if it is to be successful in convincing code enforcement agencies, known for tight budgets, to buy it.

The information presented in this section comes from multiple interviews across a wide spectrum of industries and technologies. There were many "blind alleys" in this process. In the end, promising advances in technologies from other industries can be broken down into four categories:

- Laptop and tablet computers,
- Handheld devices,
- Cell phone related photo transmission, and
- Portable printers.

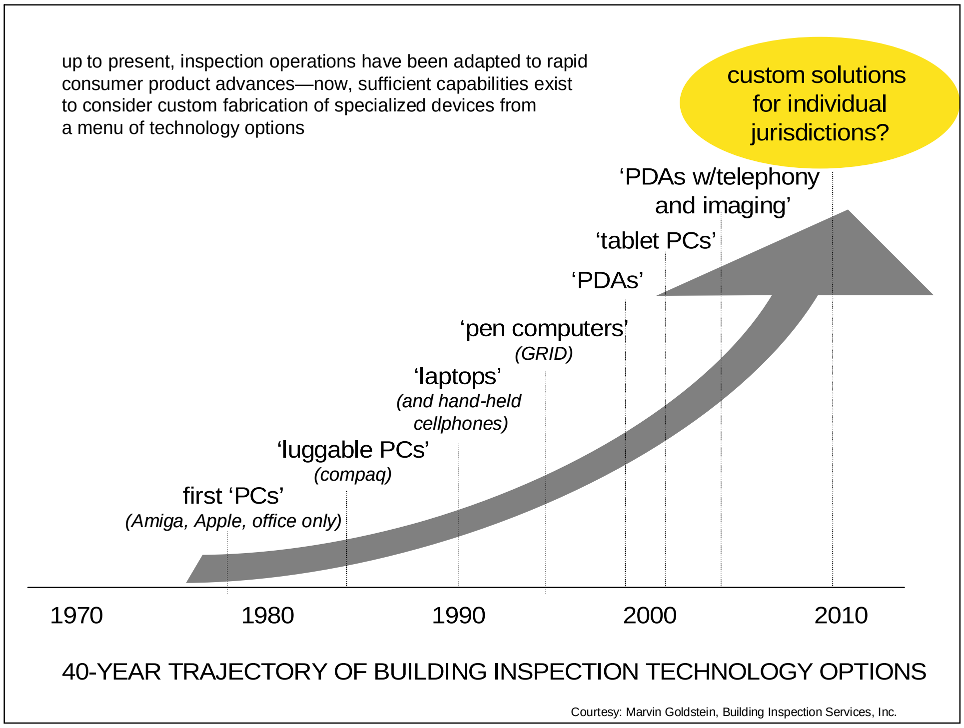
Each of these technologies will be discussed in greater detail in the section that follows.

Laptop and Tablet Computers

Since the broad introduction of computers in the 1970s, code inspection offices have been finding ways to use them to increase efficiency. All large code offices now use them for scheduling and for various aspects of inspection documentation. Figure 8, based on conversations with Building Inspection Services, Inc. (BISCO), charts the development of computers over the past 40 years and their increasing data capacity.

For a company like BISCO that does a very large volume of HUD recertification inspections, recent developments have finally made tablet PCs indispensable to their field inspectors. Reduced weight, extended battery life, affordable ruggedization, and pre-programming of HUD standard forms (such as PASS/UPCS—Physical Assessment Sub-System protocol of the HUD Uniform Physical Condition Standard) are the key feature improvements that have led to this expanded acceptance. Every BISCO field inspector now carries a tablet PC.

Figure 8
The Evolution of Inspection Computing and Communication Technologies



On the other hand, a recent assessment (2004) of mobile inspection tools carried out by Fairfax County, found that both laptops and tablet PCs still have many of the same limitations that have previously kept them from becoming common tools to be used by residential building inspectors: ruggedizing is still too expensive if it can be done at all, some hardware will not run required software (such as Windows XP) or proprietary systems, data entry options can be limited, and data entry with one hand can be difficult.

As will be discussed in the next sections, the continuing miniaturization of computing power into ever smaller packages such as cell phones, PDAs, and other handheld devices may finally move the power of the computer from a two-handed tool to a one-handed tool. That will make acceptance by code inspectors far more likely than it is today.

Handheld Technologies

Many code jurisdictions have independently investigated hardware options. In their analysis of handheld technologies, Fairfax County found several strong advantages: portability, simplicity, wireless adaptable, expandable, and modestly priced. However, there were still significant disadvantages as well: ruggedization can be expensive, data entry methods are limited, and many devices are still limited in size, storage capacity, and processing power.

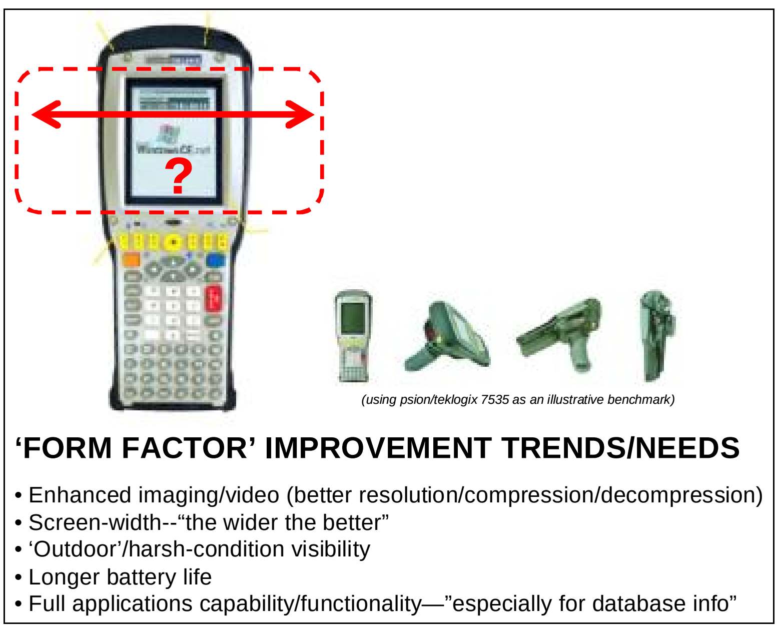
In terms of hardware currently in use in other industries, the devices used by personnel who check in rental cars at Hertz are an excellent example of a multi-function, handheld technology that can serve as a single point of data entry, transmitter of data to a central station, and printer of a paper copy for the customer. It is easy to imagine that this technology could be adapted to the most common functions of the inspection process with only modest software enhancements.

After conversations with Hertz, our research team contacted and worked closely with two manufacturers to investigate the potential for adapting handheld technology to the code inspection environment:

- PSION TEKLOGIX www.psionteklogix.com
- InnoTeleTek www.innoteletek.com

PSION TEKLOGIX (PT) is the equipment supplier to Hertz. They have a wide variety of handheld devices. As illustrated in Figure 9, the screen and keypad can be mounted on a hand-grip assembly and deliver a variety of technology options. Several versions of these "tools" are already in wide use by the military, especially to do bar code tracking of equipment being shipped all around the world.

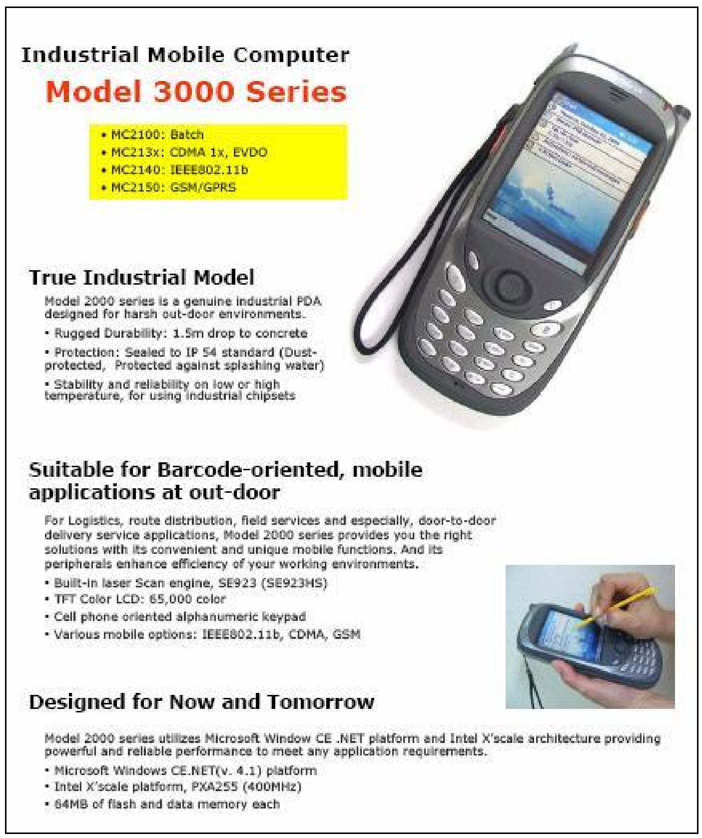
Figure 9
Adapting a PSION TEKLOGIX Model 7535 for Code Inspection Requirements



As suggested in the figure, the main thing that would be required to adapt this technology to code inspections would be a somewhat larger screen and the ability to see that screen in a wide variety of ambient light conditions. Long battery life is always a desired feature.

InnoTeleTek describes their pen-based handheld devices as "industrial mobile computers." The Model 3000, shown in Figure 10, is configured as a palm held device already built durable (1.5m drop to concrete) and has 64MB of data memory. The next generation Model 7000 in the pipeline will meet the MIL-STD-801 F specification for ruggedness, will have a wide-view, 800x480 resolution, transflective LCD display optimized for high ambient light, for use outdoors in direct sunlight. Embedded devices can include a laser scanner and a motion camera in on-demand quantities. A variety of wireless network options will be offered, such as CMDA 1X, EVDO, or GSM/GPRS.

Figure 10
InnoTeleTek Model 3000
(same adaptation requirements apply)



In conversations with both manufacturers the project team worked out a set of "functional goals" for the development of handheld tools at various "levels" representing increasing sophistication of features (and thus increasing cost) that would be of interest to potential code inspectors.

These draft specifications are laid out in Figure 11. A brief description of each level follows.

Figure 11
Proposed Specifications for Handheld Code Inspection Devices

Function	Level I	Level II	Level III	Level IV
Functional Goals:	Replace Paper Form	ADD:	ADD:	ADD:
	Retrieve Pre-Entered Data	On-Belt Printer	Photo Transmission	Video Visor
	Truck to HQ Communication	Hand-Held to HQ Data transfer	RFID Read/encode	
		Camera	Voice Recognition	
			Integrated Cell Phone	
Analogy:	FedEx Blackberry	Hertz Police Ticketing	Army (container tracking)	Low-Visibility ('Jordy' goggles)
Configuration:	Hand-Held/Belt holster Ruggedized TruckCradle/Recharge Date/Time/GPS Stamp	Same Same Same Same	Same Same Same Same **Wireless Headset**	Same Same Same Same Same
Screen:	3" x 3" Minimum Black and White	Same Same	Same Color	**Visor Projection** Same
Keyboard/Keypad:	Alpha-Numeric Buttons & Screen/Stylus	Same Same	Same Same	Same Voice Recogniton
Scanning:	Bar Codes	Same	**RFID read**	RFID encode
Imaging:	(None)	**Digital Camera** (hi-res/lo-light)	Same	**Digital Video** (hi-res/lo-light)
Data Storage:	Megabytes	Same	**Gigabytes**	Gigabytes
Printer:	(None)	**Wireless Printer** (ruggedized/belt-mounted)	Same	Same
Communication-Data:	Hand/truck/HQ	Hand/HQ	Same (digital photo compression and transfer)	Same (video compression and transfer)
Communication-Voice:	(None)	(None)	**Integrated Cell Phone**	Same
Cost Target:	Under $1,500	Under $2,000	Under $3,000	Under $4,000

Level I—The 'FedEx' Model. The tool that Federal Express uses for package tracking is the model for the first level of capability. The delivery person swipes a package before it is handed to the recipient. The event is recorded in a handheld bar code reader. When the courier places the hand unit back into its cradle on the dashboard of the truck, data confirming my delivery is radioed to the central station while the driver goes to the next stop. The sender, within moments, can know that the package has been delivered by checking a web site. This technology has the dual benefits of using otherwise unproductive down time (while driving) and keeping files back at headquarters updated almost instantly.

With the addition of some necessary programming, this technology is available now and at hardware prices some code jurisdictions could afford. The problem is getting software that is customized to the jurisdiction at a price that can be afforded. With the help of alpha-numeric codes or small booklets of pre-designed bar codes, the data entry process used by code inspectors can be speedy.

Level II—The 'Hertz' Model. Travelers will be familiar with this model. To the basic handheld input device, Hertz has added a portable printer and wireless communications to the company's central computer. This gives auto pickup and return site staff the ability to be instantly record a transaction at headquarters and to print a hardcopy "receipt" (with current information) for the customer. The similarities to the code inspection process are obvious. With a few strokes, the code inspector could record the results of the inspection to the central database and then print out a "sticker" to be left at the site. This technology is currently available and is being used by some police jurisdictions to write parking tickets. To this existing technology, we have proposed to add a digital still camera so that a minimum number of photos could be taken and stored. They could also be transmitted to the central computer but probably not while at the job site. [Note that the 'Hertz' solution relies on wireless that transmits over a relatively short distance, necessitating relay from a vehicle transmitter to the central office for inspection applications.] The addition of digital cameras is available from both of the device manufacturers we talked to.

Level III—The 'Army' Model. Including the added feature of the ability to read RFIDs, this level of handheld technology is currently being used by the Army to track containers in Iraq and around the world. At this level, we have proposed to add an integrated cell phone and wireless headset. In this combination, the code inspector could be in real-time communication with headquarters (or others) and exchange a limited number of digital still photos. By moving up to gigabyte storage capacity, this handheld device could store sizable documents. This collection of features is available today but probably not yet at the cost targets suggested to make it within reach of code offices.

Level IV—The 'Jordy' Model. This collection of features is just over the horizon. At this level, adding the ability to send streaming video and to watch the process through a headset with goggles will enhance the vision capabilities of the user. Actually, the hardware parts and pieces for this system are available now. The limitations are the compression, transmission, and decompression of the video stream. This device doesn't need to solve those problems. It just needs to wait to have them solved by others. Why "Jordy?" Figure 12 illustrates a new technology for seeing better that might be useful for inspectors.

Figure 12
The JORDY^{tm} (Joint Optical Reflective Display)

Similar in function to the visor worn by the blind character Geordi LaFarge in Star Trek: The Next Generation, the JORDY™ (Joint Optical Reflective Display by medical device manufacturer Enhanced Vision of Huntington Beach, CA) magnifies objects up to 50 times and allows changes in contrast, brightness, and display modes.

JORDY technology does not need to be worn in a visor. For code inspectors, the underlying technology could significantly enhance the image manipulation capabilities of the camera component of hand-held devices, eliminating the need for auxiliary lighting and allowing close examination of even the smallest details from anywhere in a space. Further advances may at some point even allow limited scanning of concealed spaces.

Cellular Phone Technology

Video cell phones have now put into the palms of our hands capability that used to take a television camera crew with a truck full of equipment and a satellite uplink. Assuming that sufficient lighting is available, it is now possible to imagine someone on a jobsite calling up an inspector, pointing the phone at a building feature, and asking, "is this OK?" Actually, it has probably happened already.

As we prepare and deliver this report, Motorola has just begun to deliver a new generation of wireless technology combining a 1.23 megapixel camera with Bluetooth wireless connectivity (Model V710). Available in stores at about $250 (including rebates), it can take still photos for printing and capture video for viewing and sending.
For more details go to www.motorola.com.

Not that this is the exact tool that code inspectors will use, it does illustrate the speed and intensity with which technology developers are working to solve the video compression and transmission challenges. The ability of code inspectors to record and transfer data and to collaborate, if desired, is about to take a great leap forward.

Portable Printers

Having a printer on site that can print out a "Passed," "Rejected ," or "Rejected for the Following Reasons" sticker meets one criteria that code inspectors must have. However, to be connected to a database at the central station opens up opportunities for other, even customized, documents to be delivered to the site. This could be an opportunity to enhance customer services as well. For example, if the current inspection has failed, it is important to educate the builder why he or she has failed so that there will be an increased likelihood that the inspection can be passed on the next visit. It is definitely an advantage for the inspecting jurisdiction if they can improve efficiency by eliminating the need for third and forth visits to pass an inspection. One such printer, the "Zebra," is illustrated in Figure 13.

Figure 13
Zebra PT400 Portable Printer

The printers are rugged and have good battery life. Best of all, rolls of print paper can be customized and pre-printed to suit multiple needs—snap in the green roll for a "Passed" inspection or snap in the red roll for a "failed" inspection including a brief description of the reasons for failure. At a cost of about $1200, this technology is currently being used by police departments to print customized parking violation tickets.

It isn't hard to imagine that without spending too much time, an inspector could use the technologies we have discussed above in conjunction with a slightly larger format printer to strip in a photo of the failed inspection item, reference the section of the building code or the approved plans that has been violated, and then attach pre-prepared materials that explain in greater detail common errors that are made in cases like this and how they can be corrected successfully. And, this could be done in multiple languages. The 10 or 15 minutes spent doing this could be an excellent tradeoff when compared to the 30-60 minutes that might have to be spent in doing one or more re-inspections.

Time Stamp

Although it is common practice in many industries and office functions, the common time stamp is not yet used uniformly in code inspections. As illustrated in Figure 14, the simple marking of month, day, year, and time can serve a variety of useful purposes.

Figure 14
An Electronic Time Stamp

mo / dd / year 00 : 00 : 00*

A SIMPLE ELECTRONIC 'TIME STAMP'
CAN SERVE A VARIETY OF PURPOSES:

- Documented record
- Tracking mechanism
- Work flow management
- Inspection quality control check

**adding GPS would pinpoint location as well*

Not only is it invaluable as a record of the visit to the job site (and a GPS stamp could be added to further this documentation), it is a useful management tool for tracking productivity and insuring quality control. (One source we interviewed realized that they had a quality control problem when inspection records were submitted with time stamps in the middle of the night.)

Conclusion

The investigation of tools currently used or under development in other industries has proven to be potentially very useful for the code inspection process. Although laptop and tablet computers have had only limited acceptance in the inspection process, the continued miniaturization of computing functions, data storage, and communication functions has given handheld devices an ever-increasing array of features and functions. It appears likely that these tools could soon make significant inroads into residential code inspections. Cell phones and digital cameras are already in use by inspectors. It doesn't seem long until those functions might be combined. And finally, portable printers, already in use by policemen forces could make documentation of code inspection results at the job site significantly more robust.

III. Looking Ahead: Virtual Inspection, Certification in Lieu of Re-Inspection, Voice-to-Text, Outsourcing?

Can 'Virtual' Inspections Beat the Clock?

As discussed earlier, the residential code inspection process consists of inspectors, transportation, and hardware and software to conduct operations. The most expensive component of the residential inspection process is the highly trained and experienced code inspector.

If an expert inspector could spend more time applying his or her training to making judgment calls and less time simply moving from job site to job site to do so, the impacts on cost reduction and improved efficiency could be substantial. Even when at the site, many inspection activities are routine and do not require particular expertise. It begs the question: Can expert inspector resources be leveraged by using technology to visit sites remotely and only as needed to verify non-compliance with code requirements?

Figure 15
A 'Virtual' Code Inspection

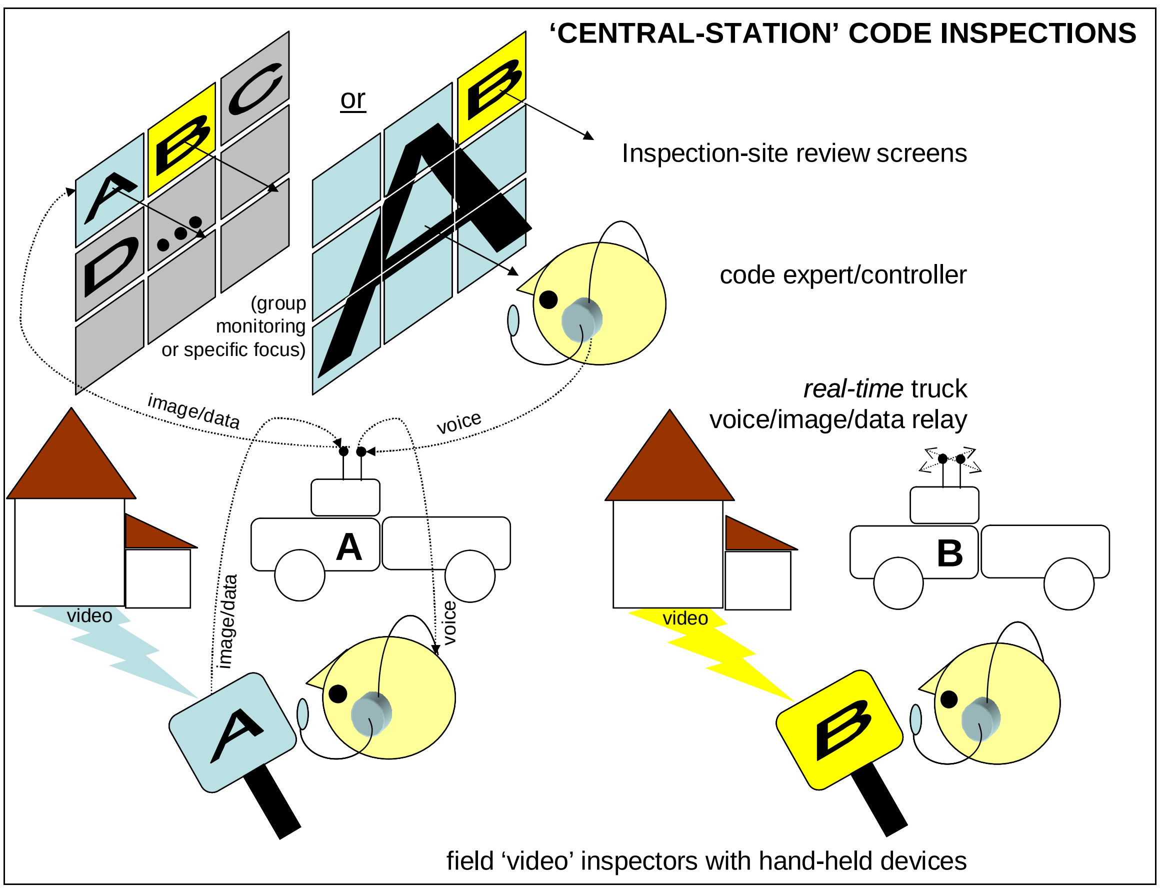


Figure 15 illustrates how we might put together all of the emerging technologies discussed in foregoing sections to create a “virtual” inspection in which a less-experienced person takes a (Level IV) handheld video device to a job site and then follows instructions from an expert code inspection team at a central site.

The video images are displayed at the central station for the inspectors to view and pass or not. “Smart” displays are already used in a variety of other industries. Those viewing the screens can monitor many remote sites simultaneously or, at the press of a button, commit the whole viewing screen to an enlargement of the transmitted image. The truck can be used as a relay if necessary to enhance the needed audio and video signals. The whole system is wireless, including the connection to the belt-mounted printer for printing out the results of the inspection to be left at the site.

Of course, it is necessary to know for sure that the building the inspector is seeing on the screen at the central station is truly the building to be inspected. This requires some sort of authentication by someone responsible to the inspecting authority, but it need not be a highly trained person so long as the “remote” person can communicate with the central station and follow instructions. GPS could also assist in authenticating the location of an image source.

The on-site handheld device is not only used to capture photo or video images but also to receive data or images. It can be used to receive additional plan information from the central station, to check data from previous inspections, or to view reference data. For all of these purposes, the handheld device is envisioned to have a larger screen than is common on handheld devices today.

The virtual code inspection process could be managed in a variety of ways: jurisdiction staff only, jurisdiction staff controller only, jurisdiction field staff only, or entirely out-sourced to a third party. The location of the controller also is not geographically constrained. The service could be national, to individual jurisdictions large and small, across the country.

For some the value of using remote video imaging will increase roughly in proportion to the amount of travel time that is spent by the team of inspectors—being less valuable in jurisdictions covering a small geographic area and more valuable in jurisdictions covering a large area or with significant traffic delays. Other jurisdictions will reap benefits from the ability to utilize less-highly trained or experienced personnel in peak periods.

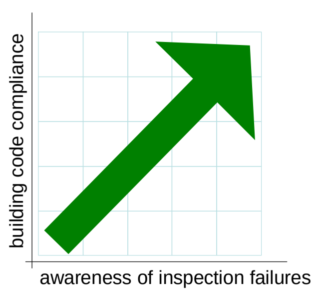
Can Builder Self-Certification Replace Re-inspection?

Builder/contractor self-certification in lieu of re-inspection for all, most, or some inspection failures could save substantial direct (labor on-site) and indirect (travel and administration) resources. Jurisdictions would need mechanisms to ensure compliance—perhaps spot checking re-inspections to verify certification, and levying fines for violations. Obtaining a principal (owner and/or builder) signature record of receipt of failure notification could also encourage compliance. RFID (radio frequency identification device) is a possible technology for remotely "turning on/off" inspection status by applying active or passive stickers at the site as part of the approval process.

As with the virtual inspection discussed above, the principal purpose of this approach is to reduce travel time for high value inspectors. Another way to reduce failure rates is to increase builder awareness of common inspection problems. In the interviews conducted for this report, we found that for many reasons, builders do not typically take time for educational programs offered by jusisdiction staff. However, it might be possible to reach out to builders with more effective ad or informational campaigns to emphasize the most common code failures and ways to prevent lost time on the job due to failed inspections.

Figure 16 illustrates the finding that as inspection failures are documented and widely reported, compliance increases.

Figure 16:
Improving Code Compliance Through Wider Reporting



HYPOTHESIS: AVERAGE CODE COMPLIANCE INCREASES OVER TIME AS INSPECTION FAILURES ARE DOCUMENTED AND WIDELY REPORTED.

…Jurisdictions may want to establish a public on-line listing of most common violations resulting in inspection failures, organized by building products, systems, and construction labor trades

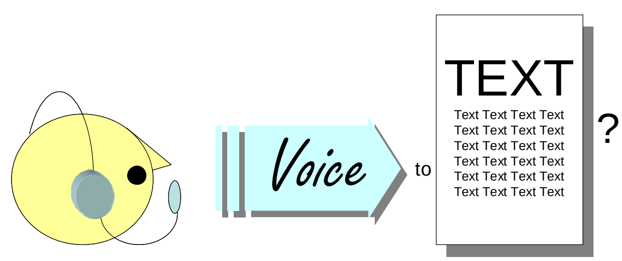
In a recent example, a jurisdiction noted that decorative composite exterior columns were being inappropriately installed as structural members in interior locations, raising both building and fire rating concerns. As soon as inspectors started seeing multiple violations, the "word" was put out through all possible channels that this represented an inappropriate and possibly unsafe use of the product. Once notified, builders responded quickly to stop the practice.

Will Conversion of Voice-to-Text Be A Big Breakthrough?

Voice recognition may be the ultimate in "hands free" mobility. It is already possible for computer-controlled systems to recognize spoken words. Though still relatively expensive, this technology is already being used to assist the handicapped. The technology as it currently exists is not very portable and does not yet have buffers that could help filter out the noise at the job site.

Figure 17 is a simple illustration of the current state-of-the-art. In this diagram, the speaker's voice is translated word for word to the electronic page—after some calibration for individual inflections of speech. Unfortunately, simply translation doesn't help a code inspector much. What is needed is the ability to fill out complex forms or to populate a database back at headquarters. These stronger capabilities have not yet been developed.

Figure 17
Limitations of Voice Recognition



May be the 'ultimate' for hands-free mobility and could save substantial time at the site…

<u>but</u> must go beyond word-processing to database, data-entry, and data-sorting capabilities to be truly useful for field inspections…

NEEDED CAPABILITIES NOT YET AVAILABLE!

In the early days of stenography, lawyers and others using Dictaphones learned to speak in new ways to accommodate the technology. Old movies have some wonderful scenes of the important trial lawyer instructing the typist by saying “new paragraph” and “full stop.” It seems possible that there is a verbal equivalent to pop-down menus. The question remains whether or not busy code inspectors will be willing to learn an entirely new way of speaking to accommodate such a technology.

Can Professional Fee-Paid Inspectors Replace Local Government Staff for Building Code Inspections?

All of the technology development of the last twenty years leads to the ultimate question of “outsourcing” code inspection services entirely. Code enforcement for housing is a clear mandate for the authority having jurisdiction. New technologies and pressures have combined to offer radically different ways to provide, monitor, and verify delivery of services and protection of the public safety. Fee-based outsourcing of code compliance inspections could be the answer (or part of the answer on an as needed basis) to improving public service while managing and controlling costs. With proper oversight, 3rd-party outsourcing of residential code inspection services could provide a consistent, flexible, and cost-effective alternative to current practices.

Fee-based 3rd-party code enforcement inspections are already common practice in many jurisdictions in Southern California. Outsourced inspections may offer several economic advantages, perhaps most significantly the ability to cost-effectively meet irregular demand from season-to-season and from year-to-year. The practice may have reached sufficient acceptance to warrant study of the how it may be best implemented and identification of issues that may need resolution before it can be considered by any particular jurisdiction.

Some leading code enforcement officials contend that it is inevitable that 3rd-party inspectors will replace government staff for building code inspections. They believe that while the public will demand involvement of government officials, oversight of building code compliance does not necessarily have to involve direct physical inspection by government employees. Moving to 3rd-party inspections may require state law changes to redefine local government code enforcement responsibilities. For instance, localities could employ spot checking of 3rd-party provided inspection certifications by professional auditors or, alternatively, some sort of licensing regimen to administratively police code compliance. In either case, costs could then be borne directly by builders and/or home owners, enabling market forces and competition to derive cost-effective solutions.

IV. Next Steps

The purposes of this study were to document the current state-of-the-art in residential code inspections and then to review technologies from other industries that might bring new ideas to code inspections that could improve efficiency by reducing time spent while improving, or at least without compromising, inspection quality. Some compelling ideas were found. So, where to from here?

Recognizing and Awarding Best Practices

In preparing this study, the authors had the benefit of contacting and learning from some of the finest code enforcement jurisdictions in the country. These professionals are committed to serving the public well and they are keenly interested in the potential for new technology to help them do this job more efficiently and cost effectively.

It may be useful for the homebuilding industry to consider spending more time and resources evaluating and reporting best practices for residential code inspections (among code jurisdictions) on an ongoing basis. It would not be too difficult or costly to set up an annual awards program to institutionalize this on an ongoing process. This would serve the dual purposes of keeping everyone up with technology as it changes and updating the industry.

Demonstrating and Testing a 'Virtual' Inspection Process

With the possible exception of the ability to cost-effectively send and receive high-quality streaming video in real-time (because of seemingly temporary limitations on compressing and decompressing data) all of the technology currently exists to demonstrate a remote "virtual" inspection with reporting back to a central station monitoring facility. With today's technology, high-resolution digital still photos could be used to represent what could become video in the not distant future.

It would be very valuable for a busy code jurisdiction to try out this concept to see if it could really work or if there are practical field limitations that would make it impossible. However, it may to be too costly an experiment for any one jurisdiction to undertake on its own.

It is recommended that appropriate industry participants jointly put together a production team to test this concept with a leading code jurisdiction. Most of the necessary equipment could be leased. In consultation with the staff of the selected jurisdiction, sample problems and "scripts" could be created to test the "virtual" inspection. Review comments from the jurisdiction staff and management would be very important to judging the likely viability of this concept. A video documentary of this test could be made so that other jurisdictions might be able to review and comment on the concept and see if it might be adapted to fit their own operational plans.