White Paper:

On Best Practices in Electronic Plan Submittal, Review, Tracking and Storage

ALLIANCE FOR BUILDING REGULATORY REFORM IN THE DIGITAL AGE AT FIATECH

A Public-Private Partnership to Enable State & Local Governments to Improve the Effectiveness & Efficiency of Building Codes Administration & Enforcement

www.natlpartnerstreamline.org

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WHITE PAPER ON BEST PRACTICES IN ELECTRONIC PLAN SUBMITTAL, REVIEW, TRACKING AND STORAGE

I – BACKGROUND & PURPOSE: Recent national surveys by the Alliance for Building Regulatory Reform in the Digital Age and its partners have shown electronic plan submittal, review, tracking and storage to be one of the fastest growing areas of interest to building departments and their customers for applying information technology (I.T.) to building codes administration and enforcement processes. Jurisdictions using I.T. for these processes are reducing plan review and tracking times by 30 to 40 percent.

The purpose of this White Paper is to aid state and local governments in considering the successful application and use of this technology. This paper identifies both the benefits of applying I.T. to the plan submittal, review, tracking and storage processes and some of the best practices currently in place for using this technology.

This White Paper has been prepared by the Alliance with input from Alliance members and from state and local governments. Copies of this paper are being distributed to building officials through the Alliance partners: National Association of Counties (NACo), U.S. Conference of Mayors, National Governors Association, NASFA, NFPA, and AMCBO. Funding support for the White Paper has come from Alliance partners: American Institute of Architects (AIA) and Avolve Software, Inc.

II – PROBLEM STATEMENT – Traditional Plan Submittal & Review

Every day in countless offices of architects and engineers across the nation buildings are designed on paper or on computers. Multiple copies of that design are then printed out, rolled up and driven to the local building department where they are received for distribution and are often reviewed sequentially by plan reviewers in several technical areas and/or agencies.

When errors are found in the drawings where the plans do not comply with the appropriate section of the local construction code, they are either mailed back to or are picked up by the architect or engineer for corrections to be made. The plans then are once again driven back to the local building department where the re-review process begins. In many cases this submittal/resubmittal process goes through three to five iterations taking as much as eighteen months before the plans are finally “approved” by the local jurisdiction and construction can begin on the project.

The advent of electronic computer design, the internet and large screen computer terminals have made this approach towards building design and approval as archaic as the horse and buggy. A process that takes months can be completed in a matter of a few days or even, for simple structures, a matter of hours.

III – EXECUTIVE SUMMARY

Over the past five years, a growing number of jurisdictions are accepting building plans electronically online or via CD-ROM and are using software programs that allow them to track building plans, either in hardcopy blueprints or in electronic format. These tracking systems have either been available just to the building department employees and/or also to the clients giving them up-to-the-minute information on the status of their project.

While the actual review of building plans electronically has been slow to develop, a few software programs have been written and are now available to enable state and local governments to review and mark-up electronically submitted plans for code compliance especially in the areas of energy code, accessibility for the disabled, and structural calculations and, in three cases, for the entire structure. In addition, a growing number of jurisdictions are using one of several technologies to store building plans electronically – on tape or in dedicated servers.

Sample benefits from e-plan submittal, review, tracking and storage include:

- Electronic plans submittal, tracking, review and storage reduce traditional plan processing times by between 20 to 50 percent by reducing the number of physical trips to and from government offices and by making these services available 24/7/365 and enabling jurisdictions to shift staff resources to other areas in need of attention.

- Improved accuracy of data transmitted contained on the plans and reduced number of building permits and plans being filed by non-licensed architects, engineers or contractors.

- Enhanced collection of revenues owed to the jurisdiction.

- Enhanced ability of government departments to conduct parallel plan review rather than perform them sequentially.

- Reduced or eliminated space and retrieval problems associated with paper blueprints.

This White Paper describes the nature of the problems that confront jurisdictions still using only paper-based plan submittal, review, tracking and storage processes and the benefits of making these processes digital. The paper also shares detailed best practices through case studies providing examples of:

- How jurisdictions successfully addressed plan review timeliness and accuracy issues through I.T.;

- What steps those jurisdictions took to successful apply I.T. to their plan review programs;

- What benefits those jurisdictions are seeing; and

- Potential future benefits from e-plan submittal, review, tracking and storage in the aftermath of a major natural or man-made disaster.

This paper also contains information on how to contact officials in those case study jurisdictions to learn more about their experience with e-plan submittal, review, tracking and storage and looks at future developments that will further shape the need for I.T. in the plan processes.

IV – THE PROBLEM OF TOO MUCH PAPER

A. *Where are my plans?*

To be effective and efficient, the building regulatory process needs to reduce the amount of uncertainty to the users of that system, be they architects, engineers, contractors, homeowners or building officials themselves.

While significant strides have been made throughout the nation over the past 20 years to reduce the uncertainty in the building permit process though such mechanisms as web-based permit application and tracking systems, until recently very little of the uncertainty has been removed from the building plan submittal and review process.

Walk into most building departments across the nation and you will find a room (or rooms) with rows upon rows of architectural plans awaiting distribution for review to one or more plan reviewer in the building department and/or for dissemination to other plan reviewers in other agencies within that jurisdiction. In some cases these other agencies include the fire marshal, boiler or elevator inspection agencies, or perhaps even the zoning and land use department or the historic preservation or architectural accessibility boards.

In response to customer demands for regulatory efficiency, most building departments have established and maintain an orderly flow of those plans within their own internal reviews. Where the plans are for relatively simple structures, such as a single family residence or small commercial structure, the review may be done by a single person. For more complex structures the review may be done by either a single set of plans or multiple sets being passed sequentially from plan reviewers with one area of technical specialty (e.g. structural) to another (e.g. mechanical or electrical) before they are then sent along out of the building department to other related sister agencies for their technical review.

Historically two major impediments to effective and timely review of building plans have been the tendency of architectural firms, contractors and engineers to submit incomplete plans, forcing a delay while more complete plans are resubmitted, and internal delays within the building department for completed plans to be reviewed.

Regarding internal delays, too few building departments have a well coordinated review and tracking system as to the status of those plans in their review in other related agencies that must review and approve some aspect of the building's design outside of the scope and authority of the building code.

Even when a building plan goes through a well conceived process of sequential technical reviews, the actual location of a set of plans on any given day is rarely reported to a single information point within the agency. Even rarer is a system for making that location/process information readily available to the architect, engineer or building owner who submitted those plans. Architects invariably find themselves making multiple calls to multiple agencies to ask: *Where are my plans? When will they be through your review process?*

Nearly every architect can recount a story of getting answers that include: *I think the plans are on Charley's desk, but he is on vacation for two weeks* or *What plans?* or worse yet, *Well we've been looking for them, but I guess they got lost between our office and (fill in the blank).*

Likewise on the external delay side, every building official can recount stories of receiving incomplete plans from their clients/customers (architects, engineers and/or contractors) and requiring the customer to have to begin a confusing loop of re-submittals until all of the plan details necessary for code compliance review have been provided.

B. Even More Complications – Re-submittals and Re-reviews & Mother Nature

Traditional processing of paper plans also far too frequently result in confusion between the architect/engineer/owner and the building department and sister governmental agencies involved in some aspect of the plan review process, when the plans are either incomplete in their submission or are rejected by one plan reviewer and sent back to the architect for corrections to be made, while reviews against the originally submitted plans continue to progress through the state or local government. A communications breakdown here has caused more than one project to either end with problems upon construction or caused major delays with the resubmitted plans then having to go through delayed reviews by the other agencies involved.

Mother Nature adds its own spin to the problem of paper plans. Local building departments in Florida, Louisiana and throughout the Gulf region have lost all of their paper building plans when hurricanes like Andrew, Charley, and Katrina have either torn the roofs off or flooded the building department either blowing away or totally soaking and ruining all of the paper plans that were in process or were stored there. The loss of those plans significantly slowed down the reconstruction process and, in some cases, resulted in buildings being in place today with no approved building designs in the possession of either the building owner or the jurisdiction where it was constructed.

C. Less Than 2% of Jurisdictions Use Information Technology in One or More of the Plan Processes – What are they missing?

While it is estimated that nationwide over 5,000 of the nation's 40,000 state and local jurisdictions that adopt and/or enforce building codes and standards are using I.T. in one or more of their codes administration and enforcement processes, less than 1,000 jurisdictions currently use information technology in one or more of the administrative processes involved in building plan submittal, review, tracking or storage. The majority of that use has been limited to electronic tracking of plans with less than 400 jurisdictions accepting plans electronically and fewer than 50 doing electronic plan reviews. Why is this so and what is it that these jurisdictions are missing by not applying I.T. to their plan processes?

First of all, what are they missing?

As noted in the case studies provided in this White Paper, the application of information technology to one or more of the administrative and enforcement processes related to the submission and approval of building plans has come about to overcome slowness and inconsistencies in the traditional paper plan submittal, review, tracking and storage processes. These are generally delays or inaccuracies that created major cost or delivery problems to the building owner, architect, and designer. In some cases these costs were to the community itself from reduced tax revenues through the delayed opening of a building or, in extreme cases, causing a firm to abandon building in that jurisdiction all together and building somewhere else instead.

Here are the basic reasons why I.T. in the plan submission, approval, tracking and storage process benefit codes administration programs.

1. Speed and ease of submission & review

Most jurisdictions that have applied I.T. to their plan processes have done so to help eliminate the three major problems associated with the paper plan process. The first is it helps reduce the tendency of architects, engineers, or contractors to submit incomplete designs. Electronic plan review tools are available to both the client and the building department. Architectural firms then can run a check of their own plans for both completeness and accuracy prior to submission to the building department.

The second is the elimination of the slowness of and both financial and environmental costs associated with driving blueprints into the building department – often from great distances. The third is the reduction or elimination of the relative slowness and inability to readily do parallel plan reviews.

Once a jurisdiction applies I.T. to any building codes administration and enforcement process, such as online permit submission, a growing number of their clients look forward to having other codes administration and enforcement processes services also made available to them. This initially included a growth in online Interactive Voice Response systems for calling in and scheduling inspections and rapid reporting of field inspection results from remote field inspection processes.

With the growth in the use of automated design tools by architectural and engineering firms, this has expanded to include the plan submission and approval area. As more and more design firms started using AUTOCAD and other electronic plan design tools, they began looking at the reduced costs and other benefits associated with not having to constantly convert their electronic plans into multiple hardcopy traditional blueprints that have to get recopied and resubmitted with every correction the building department found needed to be made.

Other savings have come in reduced travel time and costs. Osceola County, Florida, found that electronic plan submission enabled some designers in their county to save 140 mile roundtrips (often multiple round trips in the case of resubmissions of corrected plans) and enabled this service to be available 24/7/365.

Submission of plans in an electronic format also significantly facilitates the ability of the jurisdiction to conduct parallel reviews of the plans - shortening the review and approval process in some cases by as much as a month. As will be described later, different disciplines can electronically review the plans simultaneously and share their markup of the plans with each other, eliminating the necessity of the previous standard process of one set of plans moving consecutively from one design review area to the next.

2. **Reduces confusion as to what changes have been made, by whom and when**

Existing electronic plan review tools also facilitate the documentation that travels with the single electronic plan that denotes what changes have been made, by whom and when within the plan review process. Where multiple sets of plans move through a building department and over to other related approving agencies it is very difficult to identify at any given time who has made what changes and when they made them. Numerous problems with the final approved plans that are later caught in field inspections are either significantly reduced or are totally eliminated through electronic plan review tools now available to building departments.

3. **Reduces number of and shortens resubmission cycle(s)**

This has been one of the largest problem areas that e-plan submission and review has been able to resolve and not by just eliminating long drives to and from the building department. By facilitating both the submission by the architect of complete plans and the conducting of parallel reviews, the architect can get all of the needed changes to their plans at one time rather than engaging in the seemingly unending round of *No you got it wrong; do it again* multiple resubmissions for the multiple disciplines reviewing their plans (e.g. electrical, mechanical, structural, fire safety, egress, etc.). On top of that as noted earlier, the architect is able to electronically know exactly where his or her plans are within the review process.

4. **Provides the jurisdiction with a tool to measure productivity of staff and ability to perform plan review from remote locations**

Electronic plan submittal, review and tracking also provides the code administrator with a tool to accurately measure and get update reports on the amount of time it takes each plan reviewer to review building plans for different technical areas and different building types.

Another side benefit both to the jurisdiction and to their plan review staff is that e-plan review technology also enables plans to be reviewed from remote locations. This has proved beneficial in the wake of disasters that have damaged the building department or in a few documented cases where employees have been unable to travel into the office or where the jurisdiction has become involved in a community's effort to reduce rush-hour traffic in support of the environment by allowing telecommuting.

5. Speeds inspection processes where coupled with remote field inspection technologies (laptops, PDA's, etc.)

Several jurisdictions have pioneered the linking of electronic plan review with the ability of their field inspectors to download those plans (or portions of them) and take them with them into the field when they conduct a remote field inspection using a laptop computer, minicomputer, PDA or other electronic device. This has allowed quick completion of the field inspection and issuance of the inspection report to the contractor.

As noted below, plans that are available electronically are of tremendous benefit to first responders.

6. Facilitates mutual aid & speeds disaster response and recovery

One of the major problems of 9-11 was the inability of the first responders to have access to the as-built plans of the World Trade Center buildings. Fire trucks were parked over thin concrete slabs that gave way underneath their weight and opened up large voids into which the trucks began to fall. The command center for the disaster was set up in the ground floor of one of the Twin Towers and was ultimately lost along with countless first responders when the towers collapsed.

The availability to first responders as they roll-up on a disaster site of the electronic version of as-built designs of iconic buildings or large public structures can contribute to the savings of the lives of both first responders as well as the public who may be trapped in such damaged structures.

On the recovery side, electronic plan submission, review, tracking and storage enables communities in disaster-prone areas to remotely store their approved designs and be able to retrieve them after a disaster has damaged the local building department. Moreover, as envisioned by the new statewide e-permitting system being established in Oregon and recovery and statewide building code implementation plans for the State of Louisiana in the aftermath of Hurricane Katrina, electronic plan systems enable jurisdictions that have been damaged by a major disaster to have their plan review functions performed by building officials in other jurisdictions which were unaffected by the disaster, significantly speeding the recovery process.

A regional e-plan submittal, tracking and review project in the greater Cincinnati, Ohio, region is pioneering this approach. (Additional information is available on the Alliance website.)

7. Prepares jurisdiction for new technologies and processes (Building Information Modeling of 3D & 4D designs and SMARTCodes)

As noted in the closing section of this White Paper, the nation's construction industry and the International Code Council (ICC), the writers of the nation's model building codes, are moving forward with new tools to facilitate the more rapid design construction and cost effective operation and maintenance of buildings throughout their life cycle with several new tools. These include Building Information Modeling (BIM) and the BuildingSMART initiative that are working to link all of the members of the construction team and extends the use of the same data across the design, engineering, construction material specification, delivery of materials, and construction, commissioning, operation and maintenance processes. The ability of building departments to ultimately read and incorporate that data into their plan review of the structure will further speed the building of safe, durable structures in the nation.

Moreover, the ICC's efforts to build electronic plan check tools that utilize the technical provisions of their family of building codes will further increase code compliance and speed the regulatory process.

By making use of I.T. now in their plan submittal, review, tracking and storage processes, communities will ease their transition to incorporating these new tools into their codes administration and enforcement programs as they become available.

8. Increases revenues by getting buildings on tax record faster

The last benefit that jurisdictions using I.T. in their plan processes is one that benefits the entire jurisdiction and their citizens. Using I.T. is reducing by 40% the amount of time it takes some structures to go through plan review. This means that those structures are being built and are approved for occupancy faster than they were using paper plan submittal, review, tracking, and storage processes, bringing these buildings onto the jurisdiction's tax roles faster – thus increasing overall revenues to the state, county, city, town or township.

D. What Have Been the Barriers to Using I.T.?

With the above as the benefits that jurisdictions are achieving through electronic plan submittal, review, tracking and storage, why haven't more jurisdictions gone this route? With apologies to David Letterman, here are the "Top Ten Reasons Why Jurisdictions Have Not Applied I.T. to Their Plan Processes."

No. 10 – Horror Stories – Neighbors that have tried and failed

This has been one of the standard barriers to the application of I.T. to any building codes administration and enforcement process. Word of mouth, stories of jurisdictions that tried and failed or had less than positive experiences with I.T. are common, though often not the real reasons why that experience became a horror story. Often failures are related to either a problem with early technology or the lack of preparation within the community for I.T. As the former head of the National Association of State Chief Information Officers, Aldona Valicenti said at the organizational meeting of the Alliance: *If all you do is put I.T. on top of a bad regulatory process, then all you will get is a regulatory process that is bad faster.*

Some of the mistakes made by both jurisdictions and their vendors that contributed to these "horror stories," are available for reading in the Alliance's HUD funded *Guide to More Effective and Efficient Building Regulatory Processes through Information Technology*.

No. 9 – Lack of information on the benefits and reliable Return on Investment data

This is the other side of the horror stories. In general jurisdictions have found it extremely difficult to identify reliable information on the benefits of I.T. and the actual costs and Return on Investment (ROI). This led the Alliance in 2005 to develop and make available such information through several tools found on the Alliance's website: www.natlpartnerstreamline.org. Those tools include *Survey Results from the July 2006 Report* that describes the outcome of ROI data gathered in a May 2005 survey conducted by the Alliance that looked at all of the costs: acquisition, training of staff, operation and maintenance of the software systems. In general the survey reported a 4 month payback period for the jurisdictions costs in savings to the building department and its clients.

No. 8 – Lack of information on what is available and what really works and lack of maturity of the technology (e.g. reviewing plans on screens (are they large enough?))

This White Paper is a direct response to this barrier. Mention electronic plan review to most building officials and they say how difficult or impossible it is to do plan review of multiple pages (side by side comparisons) using existing computer monitors. Initially this was true enough, but the latest generation of monitors and flat panel screens has changed this. Several jurisdictions in the case studies in this White Paper specifically address how they surmounted this traditional barrier.

No. 7 – Lack of interoperable software and electronic seal laws

This area has been a major problem for many jurisdictions wanting to acquire hardware or software for any building regulatory process. By interoperability we specifically mean the ability to exchange data between different types of software supplied by different vendors.

This area is being addressed by the Alliance and its pending demonstration project in the Los Angeles Basin region of interoperability of hardware and software used in remote field inspections of structures damaged by a major disaster. Other groups are working on this issue such as Alliance partners: the International Alliance for Interoperability and FIATECH. The BuildingSMART initiative mentioned earlier is another group addressing this issue.

The second part of this reason impacts jurisdictions in those states that currently still lack legislation recognizing electronic seals of documents including electronic drawings. In those jurisdictions, only wet sealed hardcopy blueprints are recognized as legal documents.

No. 6 – *This Data is Mine!* Information is power and different agencies afraid to share

This problem is one of pure human nature. Since information is power, many agencies, indeed departments within a single agency, often are extremely reluctant to undertake the business process engineering or re-engineering work that is necessary to identify the various parties that need to share data and then structure a program that effectively shares that data.

No. 5 – Lack of support from external stakeholders/customers for I.T.

What if you build it and they don't come? As noted in Section 5A on what can be done now to prepare for e-plans, jurisdictions need to identify and begin working with their key external stakeholders/clients or customers to understand how they perceive the current plan submittal, review, tracking and storage process and what changes they would support in improving that system through the acquisition and use of I.T.

Quite frankly, some communities just aren't ready for I.T. in this area. Even those jurisdictions that were surveyed by the Alliance as little as three years ago and said their customers did not see the need for I.T. are now coming back to the Alliance and saying that they are hearing a different story from these same firms.

A second area where this has been a barrier has been in not building up support within the client/ customer community to support the funding of the acquisition, training and use of I.T. in the plan (or any other administrative and regulatory) process.

No. 4 – Lack of technical support /trained staff within jurisdiction to install, train, maintain

Many communities do not have a chief information officer or access to competent I.T. support to take on electronic plan submittal, review, tracking and storage. To aid those jurisdictions, the Alliance in 2003 produced and maintains a Model Procurement Guideline that can be downloaded from the Alliance's website. In addition, the previously mentioned Guide includes information that can be helpful to communities without access to their own technical I.T. personnel.

No. 3 - Fear of Change – Both Staff and Customers

This goes along with several other reasons already provided here. Change is difficult for most people, particularly for staff. *Will I be replaced by a computer? I am too old to learn computers now. Will they start tracking how long I take to review plans?* These are all examples of natural fears voiced by staff.

From the customer side fear of change includes the architect's worry that their design will be stolen or copied by others causing both an artistic and a financial loss. AIA and other partners in the Alliance are working with the building design and engineering community to share information allaying these concerns noting that electronic plans are at no greater risk than blueprints currently are.

No. 2 – Lack of funding or funds diverted

Lack of funding rises to the top of the list in every survey conducted by the Alliance regarding reasons why jurisdictions are not using I.T. The most common reason for lack of funds has been the failure to get the building department's clients behind the acquisition of I.T., serving as a champion for tools that will immediately benefit their firms.

This issue takes a second hit in a number of communities that succeeded in raising funds for I.T., often through the placement of a surcharge on top of their existing permit fees, but whose elected officials "raid" or divert those funds to cover other costs in the jurisdiction. Several states, including Florida, have passed laws making such actions illegal.

No. 1 – Shear Inertia (An object at rest stays at rest.)

Or as the cartoonist Walt Kelly had Pogo say in 1971, *We have met the enemy and he is us!* This clearly is the number one overall reason why jurisdictions are not using I.T. in e-plan process (or in any of their codes administration and enforcement process). People, building departments, elected officials, and the construction community tend to be comfortable with the way things are. If no I.T. is being used, then over the years I.T. will not be used.

Why change? We will wait until other communities use I.T. The fact is that I.T. in plan submittal, review, tracking and storage, has come of age and neighboring communities that have not already done so are beginning to apply I.T. to their programs. As noted earlier, sooner or later your customers will be asking your community, *Why not here?*

Why change? Take a look at the next section and judge for yourself.

V – WHAT CAN BE DONE NOW? Best Practices in e-Plan Submittal, Review, Tracking and Storage

A. Preparation for Electronic Plan Processes

Given the barriers to implementing I.T. in the plan submittal, tracking, review and storage processes, it is no surprise that less than 1% of city, county and state jurisdictions adopting and enforcing building codes and standards accept plans electronically or do electronic plan reviews and only 3% of all jurisdictions track plans electronically.

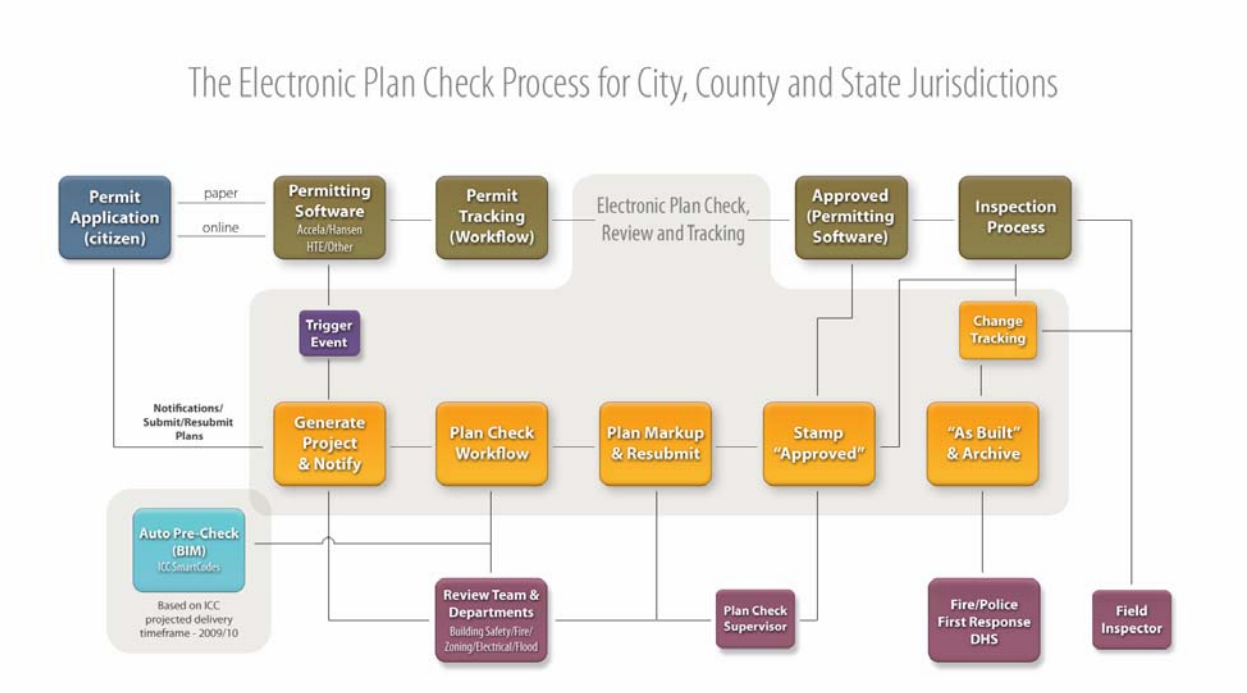
The growing trend within the building design community to prefer to submit their plans electronically rather than in multiple hard copies is placing more jurisdictions under growing pressure from their clients (architects, engineers, contractors, building owners and homeowners) to become more efficient managers of their assets and of the processes required to enforce building codes and standards while at the same time improving both the speed and quality of the building regulatory process.

The key to successful application of any information technology be it to establish an online permit application process or to move into e-plan submittal, review, tracking and storage processes lies in two areas. The first is in identifying and gaining stakeholder support not only for using I.T. but in first reviewing and where necessary undertaking re-engineering of the codes administration and enforcement process within the jurisdiction prior to the application of I.T.

The second is the development and maintenance of a strong working relationship between the building department and their clients/stakeholders throughout the I.T. acquisition and application/use processes. Each of the case studies included in this paper describes specific steps taken by jurisdictions to establish and maintain such relationships in their e-plan program.

In addition to the information provided in the case studies, available for downloading from the Alliance website (www.natlpartnerstreamline.org) is a step-by- step approach towards identifying and then working with stakeholders is found in the U. S. Department of Housing and Urban Development's funded Alliance *Guide to More Effective and Efficient Building Regulatory Processes Through Information Technology.*

B. Best Practices for Applying I.T. to Building Plan Submittal, Review, Tracking and Storage Processes



1. Existing Electronic Processes

The diagram above is a high-level summary of an integrated but parallel process for electronic plan submission, review approval and storage as it relates to the overall permit process and complimentary to electronic permitting software currently used by some jurisdictions.

Citizens first apply for a permit online or by paper application. The jurisdiction then processes the application to determine type and requirements. The permit system generates an order number and establishes account reference information used to track the *permit application.* If plans are required, the permitting system 1) signals the electronic plan review system, which in turn 2) pulls account information and populates an electronic review form, and then 3) generates a new "review project " and 4) generates notifications to the citizen and appropriate jurisdictional departments (based on permit type and process) inviting them to the review project.

In response to the invitation, the citizen uploads plans electronically to the jurisdiction via a secure server. The uploaded drawing/document files are published as renditions for the purpose of review and tracking changes. When the plan review system sees that plans are uploaded and published, review department

personnel are again notified and begin the review process. The plans are now secure *and* available online to all departments, and departmental accountability is achieved through workflow and eform time stamp and audit functionality.

Current technology makes it possible for all stakeholders – citizen and review staff alike – to have access to the drawing/documents, workflow and forms in order to obtain status updates. This keeps each stakeholder/department aware of markups, annotations and notices generated by departments and when they are made. The workflow includes the citizen as well. When review comments are consolidated, notification is sent to the citizen and a workflow task is assigned and tracked. When the citizen re-submits revised plans, the document/ drawings are published and versioned, and the review process resumes.

This re-submit process takes place as many times as is necessary. When the plans are stamped "Approved" by the Plan Check Coordinator, the plan review system notifies the permitting system that the permit is also ready for approval. The "Approved" plans are then made available to the citizen and the Field Inspection team, and further notes and comments can be added during the inspection process. The final result is an "As Built" version of the building plans which is digitally archived and becomes accessible online for the jurisdiction and other approved agencies at any time.

In the future, it may be possible for jurisdictions to begin implementing evolutionary technology systems that conduct a preliminary review process on 3D model data derived from Building Information Models (BIM). The International Code Council's (ICC) SMARTCode™ program is developing its unified building code standards as XML data that can be compared to XML/IFC component data in the model, flagging violations automatically. The SMARTCode program delivery timeframe is slated for 2009/10.

2. Electronic Plan Submittal

Less than 1 percent of the jurisdictions adopting and enforcing building codes accept plans electronically. Of those accepting plans electronically, most do it through either acceptance of a CD-ROM from the licensed architect or engineer or as an electronic PDF file.

Barriers to electronic plan submittal initially included a lack of technology to submit and receive and store electronic files, but one of the major barriers to the acceptance of plans electronically was not technology but was the statutes on the books that will only allow plans to be officially submitted in hard copy and under a wet seal. Where jurisdictions have come to allow either electronic seals or digital signatures, jurisdictions share the plans either on copies of the CD-ROM or by putting the digital plans on their servers.

The majority of digital architectural and engineering plans for construction are created using a relatively small number of engineering software products. The drawing files created are complex and normally contain layers, imbedded data and reference information to other files created during separate design and drafting sessions by one or more designers. Because of all the information contained in original pan files, they are often very large, and present a number of challenges to electronic/automated processes.

Formats: Original vs. Converted Files

There are two major document types to consider in e-plan submittal, original and converted files. The type of file submitted has an impact on how the plans are reviewed by jurisdictions.

Converted Formats — Converting original engineering files to another format for the purpose of distribution and review is a common industry practice. There are essentially two choices:

> Bitmap Images - In some cases drawings are "flattened" into a single layer representation, called a bitmap image (such as Tagged Image File Format [TIFF] format). This will normally decrease the file size for transport and generally prevents the drawing from unwarranted manipulation.

However, important layer and other vector-based information is lost during conversion, eliminating important review system features. Bitmaps are also produced by digitizing paper plans using large format scanners.

Vector Files – Common file formats are DWF and PDF. Converting files to a vector format that removes certain expendable information, but maintains important properties that assist in streamlining the review process, are preferred.

Original files — Common file formats are DWG and DGN. Original files are information and feature-rich, and are also considered valuable intellectual property. ePlan submission programs that accept original files should also support:

A secure file transport, storage, access and review process and infrastructure

Automatic format conversion tools that reduce file size but maintain fidelity and the necessary attributes contained in the original

View, markup and communication tools well-suited to the primary task of identifying and recording required changes with respect to code enforcement.

3. Electronic Plan Review or Plan Checking

For years, the lack of software to conduct complete technical reviews of all of the relevant codes to a specific structure (electrical, mechanical, plumbing, structural, accessibility, fire, etc.) held back true electronic plan review. Today, however, jurisdictions are making use of existing technologies to successfully conduct electronic plan reviews.

The basic elements of a best practices electronic plan review/check program include the following elements:

a) A centralized web/file/database server and storage configuration that provides single access point and potential fail-over access point capabilities to all authorized internal and external personnel 24/7.

b) Parallel plan review capabilities that expedite electronic files distribution and review by all concerned departments - in the same timeframe.

c) Electronic forms that are automatically generated and populated when appropriate data is entered into the permitting and plan check database.

d) Highly structured, customizable electronic workflows that control the transfer of information and tasks to appropriate individuals in all designated departments, and also to (citizen) architects and engineers when required.

e) Automated email notifications that provide real-time status and alerts to all project stakeholders and review departments.

f) Advanced visualization tools that include overlay comparison features for versioned and resubmitted drawings.

g) Access to electronic versions of applicable and current building safety codes.

h) Plan review workflow (Description of the automated tasks that occur in the plan review workflow).

i) Plan Resubmission.

j) Inspection and Electronic Plan Check System (Description of components of best practice in this field).

k) Archiving/Storage

4. Electronic Plan Tracking

A far more common application of I.T. in the plan process has been in the tracking of the plans (in either hardcopy or electronic format) once they have been submitted to the building department. When coupled with electronic plans submittal, this facilitates the ability of the plans to be reviewed simultaneously by multiple sections within the building department and/or multiple agencies within the jurisdiction – fire, environmental, public works, etc.

Approximately 20 of the vendors providing e-permitting software packages include component packages that either also accept electronic submissions of plans and or have plan tracking and status reporting capabilities for hard copy or electronic plans. Many jurisdictions with one of these packages have recently expanded electronic plan tracking to include access to information on the current status of the plans within the jurisdiction to the client.

Where it has been combined with electronic plan submittal, electronic plan tracking has on average reduced the amount of time a plan takes to move through the regulatory process by 15 to 20 percent, largely due to the reduction in delays that occur by not knowing where the plans are from the inability of multiple agencies to perform parallel plan reviews.

5. Archiving/Plan Storage & Retrieval

Electronic storage and retrieval of plans has been another area of rapid growth. Initially jurisdictions addressed the issue of storing blueprints through microfilm technology. Later developments of microfiche and digital storage medium (including CD-ROMs, electronic scanners and dedicated servers) have made this a viable option for jurisdictions regardless of whether or not they accept plans over the Internet.

VI – CASE STUDIES

A. Case Study of a Complete e-Plan System – Osceola County, Florida

Population: 244,000 Building Permits (2005): 7,996
e-Plan System includes:
- Electronic plan submission, tracking, review and storage on servers.
- Plan review for residential and new commercial currently being done with selected builders – plans to expand to all industry in fall 2007.
- Accepts plans as PDF, DWF files and on CD-ROM. Also will accept hardcopy of plans which are then scanned into system. County is using 34” and 37” monitors for reviews. Plans stored on servers, one onsite, one in secure offsite location.

1. Problems Trying to Address with e-Plan

One of Florida’s fastest growing counties, Osceola County located just south of Orlando, wanted to speed up the plan review process to address needs of their clients/stakeholders – architects, engineers and contractors. The main objective of their action was to be competitive with other jurisdictions in state and avoid problems associated with slowness and losing track of paper copies of plans. Osceola County

also wanted to eliminate the 140 mile roundtrip drive in this large county for some clients to drop off/pick-up plans.

2. How County Involved Stakeholders

Osceola County involved both their internal (staff) and external stakeholders (architects, engineers and contractors) from the beginning. The county invited them in to discuss needs and ways in which e-plan submittal, tracking, review and storage would address their respective needs. Osceola County fully involved external stakeholders in the implementation process, including asking for firms to volunteer to participate in the development of their system and testing its use.

3. Funding Source Being Used

The County used their own enterprise fund for development and purchase of hardware and software associated with e-plan processes. State of Florida statute prohibits those funds being used (raided) by other agencies, government officials for other purposes.

4. How County is Sharing e-Plan Data with Other Agencies

The Osceola County Building Department included other agencies – Planning/Zoning, Engineering/ Traffic and Fire – in their training program for internal stakeholders for e-plan review software. The county is now working with those agencies to discuss their possible subsequent use of the software in their programs.

5. How County is Training Staff and Customers

Working with the software firms involved in this project, the county has developed and is conducting training programs using PowerPoint presentations and training manuals. Osceola County has invited external stakeholders to participate in the same training programs and has also provided onsite training at firms through their customer care manager.

6. Implementation Lessons to Share

Involve internal and external stakeholders from the beginning; use dedicated funds and start slow. Don't try to do too much at once – build upon successes.

For More Information on Osceola County's Experience Contact:

Clinton Wallace, Director of Building, Osceola County Building Department
Phone: 407-343-2299; Email: cwal3@oscola.org

Jose Ramos, P.E., Technical Resources Administrator, Osceola County Building Department
Phone: 407-343-2230; Email: jram@osceola.org

B. Case Study of e-Plan Submittal, Review, Tracking & Storage – Atlanta, Georgia

Population: 500,000: Number of Plans Reviewed: 7,242
e-Plan System includes:

- Starting out on small scale, initially accepts and conducts electronic plan reviews for tenant improvements only for residential and commercial structures. This will be expanded to cover new construction in 2008.
- Does reviews on monitors of PDF files.
- Plan tracking information available over internet.
- Plans stored on server with data backup on tape stored at an offsite location.

1. Problems Trying to Address with e-Plan

Major problems the city sought to address in undertaking e-plan processes were to reduce/eliminate number of plans being lost or misdirected, plan storage limitations, need to free up staff to perform other functions, and serve growing need of design/contractor community for I.T. being used in the building regulatory process.

Georgia state law had been amended in 2005 to allow for acceptance of electronic seals on building and other documents.

2. How City Involved Stakeholders

The City Bureau of Buildings undertook a major outreach effort (including brochures) to development groups, home builders and to staff to identify the benefits of applying information technology to the plan submittal, review, tracking and storage processes. Outreach effort included presentations to internal stakeholders – staff. Outcome of effort was an expression of need and support for the e-Plan initiative.

Input from staff resulted in purchase and use of dual monitors to conduct electronic reviews.

3. Funding Source Being Used

With the support of external stakeholders and elected officials the building department used general funds for reviewing existing process, where necessary restructuring and acquisition of hardware/software needed for project.

4. How City is Sharing e-Plan Data with Other Agencies

Invited agencies that have role in plan review to participate in discussions leading to acquisition and involved them extensively in design, testing and use of hardware and software in plan submittal, review, tracking and storage for client improvements to existing residential and commercial structures.

As a result of that effort the city's Fire, Public Works and Police Department are reviewing for application with their plan processes.

5. How City is Training Staff and Customers

The Bureau of Buildings is training both internal and external stakeholders through on site training sessions and several webnars. This includes training for architects, engineers, contractors outside of the greater Atlanta area.

Initial training for external clients included interactive sessions with a small implementation group comprised of firms specializing in tenant improvements. Sessions resulted in feedback from external stakeholders as to improvements that could be made in future customer training efforts.

6. Implementation Lessons to Share

The city has noted that it is best to think of the all future users when undertaking the development of e-Plan submittal, review, tracking and storage processes. This includes both with those with small and large projects, existing and new construction.

As true for other jurisdictions, City of Atlanta recommends starting this process with simple plans and then expanding it to cover more complex structures and their plans.

For More Information on Atlanta's Experience Contact:

Ibrahim Maslamani, Director, Bureau of Buildings, City of Atlanta
Phone: 404-330-6152; Email: imaslamani@atlantaga.gov

C. Case Study of e-Plan Submittal, Review & Tracking – Lincoln/Lancaster County, Nebraska

Population: 260,000 Building Permits: 5,000 /year
e-Plan Systems includes:

- Accepts permits electronically as PDF/DWF files and on CD-ROM for commercial and residential structures.
- In final stages of beta testing of electronic review of commercial plans using 34" monitors and track online.
- As of yet have not introduced electronic storage – store on microfilm only. Plan to store electronically on servers in near future.

1. Problems Trying to Address with e-Plan

The building department for the combined city of Lincoln and surrounding Lancaster County looked at e-plan submittal, review and tracking as a mechanism to better serve the needs of their architecture, engineering and contractor community. The city/county was especially interested in speeding the plan review time and cutting down on the number of and time being spent on re-reviews of incomplete plans or plans needing significant corrections to be code compliant.

An immediate barrier that had to be overcome was the need to go to Board of Examiners of Engineers & Architects and to get their approval for acceptance of electronic seals in state law as opposed to then existing acceptance of only wet seals for plans. Stakeholders supported this action.

2. How City/County Involved Stakeholders

Lincoln/Lancaster County started their e-plan process by inviting external stakeholders into a meeting and asked them if they were interested in e-plan submittal, review and tracking. The jurisdiction noted that if there was support for such an initiative the city/county would undertake it. Consensus at that meeting was yes to go forward with an e-plan system. Out of the group, several firms offered to participate in system design, development and early testing. The city/county also made sure to fully involve elected officials, as they can become either strong advocates or a barrier to e-plan system.

3. Funding Source Being Used

Since 1998, the building department has operated as a special revenue (enterprise) agency. The jurisdiction's fee structure was set to build in the costs of deployment of their e-plan system. That funding was kept safe by county statutes that made it illegal to use building department fees for non-building department purposes.

4. How City/County is Sharing e-Plan Data with Other Agencies

Initially the building department limited to fire, public works, planning and public health department use of the building department e-plan system where these agencies do building plan related reviews. These agencies, especially planning and fire prevention, are now looking at it for their own plan reviews.

5. How City/County is Training Staff and Customers

Initially the software vendor did general training for internal customers (the city/county staff). Now the city/county staff is doing specialized training and training for external customers, both in sessions in building department and sessions at the offices of architects, engineers and contractors.

6. Implementation Lessons to Share

Keep an open mind as you put the system in place. The city/county notes that you may need to re-engineer existing system and make adjustments to best serve needs of both the internal and external customers.

Don't rush. Do things incrementally, keeping forward momentum while you are implementing I.T., but don't go so fast as to miss any important implementation steps including re-engineering the process, training internal and external clients.

For More Information on Lincoln/Lancaster County's Experience Contact:

Rita Cox, System Specialist III, Building and Safety Department, City of Lincoln, NE
Phone: 402-441-6454; Email: rcox@lincoln.ne.gov

D. Case Study of e-Plan Storage/Retrieval Process – State of California, Department of General Services, Office of the Architect

Population: 24 million Permits per year: 15,000 for school construction

e-Plan System includes: The California Office of the State Architect has responsibility for permitting, plan reviews and inspections for all public schools built or renovated within the state. In 2002, the state put in place a process to accept plans, and to store and retrieve them electronically. Approximately 20% of the plans now submitted and processed by that agency are done so electronically.

Plans that are submitted in hardcopy are scanned into the state database and maintained on servers during the plan review and inspection processes. When the building's construction or renovation has been completed the electronic plans are then backed-up on tape. Two copies of the tape are made. One is stored within the Office of the State Architect in Sacramento and the other is stored in an offsite location outside of the greater Sacramento area.

The state accepts plans electronically on CD-ROM, PDF or DWF files. A limited project of doing electronic plan reviews of PDF and DWF files is underway within the agency based on software generated internally.

1. Problems Trying to Address with e-Plan

The Office of the State Architect moved to e-plan submittal, storage and retrieval to address three major concerns.

The first was to reduce the shear volume of paper copies of plans that were submitted to and retained by their agency for all public school construction and renovation.

The second was to speed the ability to access the plans for existing buildings when renovations were being undertaken for those structures.

The third problem that the state sought to address was to facilitate the desire expressed by architects and contractors to be able to submit (and later have reviewed) their building plans electronically.

2. How State Involved Stakeholders

The Office of the State Architect invited school design and construction firms to provide input to them on the desirability of offering this service. The consensus was that this would be of great benefit to all parties.

3. Funding Source Being Used

The sate used funds that were generated through their building permit/plan review fee structure. These are dedicated funds.

4. How Office of State Architect is Sharing e-Plan Data with Other Agencies

The Office of the State Architect is sharing the scanning systems and data storage and retrieval system with several other agencies, including the Office of State Health Planning and Development. OSHPD has responsibility for permit and plan reviews for state licensed healthcare facilities.

5. Implementation Lessons to Share

Start small and build program incrementally. The state set up a phased-in process to scan existing plans and then moved backward through time to capture older and older plans.

For More Information on California Office of State Architect's Experience Contact:

Richard Conrad, Special Projects Administrator, CA Department of General Services, Office of the State Architect
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VII – A LOOK AT THE FUTURE: What's Coming Next & Benefits of Starting Now to Prepare

- 3D & 4D Design

Through groups like the Virtual Builders Roundtable, buildings are being designed, tested, built, commissioned, operated, maintained, renovated and decommissioned in computers that link to the entire supply chain using 3D and 4D electronic databases. Over the past three years, 25 buildings across the nation have been designed and built using such modeling. In every case, none of the building departments involved were able to review these plans electronically.

- National BIM Standard

To facilitate the growth and daily use of Building Information Modeling (BIM), the BuildingSMART initiative, a consortium of national and international organizations under the auspices of the International Alliance for Interoperability at the National Institute of Building Sciences are coordinating the development of Building Information Models for all types of construction and construction materials. These models will facilitate the exchange of data for all types of construction and their construction components and subcomponents.

- SMARTCode

In 2006 the International Code Council (ICC) launched an initiative called SMARTCode to place all of the I-Codes into electronic plan review software. When married at a future date with BIM models and existing electronic permitting and plan review software both architects (engineers and contractors) and building departments will begin to be able to check buildings under design for code compliance to the base ICC codes that most jurisdictions use. In years to come state-specific versions of SMARTCodes may come into existence further expanding their usefulness.

VIII – WHAT ARE YOUR NEXT STEPS?

Through its case studies and background materials, this White Paper has provided an introduction to the current best practices in electronic plan submittal, review, tracking and storage.

If you are interested in learning more about the application of I.T. in this administrative and regulatory area here are a few possible next steps you can take:

- Contact case study jurisdictions – At the end of each of the four case studies included in this paper is the name of a person from those jurisdictions who is prepared to answer any questions you may have and share their experience in greater detail.

- Visit the Alliance website for a more detailed version of this paper (40 pages) and additional case studies and list of jurisdictions you can contact (www.natlpartnerstreamline.org).

- Prepare to apply I.T. to plan submittal, review, tracking and/or storage

  - Identify and work with stakeholders
  - Identify current barriers and actions that need to be taken
  - Identify funding sources
  - Where necessary, re-engineer business process
  - Conduct research on products and vendors
  - Draft technical and process requirements document and/or RFP

Resources to undertake each of the above stages in the application of I.T. to your program are found on the Alliance website. This includes the previously referenced 83-page U.S. Department of Housing and Urban Development funded *Guide to More Effective and Efficient Building Regulatory Processes Through Information Technology*, Model Procurement Guidelines, and a Streamlining Toolkit.

ABOUT THE ALLIANCE

The Alliance for Building Regulatory Reform in the Digital Age was formed in the summer of 2001 by national associations representing state and local government, the construction industry and federal agencies to promote improvements in the effectiveness and efficiency of the building regulatory process through streamlining and use of information technology.

Partners in the public/private sector Alliance include:

American Institute of Architects
Associated General Contractors
Building Owners and Managers Association
FIATECH
National Association of Home Builders
U.S. Conference of Mayors
National Association of Counties
National Governors Association
The National Association of State Chief Information Officers
The National Institute of Standards and Technology
U.S. Department of Energy
U.S. Department of Housing and Urban Development
Accela
Avolve
Boeing
Hansen Information Technology
Intel
Marriott Corporation
Target Corporation

In June 2007, the Alliance accepted an invitation from Alliance partner FIATECH for secretariat services as "The FIATECH Project on Streamlining the Building and Land Use Regulatory Processes."

ALLIANCE VISION: *The Alliance vision is for a future state in which the building and land use regulatory process is online, streamlined, effective and efficient. In this future state, there is no regulatory overlap or duplication and information flows digitally between the construction and building community and the regulatory community.*

FOR MORE INFORMATION CONTACT:

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