

COLUMNS

ON-LINE SERVICES



Feature Stories

Build your CAD standards
Manager's guide to setting and enforcing standards

By Mark Middlebrook

*You cannot make a vulgar offensive cad
conduct himself as a gentleman.*
- A.K.H. Boyd, Lessons of Middle Age, 1868.

Were Mr. Boyd transported to our acronym-infested world, he might wonder about all the fuss over CAD standards. "That a cad might abide by any standard of behavior," he would retort, "is as unlikely as that there be honor among thieves." Even those of us hip to cyber-culture and careful about capitalization sometimes wonder: Is there any hope of standardizing CAD within our offices, never mind among the companies with whom we exchange drawings?

This focus on CAD standards assesses the current CAD standards picture, reviews the process of developing them, and suggests practical measures for improving CAD standards in your office. If you work in architecture, engineering, or construction (AEC), be sure to read Michael Dakan's CAD Manager column on the new NIBS (National Institute of Building Sciences) NCS (National CAD Standard).

Current status

The wag who said "the wonderful thing about standards is that there are so many from which to choose" might well have been talking about CAD standards. Ideally, each industry would have its own CAD standard (a real standard!) to simplify drawing exchange and greatly reduce each company's CAD standards development work. In practice, I don't know of any CAD-using industry that follows consistent file- and layer-naming conventions, never mind the more complex questions of how to organize drawings using tools such as xrefs and paper space.

The news isn't all depressing, though. The increasing frequency of electronic drawing exchange, especially in the AEC industry, is driving many companies to pay more attention to CAD standards. In the United States, many architectural and engineering design firms use CAD standards based at least loosely on CAD Layer Guidelines, the second edition of which was published in 1997 by the

[Mark Middlebrook](#) is president of Daedalus Consulting in Oakland, California, and contributing editor of CADALYST. He is coauthor of AutoCAD 2000 for Dummies and AutoCAD LT 2000 for Dummies and AutoCAD 2000 for Dummies, both from IDG Books. You can visit his Web site at www.markcad.com.

This article originally appeared in the April 2000 issue of CADALYST Magazine.

For more on CAD standards, check past installments of the [CAD Manager](#) columns.

With This Article

[CAD standards development](#)
[The well-rounded CAD standard](#)
[Project-specific standards](#)
[The search for standards](#)

AIA (American Institute of Architects). Lots of variation occurs in how different companies interpret, extend, and depart from these guidelines, but at least we're seeing moderately widespread adoption of a consistent general approach to naming layers (and, to a lesser extent, files).

CAD sophistication has increased in all industries and in most companies. Increased drawing exchange means that more people see more examples of CAD practice, and the better methods slowly drive out the worse ones. In the absence of industry standards, many companies are paying more attention to developing, maintaining, and enforcing internal CAD standards. Those efforts help improve consistency within companies, even if they don't solve the wider industry problem.

Most firms now have CAD standards documentation, either in printed form or, increasingly, in HTML. Many of these documents are incomplete or out-of-date, but at least CAD managers can offer something more durable than verbal harassment as guidance for their users. Many CAD managers have taken the "build standards into the CAD system" dictum to heart and provide custom template drawings, menu macros, block libraries, and other tools that make standards compliance easier.

On the other hand, more people with a variety of levels of CAD experience are getting their hands on CAD files. CAD drawings are no longer the sole province of a priesthood of full-time CAD drafters. In many companies, engineers and architects open drawings to view, plot, and even edit them. Many of these part-time CAD users are less attuned to the importance of CAD standards and how to abide by them. Also, they're more likely to use lower-cost CAD programs, such as AutoCAD LT, that provide limited support for customization that automates standards compliance. As more of these part-time CAD users touch more drawings, it's going to become essential to bring them into the CAD standards fold.

Developing CAD standards

Developing office CAD standards is like flossing your teeth: necessary but not fun. It's not fun for you because it involves lots of unpleasant tasks: reading boring standards documents written by bureaucratic committees, listening politely to foolish suggestions from bosses and users, writing reams of sterling prose and then editing it down to a length that someone actually will read, struggling to program around CAD and application program limitations. It's not fun for your company because it takes you away from other work, most of which probably is billable to clients.

Even worse, the job is never done. New versions of CAD programs, industry changes, revised office practices, and the inexorable march of technology that we call "progress" ensure that your CAD standards are never up-to-date. As with the programmer stuck in the shower following the directions on a shampoo bottle, developing CAD standards subjects you to an endless cycle of "Lather, rinse, repeat." The box "CAD standards development" maps out the process, complete with endless loops.

Goals and priorities

Before you create layer charts and lists of drafting rules, take a moment to define the goals and priorities for CAD standards in your office. What are the basic CAD approaches that your standards try to reflect? For example, "We focus on plotted drawing presentation and don't worry too much about electronic structure," or "We're really picky about using xrefs and paper space in this way." Companies often expect CAD standards to do everything: improve production

efficiency, increase precision, enhance plotted drawing quality, enable better data extraction from drawings, and bring about world peace. You'll be more successful if you can articulate your most important goals and aim your standards development at them.

In addition, some situations cause tension between two or more goals. For example, "This Blackletter TrueType font brings AutoCAD to its knees performance-wise, but we like the 'medieval manuscript' look it gives to our drawings." It helps to have an agreed-upon criterion for deciding these kinds of questions.

When I asked about goals and priorities on the Autodesk Professional Networking Discussion Forum's CAD Manager Café newsgroup (<news://adesknews.autodesk.com/pn.cadmanager>), Bernie Avery of ZTR Control Systems, a company specializing in industrial controller systems, responded with two precise goals:

"Accurate drawings and consistent electronic format. With a consistent file format, a monkey can plot the file and have it look the same every time. How else can batch plotting routines be effective?

"Consistent print format. I'm not talking about fancy fonts, graphics, and customer logos. I want a drawing that a 55-year-old site superintendent, with glasses that haven't been adjusted in two years, standing in 6" of mud on a cold November afternoon at 5 p.m., can read without a magnifying glass, even if it was faxed to him from a photocopy in the head office. I avoid like the plague any font that tries to emulate a hand drawing I produced 10 years ago."

Your goals may not be the same, but you should strive for that kind of clarity in defining them.

Scope

Once you've established goals and priorities, define the scope of your current standards development effort. Because the job is never done, you should focus on the most important goals and leave lower priority items for the next pass. Defining a reasonable scope also increases the odds that users can digest the new or revised standards when you roll them out. The sample CAD standards documentation chapter list in "The well-rounded CAD standard" box suggests topics that you might want to include in your scope.

As part of your scope definition process, you should ask who the CAD standards are for. Just the full-time CAD drafters? Part-time CAD users such as architects and engineers? Clients or consultants? The larger the circle of users or beneficiaries, the more effort you'll have to put into developing and maintaining your CAD standards.

On the other hand, limiting CAD standards development and documentation to the CAD nerd gulag can be dangerous. Tom Hardy at the architectural firm of Page & Turnbull in San Francisco calls his HTML CAD standards document a "Production Manual" and includes general drafting conventions, drawing production information, and tips of interest to everyone in the office. This practice encourages more people in the firm to become familiar with the standards and, conversely, educates the younger CAD nerds about production issues that go beyond CAD.

Matt Stachoni of Beyer and Associates, Inc., an architectural firm located in Wilmington, Delaware, agrees: "Like many firms, we have a 'design side' and a 'production side,' where each group spends most of its time doing what it knows

best. It's my goal to get everyone on the design side-architects and interior designers specifically-conversant with the CAD system. At the very least, [they need to understand] terms and methodology so we speak the same language."

Develop and document

Developing actual standards involves creating some sort of document, usually in a word-processor format or HTML (i.e., Web pages). If everyone in your office is networked and has a Web browser, HTML definitely is the way to go. The CAD managers I talked to who've converted their standards document to HTML are uniformly enthusiastic about having done so. Users refer to Web-based CAD standards documentation more frequently, and CAD managers can more easily update the documentation and ensure that everyone is looking at the current version.

Tip: If you're new to creating Web pages, I highly recommend chapters 1, 4, and 5 of Philip Greenspun's book Philip and Alex's Guide to Web Publishing. Even if you aren't new to Web publishing, you should look at this book. It's the most sensible, well-written, and fun-to-read book that I've found on the subject. The entire book is available on-line for free at <http://photo.net/wtr/thebook/>. Once you read part of it, you'll probably want to buy what Greenspun calls the "dead trees version."

Usually you create a standards draft document and circulate it for comments, then revise based on the comments. This cycle can go on forever, so at some point you call it good and move on to the implementation phase. It helps to have a clear chain of command that ends with someone with the responsibility and clout to say, "Okay, we're done with this part."

Customizing for standards

I've harped many times before on the folly of assuming that written documentation, even if it's available as a spiffy set of Web pages, will inspire users to follow CAD standards. You simply must build standards into the CAD system through customization if you expect any reasonable level of compliance.

The standard tools in AutoCAD include template drawings, blocks, scripts, custom pull-down menus, image tile menus, and toolbars, PCP files, AutoLISP, and VBA (Visual BASIC for Applications). Other CAD programs offer similar customization tools. You can use these tools to create such things as drawing setup utilities, standard text and dimension styles, macros that automatically set layers, symbol libraries, and streamlined plotting procedures. If people in your company use both AutoCAD and AutoCAD LT, bear in mind that any tools you develop with AutoLISP or VBA won't be accessible to LT users.

In many cases, you have the choice of customizing a particular CAD standards item by creating it in a file or writing a program that creates it on the fly. For example, you can customize dimension styles, text styles, and drawing scale settings by putting them in drawing template files (one for each drawing scale that you use). Or you can write a single AutoLISP drawing setup program that creates the styles and settings when a user sets up a new drawing. The programmatic way is almost always more elegant. It requires fewer files, and that means fewer places to make changes when you revise your CAD standards. Also, programs usually are much more flexible than static files. On the other hand, writing a program requires more sophistication and may take more time than creating a few static files.

When you revise your CAD standards, one sticky problem is what to do about existing drawings in current projects and block libraries. You may need to provide conversion utilities for renaming layers and the like, or at least give

instructions for doing "manual" conversions.

Training

Although customization to support standards is vital, don't think that customization by itself magically forces all users to follow standards all the time. There's no such thing as an idiot-proof CAD system or idiot-proof standards customization. You must train your users, and that means all users, including the ones who occasionally open drawings for plotting, viewing, or light editing.

It's best to schedule an orientation session at the roll-out of new or revised CAD standards. Walk everyone through the major points and most significant changes. Point out custom tools that help with standards compliance (and also improve efficiency). Most people won't absorb all of the standards in a single session. One good approach is to weave follow-up standards training into a regular training regimen. Matt Stachoni at Beyer and Associates does it this way:

"[When] I need to enumerate the basic dull stuff (pen weights, layers), my users get the most improvement from our bimonthly CAD meetings. We have them during lunch, and the company picks up the lunch tab from the local sub shop. Each meeting has a defined topic (next week is annotation), and we get into the nitty gritty. I can explain macros and take requests for new macros or customization. This is an integral part of the CAD manager's duties and needs to be fully supported by higher-ups to be successful."

Don't forget about temporary or new hires who show up after the initial standards implementation. You should orient these people so that they can maintain at least reasonable consistency with what other people are doing. If you use temps, there's rarely time for a full orientation, so give some thought to how to bring them up to speed quickly. Consider including a short summary chapter along the lines of the "CAD practice overview" section listed in "The well-rounded CAD standard" box.

Enforcement

One of the great conundrums of CAD standards is that there's no straightforward, economical way to verify compliance. Larry Siers of Globetrotters Engineering Corporation, a Chicago-based engineering and architectural firm, points out: "For CAD standards to be credible they must be enforceable. . . . People are intelligent enough to realize that it is unrealistic for CAD management personnel to open every drawing and scrutinize it inch-by-inch for violations." You can write utility programs that check for compliance with some items (for example, "color must be by layer," "layers must conform to this naming scheme," or "dimensions must use these dimension style settings"). But in a real design office, there's no practical way to do anything more than spot-check compliance with standards.

Thus, any CAD standards enforcement scheme will be only partially successful. A good enforcement scheme usually combines the carrot (customization, rational explanations, appeals to enlightened self-interest, praise for good compliance) and the stick (complaints, threats, random deletion of the miscreant's DWG files from the network).

In many companies, checking for compliance is something that the CAD manager or users do in the course of working with drawings from other people. Someone opens a drawing and notices that the layer names are a mess or the drawing was set up using some harebrained paper space scheme. In an office with many shared drawings and a sufficient number of compulsive neatniks, this

kind of informal checking may keep compliance at a reasonable level.

Some companies implement a periodic drawing review process. Jason Martin reports that in his firm, Frankfurt-Short-Bruza Associates in Oklahoma City, a project manager can request a drawing review, in which someone checks the drawings using a checklist that's part of the company's CAD standards document.

Your evaluation of compliance also acts as an indirect check on the reasonableness of your CAD standards and thoroughness of their implementation. When the same "mistakes" show up repeatedly in different drawings created by different people, it's a good sign that:

- the standard isn't comprehensible or sensible,
- users need more training, and/or
- you need to do more customization to support the standard better.

Work in progress

Developing and maintaining CAD standards is always a struggle between the ideal goal of doing a thorough, careful job and the practicalities of squeezing CAD standards work into busy production schedules and demands to maximize billable hours. Accept the fact that CAD standards will always be a work in progress, and don't let "best" be the enemy of "good" (or "good" be the enemy of "not too bad," for that matter).

Acknowledgments

Thanks to the people in the Autodesk Professional Networking Discussion Forum's CAD Manager Café newsgroup and to the members of the San Francisco AutoCAD Users Group's Customization Special Interest Group for their contributions to my research for this article.

[^ TOP OF PAGE](#)

Home
News
Feature Stories
CADALYST Labs Reviews
CAD Spectrum
CADDIES

COLUMNS

Exclusively on the Web

Solutions Columns

Get the Code

ON-LINE SERVICES

Newsline

CAD Training, Books, Links

Reader Services

Advertiser Services

CAD Market

Register

InfoQuick
Click for Product Info

Feature Stories

Build Your CAD Standards

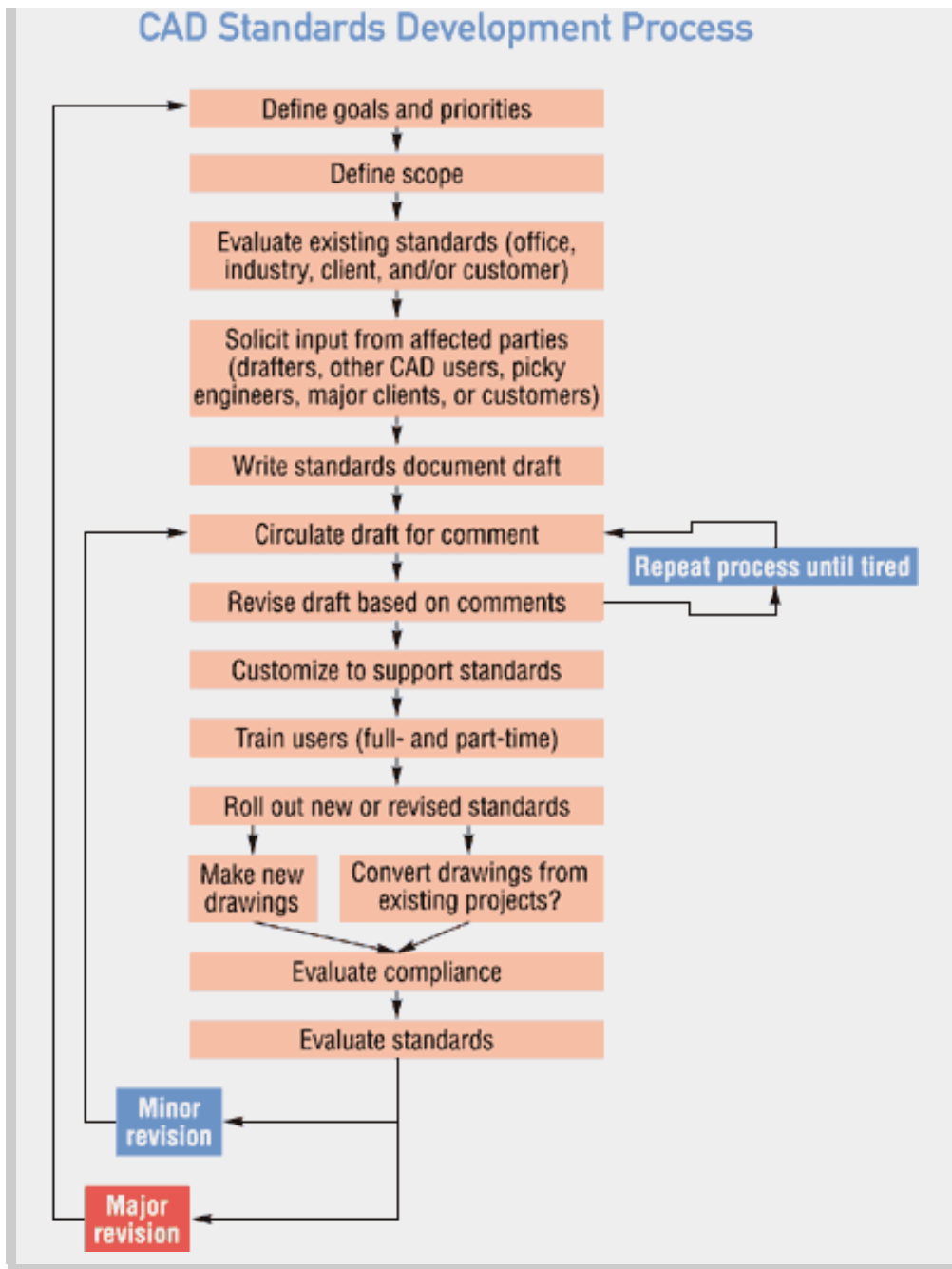
CAD standards development

Road map charts process | By Mark Middlebrook

In the early days of CAD, CAD managers often created CAD standards on their own, with little meddling from others. Few principals or project managers used CAD, so they didn't care what the standards said as long as the plotted drawings looked like the old pencil or ink drawings created by the office's manual-drafting patriarch. At the other end of the chain of command, many CAD drafters ignored any CAD standards anyway, so it didn't really matter what the CAD manager put in that thick binder.

Nowadays, most people recognize the importance of CAD standards, and a lot of them want to have a say in them. We've also become more sophisticated about how we create drawings and depend more on the electronic exchange of drawing files. As a result, the process of developing CAD standards is much more complicated.

The flowchart below attempts to plot out a full-blown standards development process. No doubt it will strike fear into the hearts of bean-counters, for whom every hour spent on CAD standards development is an hour robbed from billable projects. But the flowchart really is intended to inspire a realistic assessment of what it takes to develop and maintain CAD standards these days.



[BACK TO ARTICLE](#)

[^ TOP OF PAGE](#)

COLUMNS**ON-LINE SERVICES**

Feature Stories

Build Your CAD Standards

The well-rounded CAD standard

How to write the book on CAD standards | By Mark Middlebrook

What's in a CAD standard? It used to be as simple as a list of layer names and a color-to-lineweight plotting chart, sometimes supplemented by old manual drafting graphics standards. Most companies now realize that CAD standards must cover a much wider range of practices and organizational techniques, such as when and how to use paper space and xrefs. The contents and organization of each company's standard vary depending on discipline, work specialty, sophistication, and other factors, but the following sample chapter list should help you outline the contents of your own standard.

Some company CAD standards include CAD system information such as descriptions of hardware and software, a list of keyboard shortcuts, and custom program documentation. The frequency with which users consult your CAD standards document is inversely proportional to its length, so consider putting such additional information in a separate CAD system manual.

Table of contents

Introduction

- Purpose and scope
- Revision history

CAD practice overview

- Guiding principles (standards priorities, layer-naming scheme, etc.)
- Working methodologies (drawing organization, xrefs, paper space)
- Major "thou shalt/thou shalt not" rules
- Overview of customization that supports standards

Drawing setup and drawing set organization

- Use of xrefs
- Use of paper space
- Use of blocks and attributes
- Title blocks
- Model space and paper space setup procedures

File and folder management

- Folder structure, naming, and contents
- File naming
- Rules about xrefs in different folders
- Keeping folders "lean and clean"

Drafting procedures

- Different kinds of drawings/models/sheets
- Mixed scale sheets
- Precision requirements and techniques
- Object grouping with polylines, blocks, and groups

Purging

Drawing revisions

Layers

Names and what goes on each layer

Default colors and linetypes

By layer vs. by object color and linetype rules

Plotting

Color-to-lineweight mapping

Plotting procedures

Annotation

Text (including names and uses of styles)

Dimensions (including names and uses of styles)

Hatching (patterns, scales, and angles)

Symbols (section marks, tags, etc.)

Project CAD management

Project CAD planning

Dealing with project-specific standards

Project base points

Project CAD documentation

Archiving

Drawing exchange

Packaging procedure

Documentation requirements

Sending guidelines

Receiving guidelines

Index

[BACK TO ARTICLE](#)

[^ TOP OF PAGE](#)

Home
 News
 Feature Stories
 CADALYST Labs Reviews
 CAD Spectrum
 CADDIES

COLUMNS

Exclusively on the Web

Solutions Columns

Get the Code

ON-LINE SERVICES

Newsline

CAD Training, Books, Links

Reader Services

Advertiser Services

CAD Market

Register

InfoQuick
 Click for Product Info

Feature Stories

Build Your CAD Standards

Project-specific standards

A pain in the CAD | By Mark Middlebrook

It would be great if most companies in each industry could agree on and conform to a single CAD standard. Barring that, it would be nice if each company could settle on and get all its drafters to conform to a single office CAD standard. Too often, what we have instead is the worst of all possible worlds: project-specific standards.

The zeal of the converted

One of the dangers of developing CAD standards is that you begin to view yours with the zeal of a religious convert. If your company directs subcontractors with whom you exchange drawings, you feel compelled to inflict your standards on those poor, misguided heretics. Even worse, you might waver in your faith and use each project as an opportunity to create a revised set of standards, then impose the new orthodoxy on every other company with which you work.

Part of the problem is that the people who write and negotiate contracts usually aren't familiar with CAD and thus don't know how time-consuming and expensive it is to conform with project-specific standards. The person at the contracting company figures that CAD standards must be something like sheet numbering, and of course they dictate it. The person at the contracted company assumes that, because CAD is magic, drafters just flip a switch somewhere on the computers.

In reality, it's tremendously disruptive to switch to a completely different CAD standard that was developed in a different office with different working styles, third-party applications, customization, training, and so on. It's even more disruptive to switch among several different CAD standards as you switch among projects! You have to reconfigure third-party applications and custom utilities to support each different standard and acquaint users with the differences.

Even with all of this effort, few companies do a very good job of conforming to "foreign" CAD standards. Most companies have enough trouble getting everyone in the office to follow their own standards. And it's rare indeed that the company that promulgates project-

specific standards takes the time to enforce detailed compliance in every drawing from every consultant. (Sometimes the drawings from the promulgating company are the worst offenders!) So the reality on many projects is that consultants pretend to follow project-specific standards and the contracting company pretends to enforce them.

Exchange guidelines vs. CAD standards

Don't get me wrong: drawing exchange guidelines are important. At the very least, companies that work together on a project should agree to use naming schemes for files, layers, blocks, and text and dimension styles that avoid conflicts. It's extremely helpful to agree on a project base point so that drawings from different companies line up when they're xrefed or inserted at 0,0.

The specifics of layers (beyond avoiding name conflicts) can be trickier. If companies want to reuse data from other companies' drawings, each company

needs to be internally consistent about using layers. In addition, each company may need to reconsider layer granularity (which things belong on the same layer and which things need to be on separate layers so that other companies can isolate them). For example, the structural drafter prefers that bearing walls and nonbearing partition walls be on different layers in the architectural plans. Consistency and granularity of layer use are much more important than layer names, because the names are relatively easy to convert automatically using a script or AutoLISP program.

Avoiding naming conflicts and maintaining reasonable layer consistency and granularity should be worked out in each company's office CAD standards, rather than on a project-specific basis. If you sort these matters out within your company, project CAD planning can focus on real, project-specific issues such as base points and any unique aspects of the project that require special coordination.

As I wrote in my [April 1999 CAD Manager column](#), "a good rule of thumb is: If you can't think of a good drawing exchange reason that something should be standardized, leave it out of the exchange guidelines."

You've got to pay to play

I recognize that clients have a right to demand "do it our way, or you don't work with us," especially on larger projects. But those clients who make such demands need to face up to the costs of doing so, and alter their consultants' compensation accordingly. Complying with standards is never free and usually isn't cheap. Ask anyone who's tried to achieve ISO 9000 certification.

If you find yourself on the receiving end of project-specific CAD standards, you have two choices: change how you work throughout the project, or continue doing things in your customary way and convert the drawings before sending them out. Each approach has pluses and minuses. The lesser of the evils depends on the specifics of the project-specific standards, how often you exchange drawings, how agile your CAD users are, and how tolerant your client is.

In any case, alert your company's contract negotiators and project managers to the costs of complying with project-specific standards. If possible, let your wishes be known early on major projects. In many cases, project-specific standards are written by well-meaning but compulsive types with insufficient understanding of how their rules will affect CAD productivity in other companies. If you ask up front, you may head off rules that cripple your efficiency.

If your company is in the habit of promulgating detailed project-specific standards, step back for a moment and ask what you're trying to achieve. What needs to be standardized among companies to achieve your goals, and how much is your company willing to pay to achieve that standardization? To what extent can you restrict exchange standards to avoiding naming conflicts and thereby leave your consultants to work more efficiently and consistently within their own CAD standards?

[BACK TO ARTICLE](#)

[^ TOP OF PAGE](#)

COLUMNS

ON-LINE SERVICES



Feature Stories

Build Your CAD Standards

The search for standards

A guide to resources | By Mark Middlebrook

Many CAD Manager columns by Michael Dakan and me address CAD standards directly or indirectly. You'll find CAD Manager columns for the past couple of years on the CADALYST site under [Solutions Columns / CAD Manager](#).

General interest

The International Standards Organization has reams of documents on CAD and other standards, including a trio of documents that cover CAD layers: ISO 13567-1, 13567-2, and 13567. www.iso.ch

Industry specifics

NIBS National CAD Standard (see p. 42 of the April 2000 issue of CADALYST for details): www.nibs.org/ncs/ncs.htm.

CAD Layer Guidelines, Second Edition: Booklet from the American Institute of Architects. You can order it from the AIA (888.272.4115, order number R809-97) or purchase it as part of the NIBS National CAD Standard.

CSI's (Construction Specifications Institute) UDS (Uniform Drawing System) is available from CSI or as part of the NIBS National CAD Standard: www.csinet.org

The U.S. military's CADD/GIS Technology Center publishes an A/E/C CAD standard: tsc.wes.army.mil/products/standards/aec/intro.asp

Softco's S-MAN Standards Management system is a "fill-in-the-blanks" system for AEC drawings. Translation software converts between different sets of standards: www.softcosys.com

CADCOM's ASCAD system for civil engineering drawings: www.cadcom.ca

GDM Software offers a CAD toolkit for MicroStation users. It lets you define your CAD standards as a rule file, then uses the file to check drawings for compliance. An AutoCAD version is due out soon: www.gdmsoft.com

British Standards Institution's BS 1192-5: A popular AEC standard among CAD users in the United Kingdom: www.bsi.org.uk

Managing AutoCAD in the Design Firm, a book by Karen A. Vagts, Addison-Wesley.

[BACK TO ARTICLE](#)

[^ TOP OF PAGE](#)