

# Productivity Gains Using AutoCAD 2005

## Executive Summary

With every new release of AutoCAD® software, CAD managers are faced with a series of crucial questions:

- *When should my company upgrade to this latest release?*
- *What increases in productivity can we anticipate?*
- *How quickly will these gains offset the costs associated with the upgrade?*

Findings outlined here should provide you the baseline information needed to cost-justify your company's upgrade to AutoCAD 2005 software.

Autodesk commissioned the Design Practice Group of the College of Environmental Design, University of California, Berkeley, to examine the productivity improvements that users can expect when working with AutoCAD 2005 as compared to AutoCAD 2002 software. The study involved the evaluation of a series of tasks designed to simulate the day-to-day production drafting environment, and the time required to complete those tasks. This study is identical to the study that was commissioned for the previous release of AutoCAD, which studied productivity gains when moving from AutoCAD 2002 to AutoCAD 2004. This white paper combines the results from that previous productivity study and the results from a more recent study to give you a complete picture of the potential benefits you can realize by moving to AutoCAD 2005.

The timesavings documented in the study was then combined with survey data from a cross section of Autodesk customers that showed, on average, how much time their users spent performing the tasks investigated in the study. Once you evaluate how this data fits with your own company's work processes, you can then take the timesavings estimates provided in this paper, adjust for the size and business practices of your own company, and generate a cost/benefit analysis for upgrading from AutoCAD 2002 to AutoCAD 2005.

The tasks included in the two studies were selected because they have the greatest potential to enhance the day-to-day productivity of AutoCAD users. These tasks included the use of tool palettes for the editing, creation, and deletion of blocks and hatch patterns; the new Sheet Set Manager for creating, organizing, and publishing sets of drawings; the improved multiline (Mtext) text editor for the creation and editing of paragraph style text within a drawing (notes, numbered lists, etc.); and the new text masking tools

The study results indicate that significant timesavings can be realized by implementing the features of AutoCAD 2005, especially the tool palettes and Sheet Set Manager. Study participants were able to be more productive when creating customized tool palettes for use in repetitive tasks in a production work environment, when editing and organizing existing sets of drawings, when adding new drawings, and when publishing a set of drawings from the Sheet Set Manager. For the average AutoCAD user, new AutoCAD feature functionality can save the user up to fourteen hours per week in increased productivity.

The table below summarizes the results of each of the two studies and the survey results that we used to estimate the average time spent on each of the tasks measured. You can use this information to perform your own cost benefit calculations based on the actual work performed in your office.

AutoCAD Tasks Tested	Time Spent Doing Task (hrs/wk, average)	Timesavings Using AutoCAD 2005	Time Saved per User
Create and organize drawings	8 hrs	32% faster	2.6 hrs/wk
Insert and update drawings	3.3 hrs	26% faster	1 hrs/wk
Publishing sets of drawings	3.8 hrs	13% faster	.5 hrs/wk
Using tool palettes to manipulate blocks	7.6 hrs	43% faster	3.3 hrs/wk
Using tool palettes to manipulate hatch patterns	5.2 hrs	55% faster	2.8 hrs/wk
Using Mtext to annotate drawings	9.2 hrs	37% faster	3.4 hrs/wk
Text masking	1.9 hrs	65% faster	1.2 hrs/wk

## Introduction

The AutoCAD 2005 and AutoCAD 2004 Productivity Studies commenced as soon as a stable beta versions of AutoCAD were available. Care was taken to utilize methodology that would deliver unbiased, but user-based feedback and generate statistically meaningful results. This report provides an overview of study findings, detailed results obtained for each section of the study, observations, and analysis; background on the study design; and finally, overall conclusions that can be drawn from those results.

## Study Findings

### Familiar Environment Made Learning Easy

One key takeaway drawn from the surveys and focus group feedback at each phase of the study was the participants' perceived similarity between AutoCAD 2002 and AutoCAD 2005. AutoCAD 2005 was a very familiar environment; participants felt that they could be productive using the software without major amounts of re-training. In fact, the team observed that with only a single day of training on AutoCAD 2005 software, the majority of the participants were significantly more productive as a result of taking advantage of some of the key new features of the application.

### Sheet Set Manager Enhances Productivity

The AutoCAD 2005 study showed significant timesavings for each of the tasks associated with the use of the new Sheet Set Manager. As the researchers looked at the correlation between the the study participants' experience levels and their ability to complete the exercises faster in AutoCAD 2005 than in AutoCAD 2002, it became clear that the more experienced the users, the more productive they were when using the Sheet Set Manager. This was further confirmed in the focus groups after the exercises were complete. The general response from all participants was that the Sheet Set Manager was a new way of working with both layouts and drawing files from within AutoCAD. The more experienced users quickly grasped the concepts behind it, while the less experienced users took longer.

This finding highlights the need to train users on the use of new features within AutoCAD when a new release is deployed within an organization. Even a single day of training can get users "over the hump" of understanding a new concept like the Sheet Set Manager and make them more productive than they would be if they had to explore the feature on their own. These findings also revealed that preparation is critical for successful use of the Sheet Set Manager. Study participants noted that if the project on which they were working had been set up in the Sheet Set Manager at the beginning of the project (by a CAD

Manager, for instance), they believe that they would have been even more productive. Establishing standard template files, call out symbols, title block fields, and page setups takes advantage of the Sheet Set Manager and makes the enforcement of CAD standards across projects easier and more efficient.

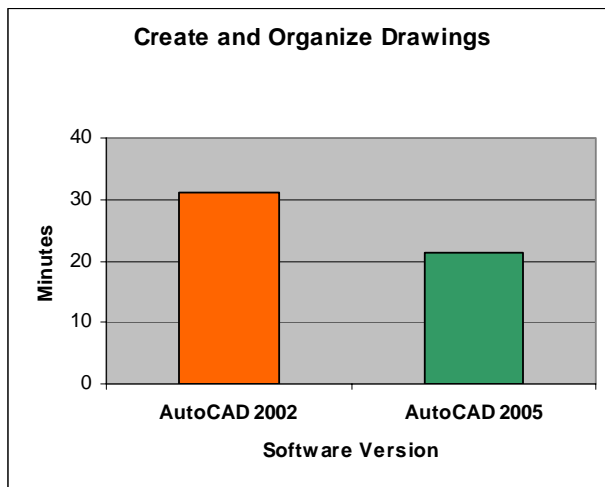
### Average Users Scored Greater Gains

The previous study (for AutoCAD 2004) uncovered an interesting variation in performance between expert and average users. Through a screening questionnaire and a post-factual evaluation of users' performance, three user-types emerged: high performers ("experts"—15% of study group), average-performers (73% of study group), and low performers ("novice"—12% of study group). In all of the study exercises, the average users experienced approximately 30 to 60 percent increase in performance, while the expert users experienced approximately 30 to 50 percent decrease in performance. Examination of the results followed by interviews with the participants uncovered the reasons for these findings. Expert users develop their expertise over weeks or months, not in a one-day training class. They are experts because they have learned to derive optimal performance from of their current AutoCAD version. Most users of AutoCAD do not have the time or level of interest to acquire that level of expertise.

The good news is that for repetitive tasks, the tool palette tasks tested in the productivity study enabled the average performer to come much closer to the level of productivity that an expert user experiences when using a familiar AutoCAD release in a production environment. The expert participants were slowed because the keyboard and process shortcuts they use in daily operations are faster than the new steps required to utilize the tool palettes features tested. However, those expert-level shortcuts are more complex to master. With extended usage, it is anticipated that expert users will integrate the new AutoCAD features into their already optimized work process and experience an overall increase in speed.

## Individual Tasks studied for AutoCAD 2005

### Task 1. Using the Sheet Set Manager to Create and Organize Drawings



**32% Faster**

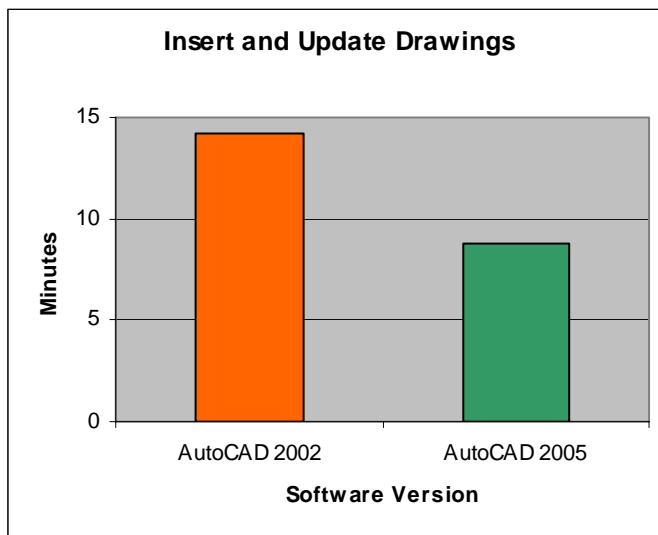
Study participants performing these tasks were 32 percent faster with AutoCAD 2005 than with AutoCAD 2002. The tasks included organizing a set of files and then creating four new drawings (a site plan, a floor plan, and two elevations) using the new views tab in the Sheet Set Manager. They then had to add into each drawing title block information that was consistent for the entire set of drawings. The study participants indicated that the ability to assign fields across the entire set of drawings, and the graphical manipulation of layout names was a very intuitive way of managing a set of drawings. The use of the

views tab to drag and drop existing views into new layouts was not a familiar way of working, but as participants used it and the associated call out blocks and labels, they could see the benefits in terms of both creating the initial layouts and in editing the information as changes were made to the entire set of drawings.

*The Sheet Set Manager seems to be a great way to organize projects. The table feature will make producing sheet indexes, schedules, etc., a lot easier. I spend a lot of time setting up the project directories, the sheet indexes, etc. This will help significantly.*

- Study participant

## Task 2. Using the Sheet Set Manager to Insert and Update Drawings



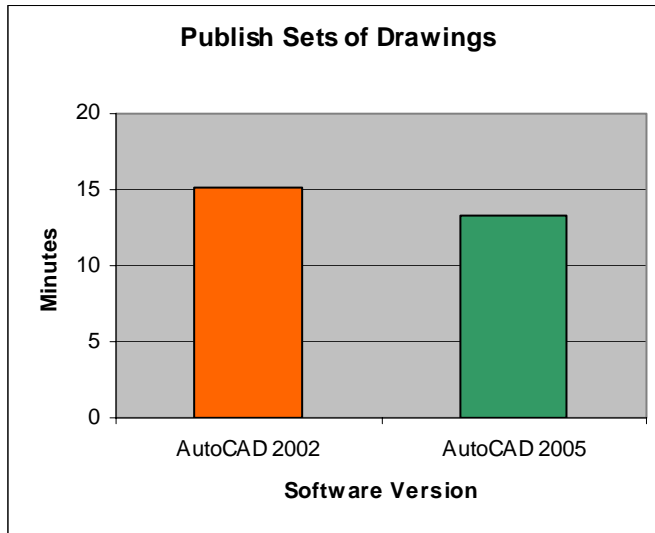
**26% Faster**

Once the drawing set had been created, the study participants were asked to insert five more layouts into the existing drawing set and then renumber them. The study participants were on average 26 percent faster for this task than they were with AutoCAD 2002. As the researchers analyzed the command count associated with this exercise, they noted that the actual number of commands used to perform the insertion and renumbering task dropped by over 50%. This data indicates that with more experience, users using the Sheet Set Manager to insert and renumber sheets in a drawing set would be even more productive over time.

*Setting standards will be a lot easier through the sheet setting manager. It will increase productivity!"*

- Study participant

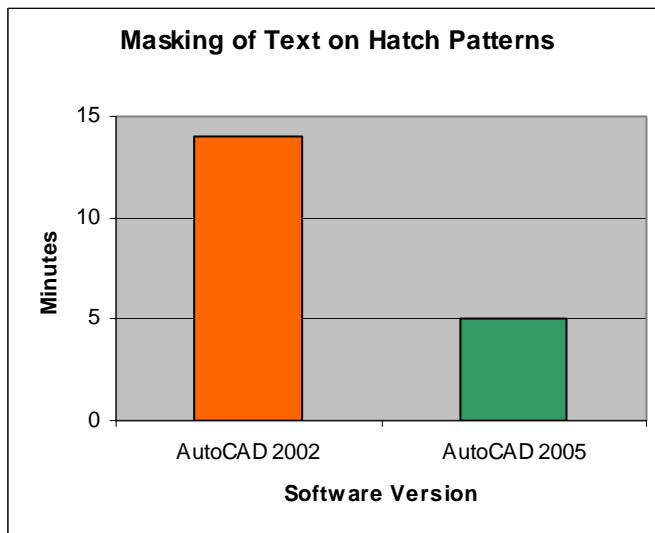
### Task 3. Using the Sheet Set Manager to Publish Sets of Drawings



**13% Faster**

The participants were asked to publish to a DWF™ file the set of drawings with which they worked in Tasks 1 and 2. They were 13 percent faster in completing this task with AutoCAD 2005 than with AutoCAD 2002. The participants noted that they did not use DWF as often as they did paper printouts, but that the use of pre-defined page setups in the Sheet Set Manager right click menu would make publishing to DWF or plotting drawings to paper much easier and more efficient.

### Task 4. Masking of Text on Hatch Patterns

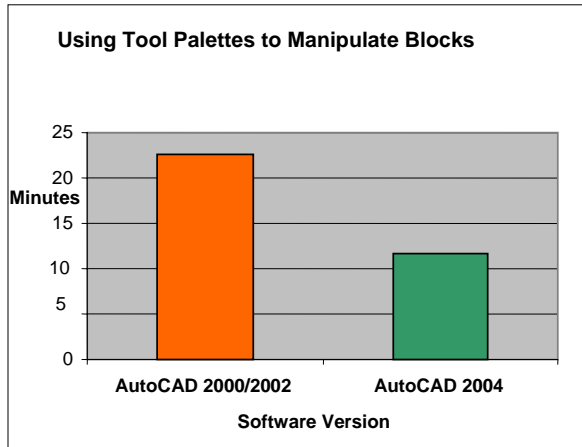


**65% Faster**

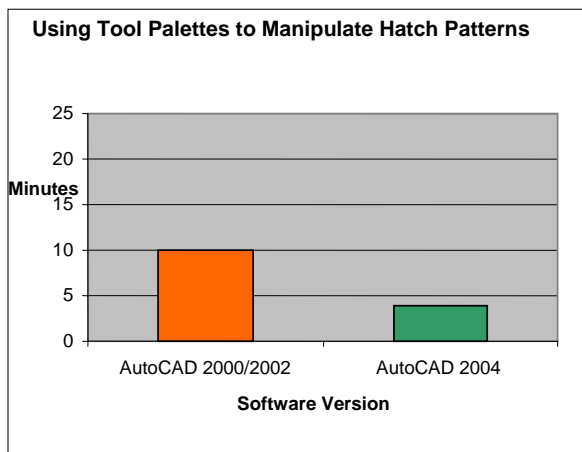
Study participants were 65 percent faster in masking a text label that had been inserted on top of a hatch pattern. In AutoCAD 2002, the participants had to perform this task by creating and inserting a rectangle behind the text and in front of the hatch pattern. Because this task is greatly simplified, there were no differences detected between expert and average users. It was simply much faster for everyone.

## Individual Tasks in AutoCAD 2004

### Tasks 1 and 3. Using Tool Palettes to Manipulate Blocks and Hatch Patterns



**43% Faster**



**55% Faster**

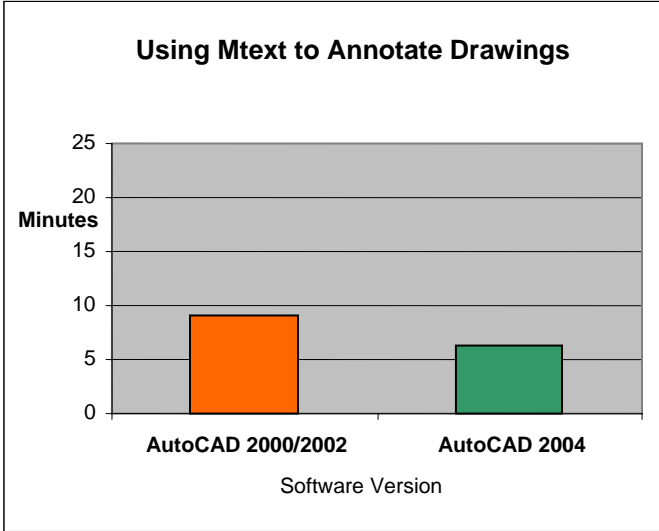
For these tasks, the average and novice users found their performance improved by 43 percent and 55 percent; the expert users were actually slowed by 30 percent and 32 percent. Based on these findings, our recommendation would be to have your company's expert users create the standard tool palettes that your average users will use in production. This will take advantage of the expertise of these users and allow them to increase the productivity of the rest of the company that uses AutoCAD. The expert users themselves can then transition to the use of tool palettes where they would make sense based on their work habits. As they work with the palettes over time, they will uncover shortcuts and work process changes that speed up their work. They can then quickly disseminate this expertise throughout the company by updating the standard tool palette

*I find the tool palettes to be a huge advantage. I envision using these heavily upon upgrading to the next version of AutoCAD. I feel that the tool palettes will be a major improvement in creating standardized drawings.*

- Study participant

Feedback provided during the focus groups indicated that the tool palettes feature is an important addition to the AutoCAD program. The participants believed that the use of tool palettes improved their productivity for tasks that required repetitive actions, such as for blocks and hatch manipulation. This was especially true for the CAD managers who participated in the study.

### Task 2. Using Mtext to Annotate Drawings



**43% Faster**

The generation of notes through the use of Mtext in AutoCAD 2000 and AutoCAD 2002 was judged to be very difficult by the participants in the study. In the general satisfaction surveys and in the focus groups, the enhanced Mtext feature was one of the most enthusiastically praised features of AutoCAD 2004.

The combined average and novice users (85 percent of the study participants) found their performance improved 37 percent; the expert users were slowed by 52 percent. These results illustrate the same effect noted for tool palettes. The majority of your AutoCAD users will experience greater speed and lower levels of frustration with the use of the new Mtext command, but your expert users will continue to be more productive using the older commands with which they are most familiar. Over time, the expert users will incorporate the new Mtext functionality into their workflow in an optimized manner.

*I would upgrade to get access to the improved MText editor, time sensitive right mouse click, tool palettes, improved dimensioning, and the ability to get thumb nail previews of drawings in Windows Explorer.*

- Study participant

## Study Design

The Design Practice Group of the College of Environmental Design, University of California, Berkeley, was selected to perform this study because of its extensive background in the study of tools to enhance architectural practice. The Design Practice Group is a research team interested in design and design practice in architecture and other design disciplines. Since 1995, the group has been developing research on both the nature of the practice of architecture and non-located collaboration in the San Francisco Bay Area.

The AutoCAD 2005 study participants were recruited from AUGI® (Autodesk User Group International) groups located in Los Angeles basin. All were experienced users of AutoCAD 2002 software; none had any experience with AutoCAD 2005 beta software (only beta, or pre-production, software was available at the time of the study). All had been using their AutoCAD applications in a production environment for at least two to three years (some for quite a while longer). 61 percent of the participants worked in the architectural industry, 6 percent in civil engineering, and 6 percent in mechanical engineering. The remaining 27 percent of the participants worked in the entertainment industry, public utilities, and 3D rendering.

The features selected for testing were:

1. The Sheet Set Manager and its use to create new drawings, to work with views in drawings and to publish complete sets of drawings in both paper and DWF format.
2. The use of masking to create a text label displayed on a hatched pattern.

The AutoCAD 2004 study participants were recruited from AUGI® (Autodesk User Groups International) groups located in Northern California. All of the 17 participants were experienced users of AutoCAD 2002 software (17 subjects); none had any experience with AutoCAD 2004 beta software. All had been using their AutoCAD applications in a production environment for at least two to three years (some for quite a while longer). Forty-seven percent of the participants worked in the architectural industry, 18 percent in civil engineering, and 14 percent in mechanical engineering. The remaining 21 percent of the participants worked in electrical engineering, interior design, landscape design, and piping engineering.

The features selected for testing were:

1. Tool palettes and their use to create, scale, rotate, and edit both pre-defined blocks and hatch patterns. The hatch pattern use focused on adding color schemes to enhance a drawing for presentation.
2. Mtext, the enhanced text editor, and its use for the creation and editing of notes in the body of a drawing.

These features were chosen because they are likely to be used by the majority of AutoCAD users, and for their potential to improve the average user's day-to-day productivity.

The participation section of the study was broken into three phases:

**Phase 1** - a day of exercises with AutoCAD 2002, followed by a survey and a focus group discussion

**Training** - a day of training on AutoCAD 2005 (or AutoCAD 2004), followed by a focus group discussion

**Phase 2** – a day of exercises using AutoCAD 2005 (or AutoCAD 2004), followed by a survey and a focus group discussion

**Phase 3** – a day of exercises using AutoCAD 2002, followed by a survey and a focus group discussion

During the exercises, each participants' performance was measured. After each day of exercises was completed, participants were requested to complete a satisfaction survey. Focus groups were also conducted to obtain participants' subjective impressions of the exercises they performed and to collect their opinions of the software itself.

## Individual Tasks

Exercises performed by the participants in the AutoCAD 2005 and AutoCAD 2004 studies included:

### **2005 Task 1. Using the Sheet Set Manager to Create and Organize Drawings**

Participants were asked to locate and organize a set of 11 separate drawing files. Participants were asked to create a site plan, a floor plan, and two elevations for the set of drawings that had been located. They also had to update the title block information and verify that it is consistent and correct for the entire set of drawings.

### **2005 Task 2. Using the Sheet Set Manager to Insert and Update Drawings**

Participants were asked to add a group of five more sheets to the existing set of drawings created in Task 1. The page numbers and other title block information for these newly inserted sheets were then updated.

### **2005 Task 3. Using the Sheet Set Manager to Publish Sets of Drawings**

Participants published a DWF file representing the set of drawings that they had been editing in Tasks 1 and 2. Prior to publishing the set to DWF, the client name had to be updated for the entire set of drawings.

### **2005 Task 4. Masking of Text on Hatch Patterns**

Participants were asked to add four text labels to four separate hatch patterns in a pre-defined drawing.

### **2004 Task 1. Using Tool Palettes to Manipulate Blocks**

Participants were asked to create five sets of drawings using seven predefined blocks (scaled and rotated in different ways) already stored in 12 different drawing files provided by the researchers. In Phase I exercises, participants performed this task using AutoCAD 2002; palette functionality was not available in these software versions. In Phase 3 exercises, the participants performed the same type of task using AutoCAD 2004 software; however, before creating the required drawing sets, they first had to create a tool palette that included the seven predefined blocks.

### **2004 Task 2. Using Mtext to Annotate Drawings**

Participants were asked to create a parts list based on the blocks created in Task 1. In Phase I, they performed this task using AutoCAD 2002. In Phase 3 exercises, the participants performed a similar task using AutoCAD 2004 software, utilizing the new Mtext (multiline text editing) functionality.

### **2004 Task 3. Using Tool Palettes to Manipulate Hatch Patterns**

Participants produced a color presentation for each of the sets produced in Task 1. In Phase I, they performed this task using AutoCAD 2002. In Phase 3, participants performed a similar task using AutoCAD 2004; however, they were required to create a tool palette with a predefined color scheme that could be used to create the color presentation in each of the sets.

## Study Metrics and Analysis

The researchers performed both quantitative and qualitative measurements of the tasks that were performed by study participants.

### Quantitative Measurements

Study participants were timed by the researchers as they performed their tasks. The output of each computer monitor was also videotaped. The research team later cross-checked the timing of each task based on detailed examination of the use of the software. In addition, the Autodesk command count utility was used to record the amount of time spent in each command and the number of times and order in which each command was used. Both the command count data and samples of the video recordings of the actual software usage were used as a method for verifying that the times recorded by the researchers were accurate and reproducible.

## Qualitative Measurements

At the completion of each phase of the study, participants were surveyed to record their subjective impressions of the software. They also were asked a series of questions in a focus group setting about the software and their experiences during the study. Feedback was recorded both by videotape and written note-taking.

## Analysis

The research team performed diverse statistical analyses of the collected data to ensure that differences observed in the tests and on the surveys were significant. In almost all cases, the data was significant at levels of  $p=0.1$  or less. They were also on the alert for several types of “confounding” errors that can enter into this type of study. This included the methods used to recruit participants, variations in the hardware and software used, and the different levels of expertise among the participants.

## Training

The day of training on AutoCAD 2004 and AutoCAD 2005 was provided by a senior technical marketing manager from Autodesk. The materials used were those under development for the AutoCAD 2005 training to be offered through local certified Autodesk Training Centers. Course material was tailored to focus on the tasks that were being examined by the study.

## Drawing Conclusions from the Study Results

The average decreases in time required to complete the tasks that were measured in the study are valuable only when placed in the context of a real work environment. To convert these measurements into something meaningful requires an understanding of how much time users perform these tasks in a day-to-day work environment.

## User Survey Data

For the AutoCAD 2005 study, Autodesk surveyed 265 customers who use AutoCAD 2002, AutoCAD 2004, and AutoCAD 2005 software in a production-level environment, in order to learn how they estimated their time in the areas tested in the productivity study. The survey was directed to three segments of customers, those using 10 seats of AutoCAD or less (48 percent); those using between 10 and 100 seats (37 percent); and those using more than 100 seats of software (15 percent). The survey questions and responses are shown below.

1. In the course of an hour, what percentage of the typical CAD user’s time is spent creating or editing details, sections, elevations etc. (include time spent adding and reviewing the associated labels and callouts) ?

**Avg. percent of time spent by CAD User= 20%    Avg. hours per week= 8 hrs**

2. In the course of an hour, what percentage of the typical CAD user’s time is spent looking for, updating and organizing existing drawing files? This would include time spent numbering pages, updating title block information, and then saving the edited DWG files in the correct directory?

**<sup>1</sup>Avg. percent of time spent by CAD User= 8%    <sup>2</sup>Avg. hours per week= 3.3 hrs**

3. In the course of an hour, what percentage of the typical CAD user’s time is spent plotting out sets of drawings to paper (this would include full size plots as well as 11x17 or 8 ½ by 11 check prints etc.)? Include the time spent finding the DWG files that need to be plotted, setting or creating plot settings, and waiting for AutoCAD to finish so that the next drawing can plot.

**Avg. percent of time spent by CAD User= 9%    Avg. hours per week= 3.8 hrs**

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<sup>1</sup> Weighted average calculated from 265 responses

<sup>2</sup> Based on 40-hour work week

4. In the course of an hour, what percentage of the typical CAD user's time is spent creating and placing text labels on hatch patterns? (Include the time spent masking the text so that it shows clearly against the underlying hatch pattern.)

**Avg. percent of time spent by CAD User= 5%      Avg. hours per week= 1.9 hrs**

For the AutoCAD 2004 study, Autodesk surveyed 100 customers who use AutoCAD 2000, AutoCAD 2000*i*, and AutoCAD 2002 software in a production-level environment, in order to learn from those users how they estimated their time in the areas tested in the productivity study. The survey was directed to customers using 10 seats of AutoCAD or less (60 percent); between 10 and 100 seats (30 percent); and more than 100 seats of software (10 percent). The survey questions and responses are shown below.

5. In the course of an hour, what percentage of the typical CAD user's time is spent inserting and orienting blocks in a drawing (e.g., placing on a layer, rotating, scaling, etc.)?

<sup>3</sup>**Avg. percent of time spent by CAD User= 19%      <sup>4</sup>Average hours per week= 7.6 hrs**

6. In the course of an hour, what percentage of the typical CAD user's time is spent inserting and orienting hatch patterns in a drawing (e.g., placing on a layer, rotating, scaling, etc.)?

**Avg. percent of time spent by CAD User= 13%      Average hours per week= 5.2 hrs**

7. In the course of an hour, what percentage of the typical CAD user's time is spent annotating drawings? This would specifically apply to creating and editing paragraph style text (e.g., general notes, bullet lists, numbered notes, etc.)

**Avg. percent of time spent by CAD User= 23%      Average hours per week= 9.2 hrs**

The data collected from the survey was then used to determine the amount of time the average AutoCAD 2002 user can save per week in a production level environment when they adopt AutoCAD 2005.

AutoCAD Tasks Tested	Time Spent Doing Task (hrs/wk, average)	Timesavings Using AutoCAD 2005	Time Saved per User
Create and organize drawings	8 hrs	32% faster	2.6 hrs/wk
Insert and update drawings	3.3 hrs	26% faster	1 hrs/wk
Publishing sets of drawings	3.8 hrs	13% faster	.5 hrs/wk
Creating tables	2.3 hrs	8% faster	.25 hrs/wk
Editing tables	1.9 hrs	8% faster	.25 hrs/wk
Text masking	1.9 hrs	65% faster	1.2 hrs/wk
Hatch editing	2.5 hrs	20% faster	.5 hrs/wk

## Summary

Study participants were able to be more productive when editing and organizing existing sets of drawings, when adding new drawings, and when publishing a set of drawings from the Sheet Set Manager. The study also showed significant improvement in their ability to manipulate blocks and hatch patterns through the use of tool palettes. These study results, combined with the user survey, suggest that these new features can save the average AutoCAD 2005 user up to fourteen hours per week in increased productivity.

The new and existing features in AutoCAD 2005 can enhance user day-to-day productivity with a minimum of disruption to your existing work practices. A small gain of just one hour per week by a single

<sup>3</sup> Weighted average calculated from 100 responses

<sup>4</sup> Based on 40-hour work week

user can potentially save more than one person-week per year. Multiples of those savings, available by upgrading to AutoCAD 2005 software, can add up to real dollars and a competitive edge for your company.

If you are still not convinced, we encourage you to investigate your potential productivity gains in your own production environment. AutoCAD 2005 is available as a 30-day free trial. To request a trial CD version of AutoCAD 2005 software or to begin your assessment immediately by using the Web-based streaming trial, visit [www.autodesk.com/autocad-trial](http://www.autodesk.com/autocad-trial).

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