Feasibility Test of CADD Webmenus

Final Report 683

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16. Abstract

The Arizona Department of Transportation (ADOT) initiated SPR Project 683: CADD Webmenus Feasibility Study to conduct a proof-of-concept test of Web-based CADD menus for ADOT agency-wide CADD applications. ADOT is currently interested in the feasibility of using Webmenus to solve various problems associated with its current CADD menu system. This research gives ADOT the necessary testing results and information it needs to incorporate Webmenus into the workflow of its CADD drafting and design staff, while also disseminating the Webmenus to the consultant community's CADD users who are required to use ADOT CADD standards.

To present CADD standards in an easily accessible and simplified format, it is necessary to use CADD menus. ADOT's current menu system is a challenge for ADOT support staff to effectively support and maintain. This has led to development of multiple menus in multiple locations, which compounds the difficulty of maintaining them. Additionally, the current ADOT CADD menu system was developed in a proprietary programming language (MDL™) which is version specific and requires compilation from various source files to be executed.

The successful development of Webmenus for use by ADOT staff and consultants would provide them a single, readily accessible menu system that had a single point of reference for all ADOT CADD standards. The basic challenge of developing and implementing a Web-based menu system is company firewall policies that restrict Web site activity and "back door" file transfer. This challenge can be overcome with adjustments to the CADD Webmenus that facilitate commands that do not require back door file transfer. CADD Webmenus may also offer a solution to the current ADOT problem of multiple menus developed in outdated code and distributed without ensuring the latest revision of the menu system. With the amount of design drafting work being sub-contracted out (approx. 90%), simplifying and distributing a single menu system via the Internet is a logical solution.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: Volumes greater than 1000L shall be shown in m^3.			
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000lb)	0.907	megagrams (or "metric ton")	mg (or "t")
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
ILLUMINATION				
fc	foot candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m²	cd/m^2
FORCE AND PRESSURE OR STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm^2	Square millimeters	0.0016	square inches	in^2
m^2	Square meters	10.764	square feet	ft^2
m^2	Square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	Cubic meters	35.315	cubic feet	ft^3
m^3	Cubic meters	1.308	cubic yards	yd^3
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
mg	megagrams (or "metric ton")	1.102	short tons (2000lb)	T
TEMPERATURE (exact)				
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m²	0.2919	foot-Lamberts	fl
FORCE AND PRESSURE OR STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380

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Terms and Acronyms

ADOT	Arizona Department of Transportation
ASCII	American Standard Code for Information Interchange
CADD	Computer-Aided Design and Drafting
CSS	Cascading Style Sheets
FTP	File Transfer Protocol
GUI	Graphical User Interface
HTML	HyperText Markup Language
MDL	MicroStation Development Language
PDF	Portable Document Format is a file format created by Adobe Systems™
VBA	Visual Basic for Applications
Backdoor	Terminology used to describe a computer programs entry point into a computer system as a method of bypassing firewall authentication.
Calling	Terminology used to describe the operation of connecting or running computer commands from one program to a separate computer program.
Firewall	Terminology used to describe a part of a computer system or network that is designed to block unauthorized access while permitting authorized communications.
Java Script	This is a scripting language used to enable programmatic access to objects within both the client application and other applications.

INTRODUCTION

In a Computer-Aided Design and Drafting (CADD) menu system, a CADD drafter/designer starts the primary CADD program (in the case of the Arizona Department of Transportation (ADOT) this application is MicroStation). The drafter then opens a design file (drawing) for editing. The drafter then loads the CADD menu for selection. For the drafter to comply with ADOT CADD standards, a series of pull-down menus is enabled through the CADD menu's graphical user interface (GUI). Figure 1 shows a current ADOT menu. This interface enables the drafter to choose specific CADD commands that force the application to point to or set specific CADD standard items that the software application needs.

Figure 1: Current ADOT CADD Menu Interface
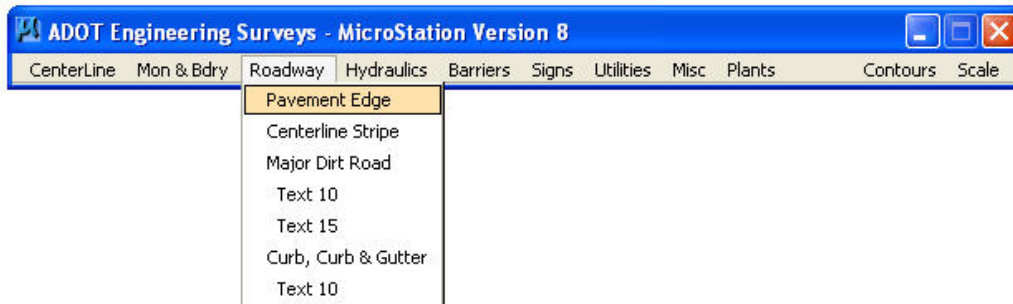
Once the drafter has chosen a command from the menu, the "mini" program runs behind the scenes. This program can be as simple as the placement of a line or as complex as invoking dialog boxes for user input. The CADD menu becomes the primary command interface for the drafter to follow and comply with ADOT CADD standards.

CADD menus must be used for design drafting to present CADD standard commands in a simplified and easily accessible format. ADOT's current custom menu system is a challenge for its staff to support and maintain. This has led to the creation of multiple menus in multiple locations, which increases the difficulty. In addition, the current ADOT CADD menu system has been developed in MicroStation Development Language (MDL), a proprietary programming language which is version specific and requires compilation from various source files to be executed.

A CADD Webmenu would solve these problems. A CADD Webmenu system gives the user all the capabilities of a CADD menu system via the internet/intranet. It provides a readily accessible menu system that has a single point of reference for all ADOT CADD standards. The basic challenge of implementing a Web-based menu system lies in the technology associated with company firewall policies that restrict Web site activity and "backdoor" file transfer. This technology can be overcome with adjustments to the CADD Webmenus to facilitate commands that do not require backdoor file transfer. CADD Webmenus also offers a solution to the current ADOT problem of having multiple menus developed in outdated code and distributed without ensuring the latest

revision of the menu system. With approximately 90% of design drafting work being sub-contracted out, simplifying and distributing a single menu system via the Internet offers a logical and effective solution.

This project conducted a proof-of-concept test of the feasibility of using Web-based CADD menus for ADOT agency-wide CADD. This test gives ADOT the necessary information to incorporate Webmenus into the workflow of its CADD drafting and design staff, and also disseminate the Webmenus to the consultant community's CADD users who are required to use ADOT CADD standards.

Business Drivers:

Key drivers for this study are listed in the table below.

Table 1 – Research Drivers and Commentary

Drivers	Commentary
Consultant CADD workspace environments are not compatible with current ADOT menus.	ADOT technical support and consultant staff have reported that current CADD menus do not accurately function within their company workspace environment.
Multiple client menus are being used within ADOT.	ADOT technical support has reported that there are multiple ADOT menus being used throughout the agency. Managing and controlling standards for multiple menus among ADOT departments has been a problem because it is difficult to determine which commands and "mini programs" are calling, connecting to the correct ADOT CADD standards.
Programming code used for current ADOT menus is outdated.	The current ADOT menus are developed in MicroStation Development Language (MDL), a derivative of C++. This language is owned by Bentley Systems, Inc.; it has become outdated and therefore it is difficult to locate or train programmers to be efficient in it.
Control of menu versions has proven difficult.	ADOT technical support has reported difficulty in managing various menu versions developed and used by ADOT departments and outside consulting firms.
Simplify menu programming for continuing internal maintenance.	Due to attrition, ADOT has lost programming staff who were responsible for creating, updating, and maintaining the current menus. ADOT support has not been successful in cross-training staff to effectively maintain these menus.

Feasibility Study

This study had two primary phases: the CADD Webmenu proof-of-concept testing and the development of supporting documentation. The proof-of-concept phase consisted of developing and testing CADD Webmenus that looked and functioned like existing ADOT menus. The supporting documentation phase consisted of developing a process chart demonstrating how the CADD Webmenu would work, a presentation that included a demonstration for the Research Council, and a final report describing the project work and making recommendations for adoption of the developed Webmenu.

Preparing and testing the Webmenu

The project's first task was to research and prepare programming code capable of accomplishing two primary objectives: have Webmenus that looked and functioned like the current ADOT CADD menus and that would center the CADD menu updates in one location.

This preparation and testing resulted in the decision to use Java Script and base HTML as the primary programming languages. Various examples of Java Script-based bar menu code exist in the industry, which made it the most useful for developing a menu system that was functionally equivalent to the current ADOT CADD menus.

Preparation consisted of coding menus that looked and responded similarly to, if not exactly like, the current menu system with command options equal to the current ADOT CADD menu. Testing consisted of transferring developed code to an external Web server and testing the interactive results of the Web-based menus within the CADD software application. The most challenging task was determining the functional process for accessing and running mini programs (macros and MDL applications) from the Web server within the CADD program. This challenge was overcome with the creation of an application that used "behind the scenes" file transfer protocol (FTP) for direct file transfer. Figure 2 shows the menu that was developed.

Figure 2: ADOT CADD Webmenu Interface

Documentation

The documentation consisted of various items necessary to communicate the findings of the project and to demonstrate the functionality of the proposed ADOT Webmenu. These were:

- A Process Chart
- A Research Council Presentation
- The Final Report

Process Chart - Depicts how the CADD Webmenu would work. This chart was developed using a simple block outline to demonstrate steps in the CADD Webmenu operation. The chart is in the appendix.

Research Council Presentation – Demonstration of the functionality of the developed CADD Webmenu. The presentation included a slide presentation along with a live demonstration of the actual ADOT Webmenu system.

Final Report – Documents the achievement of all project requirements and makes recommendations for adoption.

Key Results

The key results of this project proved the ability to develop a web-based menu system for ADOT. The results of this project were evaluated based on the project requirements for (1) Graphical User Interface (GUI) structure and functionality; (2) single source menu code location; and (3) the execution of three different commands.

1. *The menu will have a similar look and function to the current ADOT CADD menus (GUI).*

A menu with a similar look and function was created by using JavaScript code structure to control the menu's "pull-down" actions and parsed CADD commands. Cascading Style Sheets (CSS) were used to control the menu's layout and colors. Finally, simple HTML was used to format the menu bar on the Web page and call the JavaScript and style sheet formatting. The final result was a Web-based menu that almost identically matched the GUI and functionality of the existing ADOT menus.

2. *All updates to the menu will be in one location to reduce administrative overhead.*

Locating the menu in a single location was accomplished by uploading all source files and supporting application files to the Web server under a single folder. This method of loading the Webmenu HTML file from the server initiated all supporting files from the Web server to invoke command to the local CADD application. Webmenus were updated by downloading the source code from the Web server, making adjustments to the code, and uploading the changes back to the Web server. The final result was a single

source code Webmenu system updated from a single location (the Web server), and dynamically available for any user with internet access.

3. Webmenu should successfully execute three different MicroStation commands.

The result of executing three different commands was accomplished by using the MicroStation MDL application. This internal application sets object linking between Internet Explorer and MicroStation to communicate browser commands to the CADD application. Once the Webmenu is loaded, one of the three commands is picked from the pull-down list and the CADD application automatically responds to the command invoked from the Web server. The final result is a successful command stream loaded from the Web browser to the MicroStation CADD application.

Conclusions

The research concludes there are four compelling technological reasons that ADOT should adopt a Web-based menu system to make its CADD standard menus available to ADOT and external users:

1. The use of these menus would eliminate the need to manage multiple copies of the current MDL-based menus and could therefore consolidate all ADOT CADD standard pull-downs into a single Web-based menu system.

2. The current ADOT support staff would be capable of managing and maintaining these menu systems with minimal effort and training.

3. The Web-based menu system is independent of CADD software versions and not restricted to any specific version of CADD; in other words, it is "scalable."

4. The Web-based menus enable the same functionality as the previous menus through parsing key-in commands through the CADD engine.

Recommendations

Based on the results of this project, we recommend that ADOT allocate resources to develop CADD Webmenus to make CADD standards available to internal and external design drafters. The key factors in this recommendation are based on documented issues with the current menu system and the convincing results of the proof-of-concept test of the Webmenu system. For this recommendation to be successfully adopted, four considerations should be taken to ensure successful development and implementation.
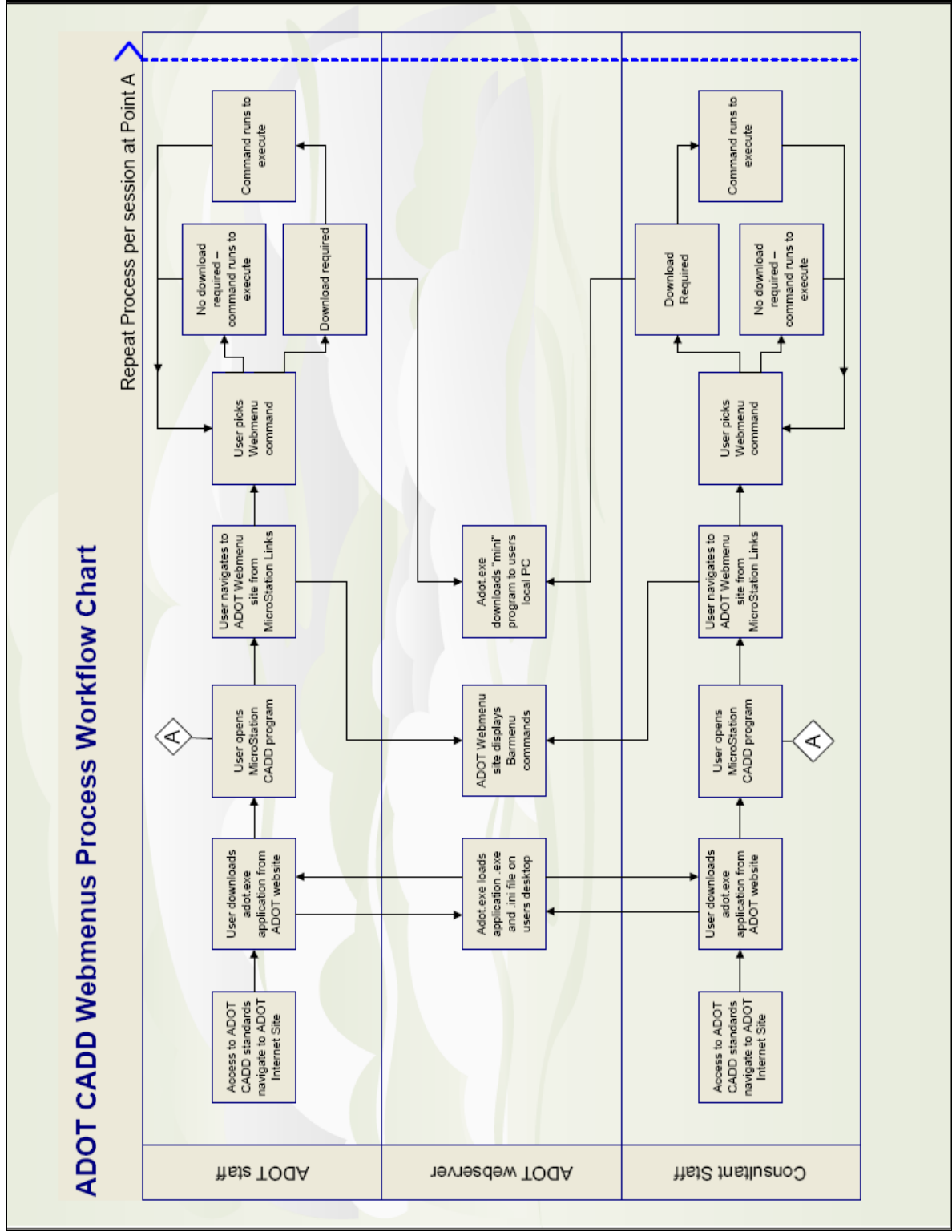
1. A thorough evaluation of all current "mini" applications to determine their functional necessity would be needed.

2. Communication and training would be needed to facilitate the use of the new menus.

3. Internal ADOT staff should be responsible for maintaining the menu system, communicating changes, and monitoring its use.

4. Internal ADOT management should be identified as the owners of the Webmenu application. This policy would ensure a single administrative source of responsibility for all ADOT menus while ensuring that correct and accurate CADD standard information is being disseminated from a single source within the Department.

Summary

In summary ADOT would greatly benefit from a centralized Web-based CADD menu system. This menu system, consolidated into a single location, would reduce the amount of administrative overhead required to maintain the application and accurately deliver the latest approved ADOT standards to internal ADOT staff and external consultants while enabling ease of maintenance for future ADOT support considerations.

APPENDIX

ADOT CADD Webmenu Process Workflow Chart

ADOT CADD Webmenus Process Workflow Chart

Repeat Process per session at Point A

ADOT staff

- Access to ADOT CADD standards navigate to ADOT Internet Site
- User downloads adot.exe application from ADOT website
- User opens MicroStation CADD program
- User navigates to ADOT Webmenu site from MicroStation Links
- User picks Webmenu command
- No download required – command runs to execute
- Command runs to execute
- Download required

ADOT webserver

- Adot.exe loads application.exe and .ini file on users desktop
- ADOT Webmenu site displays Barmenu commands
- Adot.exe downloads "mini" program to users local PC

Consultant Staff

- Access to ADOT CADD standards navigate to ADOT Internet Site
- User downloads adot.exe application from ADOT website
- User opens MicroStation CADD program
- User navigates to ADOT Webmenu site from MicroStation Links
- User picks Webmenu command
- Download Required
- No download required – command runs to execute
- Command runs to execute

ADOT CADD Webmenu System Architecture

ADOT Webmenu System Architecture

ADOT Webmenus system architecture chart

World Wide Web (WWW)

CSU
DSU
Modem

Web Server
ADOT Webserver

Firewall

Internal ADOT
Server

ADOT PC

ADOT PC

CSU
DSU
Modem

Firewall

Internal
Consultant
Server

Consultant PC

Consultant PC