Use of Computer Graphics Systems for Facilities Design in Public Agencies (1990)

Pages
33

Size
6 x 8

ISBN
030929343X

Federal Construction Council; Consulting Committee on Computer Applications; National Research Council

Technical Report

No. 102

The Use of Computer Graphics Systems for Facilities Design in Public Agencies

Federal Construction Council
Consulting Committee on Computer Applications

NATIONAL ACADEMY PRESS
Washington, DC
1990

NOTICE

The Federal Construction Council (FCC) is a continuing activity of the Building Research Board of the National Research Council (NRC). The purpose of the FCC is to promote continuing cooperation among the sponsoring federal agencies and between the agencies and other elements of the building community in order to advance building science and technology--particularly with regard to the design, construction, and operation of federal facilities. Currently, 16 agencies sponsor the FCC.

As part of its activities, the FCC periodically publishes reports like this one that have been prepared by committees of government employees. Since these committees are not appointed by the NRC, they do not make recommendations, and their reports are not reviewed and approved in accordance with usual NRC procedures. Consequently, the reports are considered FCC publications rather than NRC publications.

For further information on the FCC program or FCC reports, please write to:

Executive Secretary
Federal Construction Council
Building Research Board
2101 Constitution Avenue, N.W.
Washington, DC 20418

FEDERAL CONSTRUCTION COUNCIL
CONSULTING COMMITTEE
ON
COMPUTER APPLICATIONS*

Chairman

Al Lew, Facilities Engineering Division, National Aeronautics and Space Administration

Members

Hugh Adams, Corps of Engineers, Department of the Army
Lawrence D. Barnes, Public Buildings Service, General Services Administration
Parry Carlson, Office of Foreign Buildings Operations, Department of State
Philip Clark, Directorate of Engineering and Services, Department of the Air Force
Patrick Collins, Office of Foreign Buildings Operations, Department of State
Rich Dennis, Directorate of Engineering and Services, Department of the Air Force

---

* When the study reported here was initiated, Kent Reed of the National Institute of Standards and Technology was the committee chairman, Richard Malm represented the Army Corps of Engineers, Tom Kurihara represented the Department of Energy, Keith Trace represented the U.S. Public Health Service, and Peter Smeallie served as committee staff.

Paul Fardig, Office of Environmental Health and Engineering, U.S. Public Health Service
Richard W. Flohr, Facilities Department, U.S. Postal Service
John Gross, Center for Building Technology, National Institutes of Standards and Technology
Tony Hinson, Naval Facilities Engineering Command, Department of the Navy
Randy Holt, Office of Facilities, Department of Veterans Affairs
Ronald L. King, General Government Division, U.S. General Accounting Office
Richard Malm, Office of Foreign Buildings Operations, Department of State
Mike Pryor, Air Force Engineering and Services Center, Department of the Air Force
Kent Reed, Center for Building Technology, National Institutes of Standards and Technology
Lee Robison, Health, Resources and Services Administration, Indian Health Service
Dana K. Smith, Naval Facilities Engineering Command, Department of the Navy

Public Facilities Council Liaison

Brendan Donegan, Department of Facilities and Services, Montgomery County, Maryland
Carl Greeson, Division of Design and Construction, State of Missouri
Sal Salamone, Mayor's Office of Operations, New York City
Joseph Thelen, The Port Authority of New York and New Jersey

Staff

Henry Borger, Executive Secretary, Federal Construction Council
Lena Grayson, Senior Secretary

CONTENTS

1

INTRODUCTION

As part of its continuing effort to promote an interchange of information about computers among government agencies, the Federal Construction Council Consulting Committee on Computer Applications has assembled information on the policies and practices of agencies regarding the use of computer graphics systems in the design of public facilities.

The information was gathered by means of a questionnaire, which was sent to the agencies represented on the committee. Responses were received from 11 agencies:

- The Department of State, Office of Foreign Buildings Operations (FBO)
- The National Institute of Standards and Technology, Center for Building Technology (NIST/CBT)
- The Naval Facilities Engineering Command (NAVFAC)
- The Public Health Service (PHS)
- The U.S. Postal Service (USPS)
- The Department of Veterans Affairs (VA)
- The General Services Administration, Public Buildings Service (GSA/PBS)
- The Port Authority of New York and New Jersey (PANYNJ)
- The Army Corps of Engineers (CoE)
- The National Aeronautics and Space Administration (NASA)

- The Air Force Directorate of Engineering and Services

The agencies were asked to provide information on five topics. Their responses are summarized in the chapters that follow. Some agencies did not provide information on all topics.

2

COMPUTER GRAPHICS SYSTEMS IN PLACE TODAY

DEPARTMENT OF STATE, OFFICE OF FOREIGN BUILDINGS OPERATIONS (FBO)

At this time, FBO does not have CAD systems installed. It does have MS-DOS-driven hardware with commercially available graphics systems such as the Aldus pagemaker and Microsoft chart. These are used primarily for developing presentation material.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY CENTER FOR BUILDING TECHNOLOGY (NIST/CBT)

Many different computer graphics systems are used throughout NIST for research activities. Within the Structures Division of CBT computer graphics systems include Vax 11/750, Raster Technologies Model One/80, Evans/Sutherland PS 390, and Seiko hard copy devices. These are used primarily for solid modeling and finite element analyses.

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

Computer graphics systems currently in use include:

- Graphic Engineering and Mapping System I (GEMS I); ComputerVision turnkey CDS 4000 minicomputer systems,
- Engineering Microcomputer Graphics: Modular Engineering Design System (EMG/MEDS); 80386SX/80387-based microcomputers using AutoCAD or equal plus AutoCAD AEC, AutoCAD Mechanical and other third party support software.

Current applications include: real estate and base mapping, master planning, facilities design (quarters, magazines and medical facilities), preliminary design, and design contract drawings.

THE PUBLIC HEALTH SERVICE (PHS)

The Facilities Engineering Branch of PHS currently uses Compaq 386 microcomputers with AutoCAD software, 2 digitizers (Hitachi & Calcomp), and a plotter (Houston Inst.). These are used for the preparation of archive drawings of the National Institute of Health's facilities and grounds. Site drawings of utility and facility lay-outs are being developed for reference purposes. These will be utilized in an on-going "Infrastructure Enhancement Program" which will completely renovate, expand and replace existing utility generating and distribution systems throughout the campus.

U.S. POSTAL SERVICE (USPS)

Office of Design and Construction

The primary CAD systems in use are Intergraph and AutoCAD. The Postal Service has developed specialized software for these systems, through which the working drawings for constructing new post offices can be prepared.

- CAD-based software running on Intergraph enables almost immediate design of small post offices. Other standard plans for small post offices run on AutoCAD, using IBM compatible microcomputers.
- The design of medium-sized post offices, which extend in size up to 35,000 square feet, is accomplished through the computerized assembly of predesigned functional modules that meet the specific needs of each facility. With this CAD process, complete working drawings are prepared in under eight weeks. This software runs on all three CAD systems listed above.
- AutoCAD-based CAD software is used to plan new facilities, including layouts of mechanization. The resulting plans are then transferred to architect-engineer firms for completion of working drawings.

Office of Operations, Methods, Systems, and Quality

Current computer graphics systems in use in this office include:

- Compaq Deskpro 386/33 mhs
- Monitronix MX-210 19" color monitor
- HP Laser Jet III printer plotter
- Hewlett Packard A-E size model EXL plotter
- Digitizer, Summagraphics Summasketch model MM1201
- AutoCAD version 10
- Compaq DOS 3.31
- AutoCAD AEC architectural template
- The space program by Graphics Systems
- CAD overlay
- Procomm Plus

Current applications include layout of postal facilities, mapping for zip+4 areas and delivery routes, preliminary operating system designs and operating system designs.

DEPARTMENT OF VETERANS AFFAIRS (VA)

The majority of construction projects within the Department of Veterans Affairs are performed at 172 medical centers. Each medical center has an engineering department which is responsible for many functions including those related to project design, construction, and facility management. The project sections within Engineering Service at the medical centers use a variety of CAD systems such as Accugraph, AutoCAD, Cadvance, and Versacad. By far, the most widely used system consists of AutoCAD running on a 386 or 486 based PC. The Office of Facilities in Washington uses an Intergraph based system for in-house preliminary work on a small number of projects.

All DVA medical centers are running standardized software and hardware which includes space information, project information, etc. on our DHCP (Decentralized Hospital Computer Program) systems. All of the software was developed in-house in the MUMPS language. DVA is presently testing the integration of prototype CAD systems into the DHCP system.

GENERAL SERVICES ADMINISTRATION
PUBLIC BUILDINGS SERVICE (GSA/PBS)

The use of computer-aided design for real estate functions has been endorsed by PBS and several CAD systems are being used by the various PBS regional offices. The most prevalent is AutoCAD but some regions are using Versacad and Acugraph. AutoCAD version 10 has been selected as the standard software package for PBS.

These systems are used for space planning, for the layout of space, and for related demolition and construction projects, e.g., wall locations and telephone and electrical wiring.

PORT AUTHORITY OF NEW YORK AND NEW JERSEY (PANYNJ)

CADD SYSTEM	HARDWARE PLATFORM	# OF WORKSTATIONS
ComputerVision CDS4000	ComputerVision 200X Mini Computer	14
ComputerVision CADD	Sun 4 Series Workstation	10
	386-based PC	6
ComputerVision Personal Designer	386-based PC	15
Micad	386-based PC	3

CADD has been put to a variety of uses at the Port Authority by several departments (Engineering, Aviation, World Trade, Rails, General Services, Ports). Among the classes of projects using CADD are:

1) Capital Expansion (e.g., airport taxiway extensions, airport redevelopment, electrified rail station rehabilitation, roadway design),
2) Maintenance,
3) Real estate marketing, and
4) Facility management.

Within the Engineering Department, CADD is used for the following:

1) Civil: roadway/site design and plan production; mapping; surveying,
2) Structural: plan production for bridges/ buildings,
3) Mechanical: HVAC layout and plan production; plumbing; mechanical equipment room layout and design,
4) Electrical: wiring/lighting diagrams,
5) Architecture: 3-D architectural building design; architectural plan production, and
6) Geotechnical: soil boring logs.

U.S. ARMY CORPS OF ENGINEERS (CoE)

The Corps of Engineers, in its third year of a contract with Intergraph, has installed 300 workstations in 29 offices. Also installed are 350 copies of Intergraph CADD Software (MicroStation PC) which runs on MS-DOS microcomputers. A typical configuration at a large design office includes a dual MicroVAX, six dual screen UNIX-based workstations, four single screen UNIX based workstations, and sixteen 80386-based PC's running MicroStation, all on the same network.

AutoCAD maintains a strong hold in many offices. The loyalty to AutoCAD is reported to be due to the high level of familiarity and expertise.

The systems are being used for a variety of tasks including design and production for architectural, civil, structural, mechanical, electrical, geological, and topographical work. Specific applications are being used to perform subsets of the overall process. The majority of time devoted to CADD use is for production and editing of construction documentation. However, designers are beginning to take advantage of CADD capabilities to a greater degree for design and design studies in the structural and mechanical areas.

The current CADD contract has emphasized advanced design packages where the construction drawings are a by-product of design. The 3-dimensional capability of these systems is expected to greatly improve our analysis of complex system interfaces in our major facility designs.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA's Facilities Engineering Division currently uses the following computer graphics systems:

- IBM AT's with AutoCAD,
- IBM PC's with Anvil 5000, CASE 2000,
- Apple Macintosh with MacDraw, AutoCAD, VersaCAD,
- CADAM

- Microcadam
- ComputerVision

They are used for facility drawings and site utilities mapping.

AIR FORCE DIRECTORATE OF ENGINEERING AND SERVICES (AF)

Over the past several years, the Engineering and Services communities have been developing and implementing an Integrated Graphics Systems (IGS) that includes CADD. AAM/FM and GIS. In the late 1970s, an early Intergraph system was in use at one location to display ground communications lines as overlays to base maps. Since that time, approximately 75 (of about 140) Air Force Civil Engineering organizations have placed CADD in operation. The extent of actual operation varies at each base, from a single user, stand-alone CADD system, to the highly complex, multi-user work stations capable of performing all required tasks within the IGS platform. Hardware varies from the Intergraph Intervue two screen workstations in place at several large industrial installations to 286 and 386 hardware by various manufacturers, running AutoCAD software, in place at many other installations.

Under the Air Force's Base Comprehensive Planning program, about half of the installations have completed vector CADD digital maps, which now follow an Air Force-wide standard for layering, design file structure, symbology, etc. There is a similar standard for architectural and engineering services required for facility design.

Numerous on-going initiatives at various installations are evaluating ways to better integrate different data bases to ensure that future software/hardware platforms will have the interoperability to meet the Air Force mission. An example is a Defense Mapping Agency-supported research effort at the Department of Economics and geography at the U.S. Air Force Academy to investigate the potential benefits and the several integration problems

associated with various GIS software applications to the USAF.

The Air Force Academy also created a micro-based computer called Combat Readiness and Infrastructure Support Icon Software (CRISIS) which is a third-party application program under AutoCAD. CRISIS can be used by bases to perform Base Comprehensive Planning analyses; to develop facility requirements for force beddowns, exercises, and force deployments; and to function as an Air Base Operability peacetime training model, and a wartime combat support assessment model. CRIS, which can be used on a laptop computer by personnel deployed in the field, is being made available across the USAF.

Twice a year, people running these various initiatives meet to review, advise and crossfeed information to help establish guidance, policy and standards for the engineering community. Key players from the installations, major commands, Air Staff and the Air Force Academy are leading the way for a true interactive IGS platform for the 90s.

3

COMPUTER GRAPHICS TRAINING

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

Training for computer systems is approached from many directions. Initial training is normally in-class and hands-on. Application training is oriented to each discipline; other training includes system management, macro languages, standard operating procedures and data translation issues. Follow-on training may include additional in-class time. On-line tutorials and video tapes are also used.

NAVFAC training attempts to provide computer training related to the use of computers applied to an application. Separate training is provided for teaching the application (i.e., cost estimating is taught as a separate course).

NAVFAC trains in-house personnel and supports training efforts for all users including private A/Es using its systems. This training may be provided by private contractors, other Navy activities, or in-house NAVFAC personnel.

"Hot-line" support is provided for all systems; information is fed back to improve user documentation, tutorials and classroom training.

U.S. POSTAL SERVICE (USPS)

Office of Design and Construction

Personnel are trained in the use of CAD systems by commercial training facilities. Training in the use of the specialized software is generally provided through the architect-engineer responsible for its development.

User groups are formed for specialized applications, such as our current task forces for further CAD-based development of existing small and medium-sized standard plans, and for adding additional standard plans for other sizes of facilities.

Office of Operations, Methods, Systems, and Quality

Training is undertaken through the following activities:

1) AutoCAD basics is obtained through Autodesk approved training vendors,
2) An electronic bulletin board is available through a USPS support site, and
3) Plan to establish courses at the USPS management academy for advanced CAD training.

GENERAL SERVICES ADMINISTRATION
PUBLIC BUILDINGS SERVICE (GSA/PBS)

PBS reports that training is provided by the vendors and by contractors. There are no formal user groups. The level of participation in outside groups is not known.

PORT AUTHORITY OF NEW YORK AND NEW JERSEY (PANYNJ)

Currently, training on ComputerVision is handled in one of three ways:

1) Off-site by the vendor or consultants,
2) On-site by the vendor; or
3) Self-paced training, on-site, using vendor-supplied training materials. Training in AutoCAD is performed by consultants either on-site or off-site. Internal user groups for ComputerVision once existed and were disbanded. There are plans to reinstitute user groups for ComputerVision. The Port Authority is an active member of the National ComputerVision User Group and participates in their annual meeting.

ARMY CORPS OF ENGINEERS (CoE)

Within the Corps, Intergraph sites use Intergraph supplied training either on location or in Huntsville, Alabama. The offices often designate generalists and specialist personnel and train them accordingly. One-on-one (expert to novice) training is used in many cases to supplement the formal Intergraph training.

The AutoCAD sites use various formal training institutes, but not as extensively as the Intergraph offices. The AutoCAD sites depend more heavily on expert to novice assistance. Most offices report that training is an area of considerable cost and that proper pre-training preparation contributes to the effectiveness of formal training.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

The Facilities Engineering Division of NASA reports that training is undertaken by outside contractors on-site or at a computer training center. While there are no internal user groups, CADD user groups exist at some NASA Centers.

OTHER AGENCIES

The National Institute of Standards and Technology's Structures Division of the Center for Building Technology reports training is undertaken in Patran. In the Department of Veterans Affairs select personnel are trained by Intergraph at their training facility. Public Health Service reports that all training is provided through outside vendors.

4

SYSTEM MAINTENANCE

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

Maintenance contracts are in place for most equipment. Software and hardware maintenance is currently provided for the existing Graphic Engineering and Mapping System (GEMS) turnkey system. Microcomputer hardware maintenance is provided on an as required basis, with in-place contracts.

U.S. POSTAL SERVICE (USPS)

Office of Design and Construction

Maintenance of hardware is provided by vendors. Changes to specialized software is determined by the task forces formed to guide the programs. The changes are then implemented by the A/E that developed the software.

Office of Operations, Methods, Systems, and Quality

Maintenance is provided by vendors for one year and then by vendors on a service call basis.

DEPARTMENT OF VETERANS AFFAIRS (VA)

All locations with CAD have in-house specialists who provide daily support and occasional maintenance. A variety of maintenance methods are used. Some facilities have computer repair technicians or staff who do all in-house maintenance. Other sites perform some maintenance in-house and contract out the rest. Some locations contract out all maintenance.

PORT AUTHORITY OF NEW YORK AND NEW JERSEY (PANYNJ)

PANYNJ has a detailed maintenance agreement with ComputerVision, which provides for the following services: Response time priority; spare parts priority; uptime guarantee; discounts on training, documentation and software; new software releases; preventive maintenance; telephone support; second shift support; and annual vendor supplied productivity review.

The Port Authority's contract with Autodesk provides for bug fixes, and telephone support for AutoCAD. Software upgrades for AutoCAD, when available, may be obtained for a nominal fee.

ARMY CORPS OF ENGINEERS (CoE)

Most of the Intergraph sites have maintenance contracts with Intergraph. These contracts are fairly comprehensive and include coverage of both software updates and hardware maintenance and repair. The offices report varying levels of in-house technical expertise concerning hardware and software. Many offices rarely need outside support beyond initial setup.

The AutoCAD sites rely on a less centralized vendor support mechanism. Software updates are provided by Autodesk for all software while hardware platforms are supported by the hardware vendors. Some of the offices have service contracts with a vendor while others do not.

AutoCAD sites also rely on in-house technical expertise when hardware and software problems arise.

OTHER AGENCIES

NIST/CBT reports that all hardware is under hardware service contract; no software is under contract. At the PHS, hardware maintenance and software maintenance are provided on an "as-needed" basis with an outside vendor. NASA reports that hardware maintenance is done primarily by outside contractors with some done in-house. Software maintenance is provided by individual system resource manager or through outside contractors. GSA/PBS has maintenance agreements in preparation, from both vendors and contractors.

5

GRAPHICS CAPABILITIES REQUIRED OF PRIVATE ARCHITECTS AND ENGINEERS (A/Es)

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC requires digital submittals on photogrametric mapping and only those design projects where there is currently an identified follow-on use. The format for the submission is in either ComputerVision CADDS 4X, IGES, or AutoCAD DXF. Mapping standards for layering and symbology are required on digital submittals. As follow-on design requirements are defined and as standards are adopted for layering, symbols and other parameters, additional submittal requirements will be imposed.

U.S. POSTAL SERVICE (USPS)

Outside contracted A/Es are required by the Office of Design and Construction to have a CAD system capable of running Postal Service software if the purpose of the contract is the site adaptation of CAD based standard plans. For other facilities, the A/E's CAD capability is generally only a factor in the A/E selection process, but is not a mandatory requirement.

DEPARTMENT OF VETERANS AFFAIRS (DVA)

A small number of DVA facilities are starting to require the submission of project drawings and as-builts in a specific CAD format, but do not require the A/E to necessarily use the same system to create the drawings. The medical centers are starting to require that all CAD drawings utilize the national CAD Layer Guidelines as specified by the ACEC/AIA/ASCE/IFMA (American Consulting Engineers Council/American Institute of Architects/ American Society of Civil Engineers/International Facility Managers Association) Task Force on CAD Layer Guidelines. The DVA needs compatibility with its CAD systems, yet it has legal concerns.

GENERAL SERVICES ADMINISTRATION PUBLIC BUILDINGS SERVICE (GSA/PBS)

PBS requires the measurement of a building to determine its current layout and the input of this information together with an up-to-date assignment plan to a disk for subsequent GSA use.

ARMY CORPS OF ENGINEERS (CoE)

The vast majority of Corps work is contracted to A/E firms. Some offices strongly request that the A/E firm support the end product in a form that is compatible with the office's hardware/software set-up. Some offices are presently sorting out legal issues concerning the specification of certain platform. All of the offices expressed a growing need for compatibility of electronic information.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Some NASA centers required design for large projects to be done on a CADD system compatible with the NASA

center system. Some centers are permitted (not required) to use CAD. Their drawings will be translated to the NASA center system.

OTHER AGENCIES

The Department of State and the Port Authority of New York and New Jersey report no graphics capability requirements from outside contractors. The Public Health Service reports that new A/E contracts are stipulating that drawings be provided in AutoCAD format.

6

COMPUTER GRAPHICS PLANS

DEPARTMENT OF STATE (DoS)

DoS plans to install six workstations with AutoCAD in the near future.

NAVAL FACILITIES ENGINEERING COMMAND (NAVFAC)

NAVFAC's long range goal is to develop capabilities to collect, use and reuse intelligent graphics information throughout all phases of planning, design, construction and facility management.

NAVFAC is currently participating in a procurement for second generation computer graphics equipment through the Navy-wide CAD 2 initiative. This equipment will provide the mid- and high-end platforms and networking to accommodate the goal of integrating and passing information between disciplines and activities. The CAD 2 equipment will also provide the information storage and retrieval capabilities to allow building and maintaining multiple purpose facility information databases.

NAVFAC is procuring microcomputer-based graphics equipment and software to provide drafting graphics, cost engineering, specifications and engineering analysis. This equipment will link to the CAD 2 equipment and provide for low-end personal graphics workstations for small jobs and offices.

U.S. POSTAL SERVICE (USPS)

Office of Design and Construction

The current specialized software for the automated design of small and medium-sized post offices will be maintained and improved, based on field experience and additional needs as they are identified. A system for assembling functional modules to produce concept design drawings for vehicle maintenance facilities is completed and two projects have proceeded to full design and will be constructed in FY'91.

There are no plans for the in-house production of working drawings for new facilities.

Office of Operations, Methods, Systems, and Quality

There are now about 25 postal field locations using customized postal-CAD layout software. Several other locations are currently purchasing CAD systems. The office is now customizing CAD software for a mapping application. The facility service department is using the system to develop operating system designs and is currently installing the system at facility service centers.

GENERAL SERVICES ADMINISTRATION
PUBLIC BUILDINGS SERVICE (GSA/PBS)

A policy memorandum has been sent to all GSA regions in support of the use of CAD systems. In addition to the regions that already have systems, three additional are purchasing them. One region has its planned procurement on hold and a region with an existing system is planning a switch to AutoCAD.

PORT AUTHORITY OF NEW YORK AND NEW JERSEY (PANYNJ)

Over and above what is currently being accomplished with computer graphics at the Port Authority, plans are underway to increase our system productivity in the following ways:

1) Greater utilization of computerized analysis and design software which is integrated with CADD, and
2) Creation of graphical project databases via the application of "intelligence reporting" capabilities of CADD.

ARMY CORPS OF ENGINEERS (CoE)

CADD technology, properly applied, will provide the Corps the opportunity to significantly improve our efficiency and provide our customers a product that is of benefit far beyond the completion of construction.

In addition our Corps-wide CADD system will give us the vehicle to distribute standard designs. It will also allow us to share work and better respond in times of emergency and natural disaster.

We are implementing CADD technology by capitalizing on the tremendous wealth of talent in our field offices. The vehicle to make this possible is the CADD Center established at the Waterways Experiment Station. Although the CADD Center has a small staff of four or five it is the catalyst which is bringing this talent together in Single Discipline Task Groups (SDTG).

The management objectives of the CADD Center includes assistance in transition and start-up of new CADD installations. Coordination of technical design applications. Standardization of drawing details and file layout. Publishing lessons learned, and assisting the SDTG.

The mission of the SDTG includes taking a lead role in standardization efforts. Reviewing symbols and standards used in Corps offices. Reviewing and evaluating current computer applications. Acting as spokesperson on CADD areas in specific disciplines. Recommending new software

to be added to the CADD system and assisting the CADD Center in evaluation of software.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Some NASA centers will require complete in-house conversion of documents to their CADD system.