COMPUTER APPLICATIONS EQUIPMENT DATABASE

GRADUATE PROJECT

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ABSTRACT

This project is the construction of a computer-based equipment tracking system. The system, utilizing database technology, maintains information on the equipment administered by the Computer Services Department of CITGO Refining and Chemical Company's Corpus Christi Refinery.

The equipment system replaces a predominantly manual system. Replacement is scheduled to occur when a module for the physical inventory of the equipment is completed. This module will utilize bar-code technology in the physical inventory process.

Compared to the system it replaces, this project provides more reliable data on a wider range and volume of equipment. In addition, it provides maintenance history, warranty and maintenance contract information, and information on physical and network relationships between equipment. The system provides for input, update and inquiry via formatted displays. Reporting is provided through selected batch reports, and ad-hoc report generation packages.

The system is menu-driven. It utilizes database technology to maintain the integrity of the data, and to provide concurrent multi-user access. Routine activities are automated, reducing the time previously required to record them.

The goal for the system is to provide the above services while creating no additional demands on the Computer Services Department personnel. It is also intended that the system will not adversely impact the availability of the computer on which it runs.
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The Corpus Christi Refinery of the CITGO Refining and CHEMICALS Company had maintained a predominantly manual system for the tracking and reporting of the equipment administered by the Computer Services Department. This equipment, which is comprised of all data and voice processing, communication, and terminal equipment; has increased in volume and importance to the point where a more automated system was required.

The equipment system had several severe problems. The first was that there were no checks upon the quality and integrity of the data. Data could easily be obliterated, entered incorrectly, or duplicated. The system's data existed as a text file. Data was entered or changed in the file through the use of the DEC EDT text editor. The data was entered into the file as though it were being entered on a columnar report. The first several records of the file contained report and column headings.

In addition to data integrity problems, the system's reporting was very inflexible and time consuming. Information on individual items of equipment was obtained through the text editor's FIND command or by printing the entire file. Reports on subsets of equipment, or lists of equipment other than in existing order, required use of system sort utilities and text-editor block-manipulation commands.

Another problem associated with the original system was the lack of multi-user access. The system's data file was maintained by one individual who also performed most maintenance and installation of end-user terminal equipment. Frequently, however, persons other than this individual made changes in the equipment which was
tracked by the system. Often these changes were not entered into the system since those making the changes did not have access to the data file.

Finally, there were a number of data-items which the original system could not handle. The system was limited to the number of data-items that could be displayed on a single 132 character line. The system provided no data on maintenance history and maintenance contracts. No information was provided on equipment acquisition. The system also contained no information regarding the physical and network connections between equipment.

The original system was initiated when the volume of equipment was less than 100 items. At the current time the volume of equipment exceeds 1,000 items. This number consists of computer-user terminal equipment (terminals and printers), work-stations, personal computers, and data communications equipment. It is desirable, however, that the system include computer processor equipment, process control computer and terminal equipment, and telephone system equipment. The addition of these pieces of equipment to the system in turn would increase the volume to well over 2,000 items.

Over the past several years the volume and importance of computer and communication equipment at the refinery increased. For several years, capital expenditures on computer equipment have exceeded $500,000/year. This rate of expenditure is expected to continue for the foreseeable future. A project is well underway in the refinery to install a computer-aided manufacturing system to control and integrate all processing units. The telephone system within the refinery has recently been replaced and upgraded. This change has brought about an increased awareness of the cost, complexity, and importance of the telephone system. At the current rate, within a very few years, all functions within the refinery will be completely
dependent upon computer and communications equipment. The realization of these expenditures and dependencies have understandably resulted in increased management scrutiny. The volume of reports and questions regarding equipment have and will continue to increase.

The purpose of the project was, therefore, to develop a system which would provide asset tracking, maintenance tracking, and network connection information on all equipment administered by the refinery Computer Applications Group. The system was intended to maintain information with a minimum of effort. It was to be designed so that new types of equipment, increased volumes of equipment, additional data elements and additional reporting could be added with a minimum of effort.

The project was conceived and proposed in early 1990. The initial design work was done within the framework of the standards set by the Refinery Computer Applications Department. The initial decision was to use the INGRES database package, in conjunction with the Digital Equipment Corporations VAX FORTRAN language and the Digital Equipment Corporation VMS RTL Screen Management Facility (SMG). The INGRES package was the only database package at use at that time at the plant. FORTRAN and SMG were the standard within the department for programming language and screen generation.

During late 1990 and 1991, both the screen-management package and the database packages intended for the system were changed. The Digital Equipment Corporation screen-management package DECforms was introduced into the refinery environment in early 1991. The Digital Equipment Corporation VAX Rdb/VMS relational database package was introduced in late 1991. These packages soon became the department standard and the development of the system was revised to use the new
packages in place of INGRES and SMG. The INGRES package was completely eliminated from the refinery environment by 1992. The system’s design was finalized in late 1992. The system was completed in late 1993. The system is scheduled to be placed into production in early 1994.

The general approach taken in the development of this system involved the following steps, which will be elaborated on in succeeding pages.

1. Research the current equipment tracking system.
2. Obtain user requirements from the current and previous users of the original manual system, and from management personnel requesting information from the system.
3. Design a relational database system to meet requirements obtained from the system’s intended users.
4. Implement the database using VAX Rdb/VMS, FORTRAN, and DECforms.
5. Load and test the system with data taken from an actual physical inventory.
6. Develop user and system documentation
7. Provide user training.
8. Create a schedule of additional features and enhancements to be included into the system beyond the initial scope of this project.

The former system was documented by the examination of the data file. Over a period of years the increasing demands on this file had resulted in many of the columns having functional data which varied with the type of equipment listed on the particular line. In addition, some data columns had been eliminated without the removal of all the data contained in the column. The file was examined line-by-line, and all unique data-
items were listed. A list was made of the various reporting which had been produced from the system in the past, with emphasis being placed on those elements which were used for selection and sorting criteria. This information gathered from the old system provided a core of information for the new system and a basis for interviews with those using and making demands on the current system.

To obtain information on current and future needs and requirements for the system, interviews were held with the current and past users of the system, and with management personnel who require information from the system. These interviews resulted in a list of desired functions. These functions in turn provided a list of data-items which were not present in the old system. This list of data provided the basis for the database design.

Using the list of data elements from the old system and user requirements, a database design was developed. Tables and views were designed using An Introduction to Database Systems by C.J. Date as a guide. Standard techniques such as normalization of data were employed.

Following the design of the database the packages to be used in its implementation were studied and used in the creation of minor, unrelated applications. This portion of the project proved to be the most time-consuming, as neither the DECforms nor the VAX Rdb/VMS products had texts available suitable for use in learning the products. Only reference manuals were obtainable. The core group of panels, reports and programs were then produced.

In conjunction with the development, plant equipment data was obtained and entered into the database tables. This allowed for realistic testing of the system during the later stages of the development. In conjunction with the development of the
programs, reports, and panels, user and system documentation was developed. Near the end of the development, it was decided that a project would be undertaken to provide bar-code labels and related inventory procedures for all the equipment that would be handled by the system. With the added requirements of the labeling and associated reinventory of refinery equipment, the placement of the system into full production status was delayed until early 1994.