U.S. DEPARTMENT OF ENERGY'S AUTOMATED TRANSPORTATION MANAGEMENT SYSTEM

Roy F. Garrison, Ph.D.
Transportation Management Division
Office of Technology Development
U.S. Department of Energy
12800 Middlebrook Road, Suite 400
Germantown, MD 20874

Stanley A. (Stan) Harmen, Ph.D.
Manager, Automated Transportation Systems
Westinghouse Hanford Company
c/o U.S. Department of Energy
12800 Middlebrook Road, Suite 400
Germantown, MD 20874

James H. Portsmouth
Transportation Specialist
Westinghouse Hanford Company
(G2-02) P.O. Box 1970
Richland, WA 99352

ABSTRACT

The Automated Transportation System (ATMS), currently being developed by the Department of Energy (DOE), offers the capability of facilitating numerous tasks for that agency. This automated information system is made up of four main parts, each with its specific computer applications: (1) an Operational database to assist in the preparation of shipping documents and in tracking shipments of radioactive and hazardous materials or wastes; (2) a HAZMAT component to provide information for emergency response; (3) a Management Reporting and Analysis module to provide data retrieval for ad hoc querying and routine management reporting; and (4) an Historical component to serve essentially as an enhanced SMAC database. Functionally, the ATMS will provide support in most routine matters related to transportation operations management, such as rating and routing, prepayment auditing, and routine documentation. In addition, the system can be adapted to site-specific needs and provide data on rates, tariffs, hazardous materials transportation, and related matters. Finally, since the ATMS incorporates existing information systems such as RAMPAC and TRANSNET into the enhanced management database, access to it can provide the user with a wide range of useful tools including DOE-wide freight rates, carrier performance, and historical shipment information. All these applications will be particularly useful to those operations related to the transportation of radioactive and hazardous materials and wastes. Indeed, the capabilities of the ATMS promise increased safety, economy, and efficiency in all areas of DOE concern.

INTRODUCTION

Currently the U.S. Department of Energy (DOE) has approximately 80 transportation facilities throughout the Nation that specialize in science, engineering, technology, production, and waste management activities. These facilities vary in size from small laboratories to large industrial research plants such as the Savannah River site. The DOE differs from other government agencies in that these facilities are Government Owned and Contractor Operated (GOCO). At these facilities, each contractor transportation management operation operates somewhat differently because of internal and site specific procedures and reports to a DOE regional Field Office Traffic Manager (FOTM).

The DOE Transportation Management Division (TMD) has the overall responsibility to provide a well managed transportation program for the safe, efficient and economical transportation of DOE-owned material. Headquarters DOE TMD provides oversight responsibility, formulates policy, and conducts site appraisals to ascertain that DOE policies and procedures are being adhered to at the contractor level. As a part of its responsibility, TMD develops and administers department-wide transportation operations and traffic management policies and programs for materials, including radioactive materials, other hazardous materials, hazardous substances and hazardous wastes, pursuant to applicable Federal regulations (e.g., 49 CFR, 40 CFR).

Transportation has become an increasingly critical and integral part of DOE's business operations. Transportation issues regarding the shipment of radioactive materials and hazardous wastes are frequently the focus of public concerns. To more efficiently manage the transportation management functions of the DOE during the 1990's, an increase in the automation capabilities of the TMD will be required. A large, nationwide organization such as the

DOE, with an annual shipment volume of approximately 400,000 shipments requiring millions of business transactions, necessitates the establishment of automated procedures and controls to ensure that the transportation management process in being handled in a safe, efficient, and economical manner. As the mission of many DOE facilities changes from that of production of special nuclear materials for defense purposes to environmental restoration and waste management, the role of transportation management will become even more important to the safe and efficient movement of waste materials to prescribed locations.

In support of this task, the Automated Transportation Management System (ATMS) Program was conceived to assist the DOE and its contractors in the performance of their day-to-day transportation management activities. The ATMS program, utilizing the technology of the 1990's, will supply the automated tools to support DOE's transportation management in current and future physical distribution needs during the next decade.

The thrust for developing an ATMS program for the DOE comes from two directions. First, the developments in computer technology during the last decade have made it possible for transportation managers to utilize the powerful technologies available to them to build and maintain sophisticated, current transportation information databases, including the technology to track shipments of high-level radioactive waste shipments from origin to destination through the use of satellites. The use of Electronic Data Interchange (EDI) also makes it possible for the electronic, paperless exchange of shipping information, i.e., bills of lading and freight bills. This technology can eliminate the need to reformat or re-enter data received from different organizations due to computer compatibility problems.

Secondly, the DOE has been criticized (e.g., DOE Inspector General and DOE Tiger Teams) for not having an integrated, automated freight transportation management program, particularly in the areas of hazardous materials handling and freight bill payment and auditing functions. The recent DOE-IG findings state that "consistent use of low-cost carriers and verifying carrier invoice charges prior to payment would save DOE an estimated $3.2 million dollars annually." The ATMS program presently under development by the TMD is an integrated systems engineering approach to correct these conditions.

Recently many government agencies, including the DOE, have been taking a lead from their civilian counterparts and the carrier industry in studying the feasibility of automating various transportation management operations. Agencies within the Department of Defense (DOD) and the General Services Administration (GSA) are among the government institutions studying the feasibility of automating their transportation business transactions. In addition, automation of transportation management applications, including the use of EDI in the private sector (particularly among many Fortune 200 companies), has increased significantly since the Motor Carrier Deregulation Act of 1980. The U.S. Congress has also mandated in Public Law 99-627, which became effective November 7, 1986, that all government agencies study automating their transportation management activities. This law directed the GSA to establish an interagency task force for the purpose of studying the feasibility of developing an integrated, automated transportation management system that could be used by the various Federal agencies.

Through the collection and effective analysis of data describing shipment activities of the DOE, the ATMS will enable TMD executives and DOE field office and contractor traffic managers to take advantage of opportunities that were unavailable in the past. They will be able to:

- Perform more effective rate negotiations with carriers;
- Better understand where DOE's transportation dollars are spent;
- Track hazardous materials shipments more effectively;
- Analyze transportation patterns and carrier usage;
- Provide specific shipment information for emergency response;
- Track inventory and maintenance status of RAM and hazmat packagings.

The objective of the ATMS program is to effectively integrate existing DOE and contractor computer capabilities, as well as future planned applications, into a DOE-wide transportation information system. Although automated transportation management capabilities are currently available within the DOE, this endeavor has suffered from fragmented contractor efforts and a lack of common directional focus. Seeing that many contractors are working on similar computer applications in the transportation management area, ATMS will ensure no duplication of developmental efforts.

One important concern is that DOE transportation management staffs have suffered because of the retirement of many experienced traffic managers from both the DOE and contractor ranks. As a result, many TMD and contractor transportation management staffs are facing an increasingly complex transportation logistics environment with reduced levels of staffing and experience. Automation of some transportation activities then becomes a significant means for supplementing staff limitations.

The implementation of the ATMS program will provide DOE with many direct administrative and strategic benefits, namely:

- To provide reliable quantitative information to DOE management in a timely manner;
- To utilize available technological advances in order to reduce the current reliance on manual processes for the majority of its routine business functions;
- To provide DOE site installations with low-cost tools to perform expensive, labor-intensive functions;
- To integrate separate semi-automated and manual functions into a seamless, automated system;
- To provide for the DOE-wide implementation of EDI to reduce error rates on hazmat documents, streamline clerical efforts, reduce paperwork, and speed information transmission;
- To provide automated access to DOE-wide freight rates and routing as well as routing guides for making instant routing/rating/carrier selection;
- To automate the labor-intensive prepayment auditing of freight bills and save on money paid out to carriers.

Existing automated functional capabilities of the various contractors will be coupled into an integrated systems architecture. The Shipment Mobility Accountability Collection (SMAC) system database, which functions as DOE's historical database, is an example of an existing system that will be enhanced by the ATMS program. The SMAC database presently serves as a logistics management tool for DOE Operations Offices and their contractors for rate negotiations, monitoring carrier performance and reporting to management. As presently envisioned, carriers will be able to transmit freight billing and shipment status information directly to the historical database via EDI.

It is contemplated that enhanced SMAC will function in a similar capacity to a commercial third party network or Value Added Network. The SMAC database will be upgraded to function as an electronic mail box, receiving shipment status and freight bill information directly from carriers, and performing needed software translation services to convert data from a Transportation Data Coordinating Committee format to American National Standard Code Information Interchange (ASCII) file which is capable of being imported to a TMD database file. Data in the standard ASCII format can also be readily imported from SMAC into contractor site level computer systems for use in a number of applications such as procurement, prepayment freight bill auditing, or inventory management. An immediate advantage offered with the implementation of EDI is the dramatic reduction in effort and cost expended by the contractors in reporting and verifying their shipping activity to the current SMAC database. This process will greatly reduce data collection costs by allowing greater participation in the enhanced SMAC database by smaller site locations. Many DOE facilities presently do not participate in the current SMAC database, primarily because of the technical problems of uploading the data to SMAC in its current configuration. This obstacle would be eliminated by direct EDI communication links between carriers that DOE utilizes and the current SMAC database.

Figure 1 presents a conceptual view of the integrated ATMS system. The ATMS systems architecture will be comprised of several distinct application modules which are designed to perform specific functions for the DOE. Each application is integrated with (or interfaced to, where necessary) the other application modules to maintain a common database. This database will be maintained according to a rigorous systems architecture and specific data administration procedures. Figure 1 also distinguishes the four primary DOE transportation informational needs, categorized as 1) Operational, 2) Hazardous Materials (HAZMAT), 3) Management Reporting/Analysis, and 4) Historical data. Each of the four transportation information categories has specific computer applications that will assist TMD and its contractors in their daily operations.

The Operational database modules include functions such as carrier rate and routing selection which is predicated on identification of the lowest cost carrier rates for a particular shipment. It should be noted that this is a legal requirement for Federal agencies according to Public Law Number 99-627. Carrier freight bills will also undergo a prepayment audit to verify that the proper freight charges have been assessed by the carrier. The current status and locations of shipments, including hazardous materials and wastes, will be electronically ascertained utilizing EDI technology as well as direct computer connections with selected carriers. The preparation of shipping documents such as commercial and government bills of lading and export declaration forms, and the use of EDI and Electronic Funds Transfer (EFT) technology will be included in this component of the systems architecture design.

The HAZMAT database component of the ATMS will include such computer-generated output as emergency response data. The necessary Emergency Response Module will allow DOE TMD management, as well as operations personnel, to access needed information in order to respond to an emergency involving a DOE hazardous materials shipment. Specific shipment information relating to shipments of hazardous materials including radioactive materials and waste may prove to be invaluable in an accident scenario. It is also envisioned that the actual Department of Transportation (DOT) Emergency Response Guide (ERG) will be input into a database, utilizing currently available technology such as Optical Character Recognition (OCR). The computerized ERG database will then be

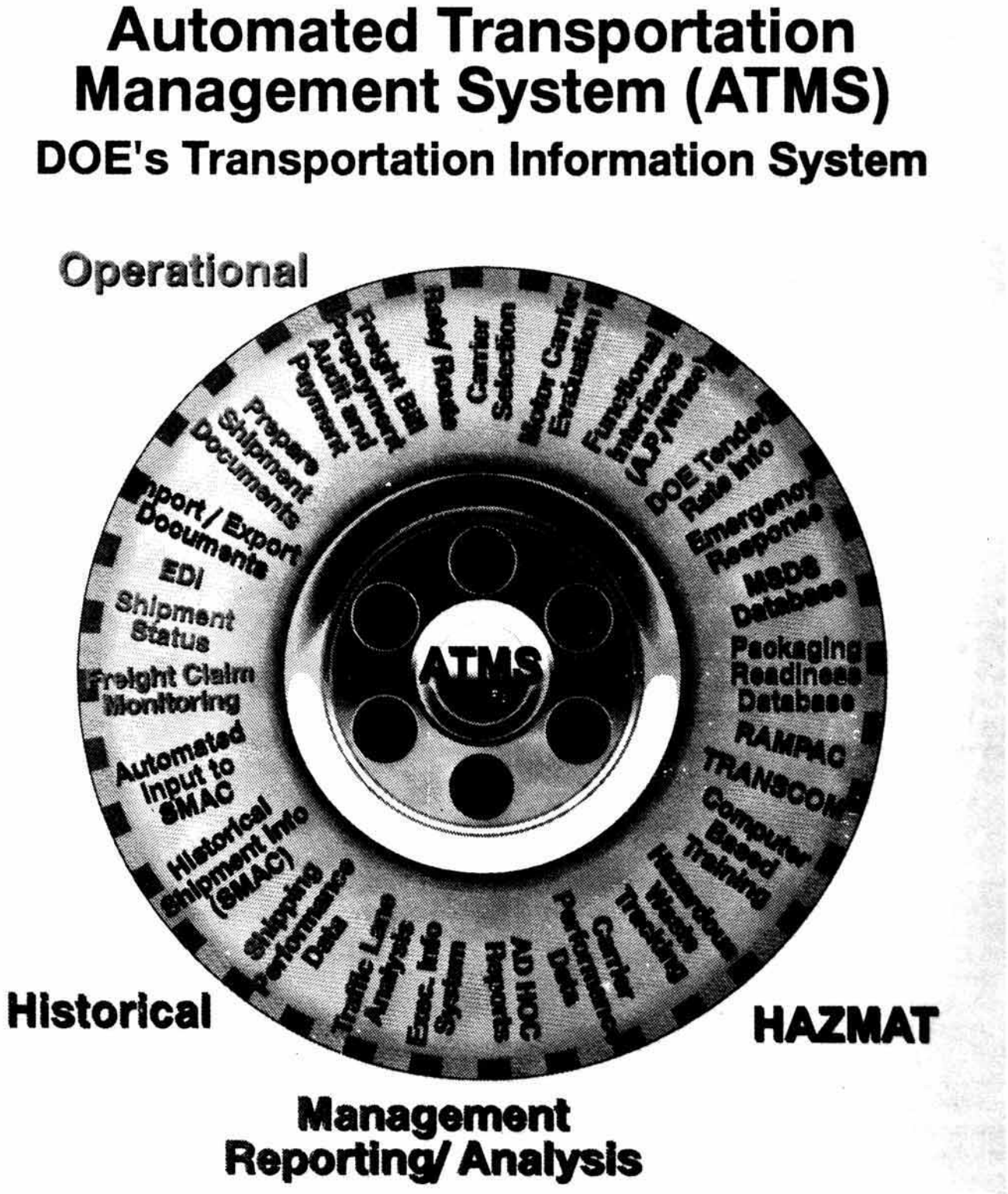

Fig. 1. Automated transportation management system (ATMS) DOE's transportation information system.

accessed in order to provide TMD operations personnel with emergency response information pertaining to each class of hazardous materials. This information will also be retrieved in printed format to accompany specific shipments of hazardous materials as required by a recent DOT communications regulation in HM-126-C.

The HAZMAT database module of ATMS will furthermore incorporate information from the Radioactive Material Packaging (RAMPAC) and the Packaging Readiness Database (PRD) data as an informational tool to allows users to verify the technical descriptors of containers (e.g., cask cavity dimensions, approved radionuclide contents), container inventory, and present locations of usable nuclear containers.

Another functional capacity of the HAZMAT module of the ATMS will include TRANSCOM, which is an ATMS communication system utilizing the technologies of navigation, satellite communication, and computerized database management, to provide near-real-time position locations and two-way messaging capability for the movement of selected radioactive materials shipments anywhere in the United States.

An interface of the ATMS system to hazardous waste tracking systems of individual facilities will be made available. This will allow DOE to monitor and track hazardous materials chemicals from the time they are procured, through the transportation process, and until they are received by the DOE shipping and receiving facility. These chemical shipments will be tracked further from the warehouse inventory complex, through the use of bar coding technology, at a DOE facility through the plant usage cycle. When a chemical is no longer usable by the DOE facility, it will be tracked through the waste accumulation and disposal phase until it is shipped offsite to an Environmental Protection Agency Transportation, Storage and Disposal (TSD) facility for ultimate disposal.

The Management Reporting and Analysis module of the ATMS system will provide a data retrieval capability for both ad hoc querying and routine management reporting. Specific transportation information will include carrier performance, shipment volumes by traffic lane and by shipping location, as well as DOE shipper performance data such as the percentage of inbound shipments procured FOB origin versus FOB destination. An Executive Information System (EIS) will be developed to provide TMD and senior DOE management with access to information needed to better manage and control the day-to-day transportation management activities of the DOE.

The Historical component of the ATMS systems architecture consists primarily of an enhanced SMAC database. The current SMAC database serves as the central source of historical shipment information on DOE's unclassified commercial shipments, including both hazardous and non-hazardous shipments. The new ATMS database will serve as a central source of data utilized extensively for responding to requests for all types of shipping and receiving information. An automated interface to the ATMS database via an EDI link between the carriers and the field office site locations will enable the collection of historical data to be performed automatically by the carrier, thereby dramatically reducing the present, labor-intensive data entry process.

A strategic plan for the ATMS program was developed in Fiscal Year (FY) 1989 along with a preliminary conceptual systems architecture. A planned product for FY 91 is to develop an Information Strategy Plan (ISP) using Information Engineering Methodology and Computer Aided Engineering Tools (CASE). The ISP will provide "high level" architectures which will act as the "blueprint" from which the ATMS will be derived. A functional requirement of the ATMS as defined in the original "Department of Energy/Contractor Electronic Data Interchange Task Force Automated Transportation Management Strategic Plan" was that individual DOE sites will fund and develop their own ATMS computer applications to meet their own unique requirements. Because of the decentralized nature of the DOE field office organizations and the fact that most DOE facilities are operated by various contractors, it has been recognized that a certain amount of autonomy is necessary in the development of any ATMS. Conversely, a need for some data such as that concerning historical shipment information, HAZMAT, and Emergency Response to be available at a centralized database location was acknowledged. In response to the varying degrees of need at different management levels for transportation data, as well as other factors, it has been decided that a computer system which will function at both the site and TMD level is needed.

Figure 2 shows a diagram of the Distributed ATMS Functional Concept. The large circle on the left side of the diagram depicts the automated functions which would be performed at the site level, using microcomputers (PC's), which are readily available throughout the DOE and contractor organizations. (The option to download these applications to local work stations from a host computer may also be available.) The input of inbound and/or outbound shipment data into the ATMS historical database, which will reside at the central database location (depicted in the smaller circle on the right hand side of the Fig. 2), will also be stored at the site level. As mentioned before, it is proposed that a direct EDI link between the carriers which DOE and its contractors regularly utilize and the historical ATMS database be initiated. This will significantly reduce the data input required at the local level. However, even with a direct EDI interface between the carriers and the

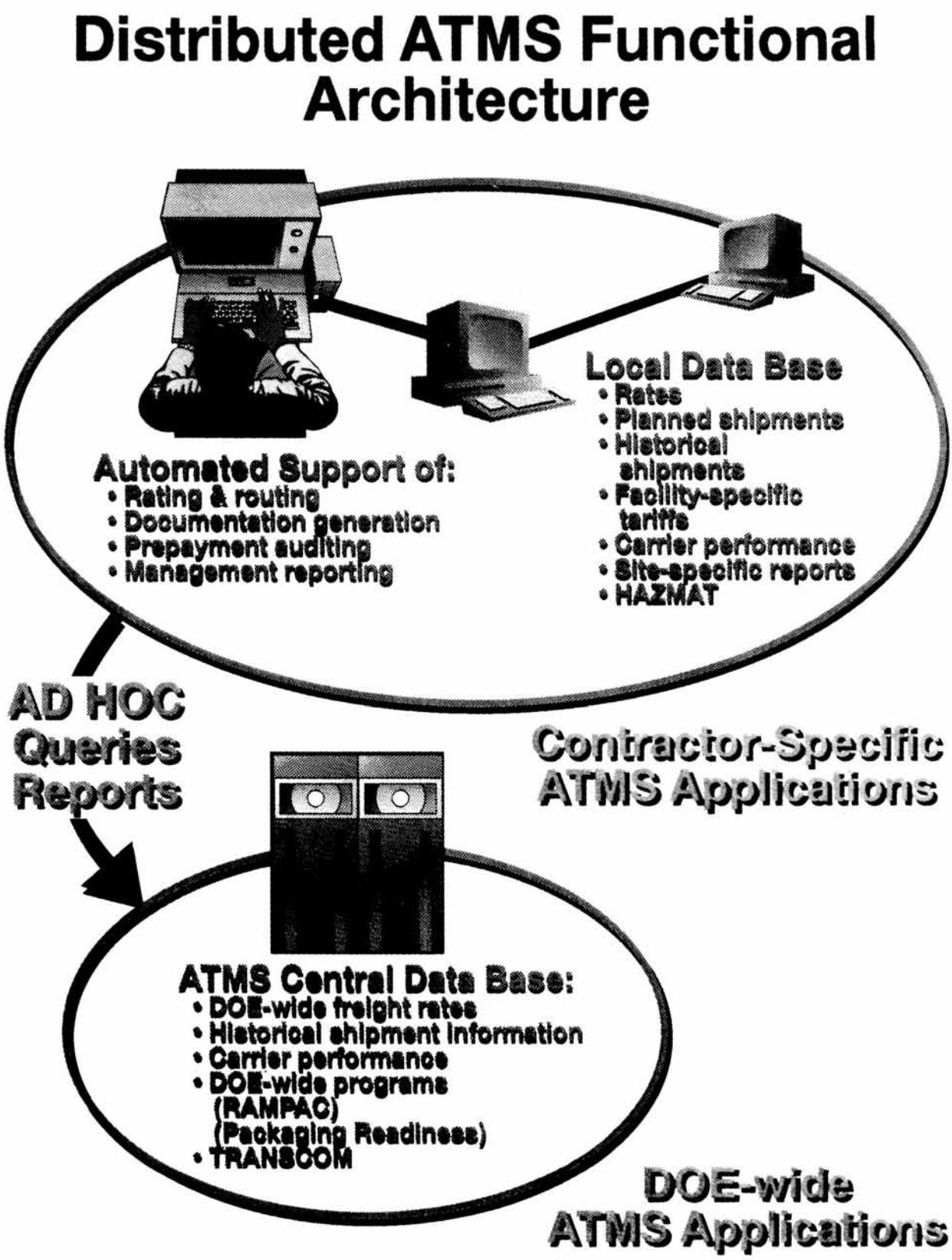

Fig. 2. Distributed ATMS functional architecture.

historical database, a certain amount of data entry at the local level cannot be avoided.

As previously stated, a primary goal of the ATMS program is to provide an integrated computer system capability to assist DOE and contractor transportation operation personnel in successfully processing the thousands of transactions needed to meet the day-to-day requirements. Certainly, a PC-based distributed ATMS concept will allow for the site transportation management functions to interface more effectively with other functions of the DOE or contractor organization. An essential requirement for DOE is that a data interface be developed between the transportation management functions of an organization and site functions such as accounts payable, procurement, and warehousing. A DOE-wide, centralized, mainframe-based ATMS architecture will encounter many technical and political difficulties in attempting to integrate the multitude of the various contractors' software and operating platforms into one centralized system. Therefore, a distributed PC-based systems architecture is thought to be the most effective short-term solution to TMD's automation needs. This PC-based solution will then be integrated with mainframe capabilities to provide a long-term solution in what will truly be a distributed national system.

Figure 2 also pictures the central database in the smaller of the two circles. A feature of this long-term solution is a central TMD database that will incorporate elements of the SMAC historical database, now the central repository of DOE shipment information for hazardous and non-hazardous shipments. The conceptual design of the ATMS central database will, moreover, include other functions, such as a DOE-wide repository of data on carrier performance information to be used by TMD management to identify unresponsive carriers. This will aid site contractors in their carrier rate negotiations. Another ATMS module will be developed to serve as a repository of information collected by DOE on carriers who are utilized to transport truckload quantities of radioactive materials as well as radioactive and hazardous wastes. At present this information is gathered through onsite visits to carrier facilities, from an annual questionnaire completed by the carriers, and from reports obtained from the Office of Motor Carriers, Federal Highway Administration. All this information is now maintained only in hard copy format. However, future plans for the ATMS Motor Carrier Evaluation module call for this data to be placed in an electronic data format capable of being downloaded from the ATMS central computer to a DOE site traffic manager's PC.

At the same time, the ATMS central computer will host computer programs such as RAMPAC and PRD, two radioactive materials packaging and container inventory/location databases. The purpose of these packaging modules on the ATMS is to provide site operations personnel with access information on nuclear containers to ascertain that these packages are properly tested, maintained, and certified to transport radioactive materials and/or wastes.

An additional module on the ATMS host computer will be a carrier selection module. The DOE nationwide freight rates and carrier tenders will also be stored and maintained at the TMD level. With this information all site locations will have immediate access to up-to-date carrier pricing data for the shipments of DOE-owned materials to compare with localized rating and routing information. The ATMS screens will permit easy-to-use comparisons for all local traffic managers.

In order to integrate and coordinate all participating DOE contractor and carrier sites, the central ATMS system will collect and distribute non-secured information from the local ATMS site facilities. The information transferred to and from the host computer and the site facilities locations will be networked by any number of available communications methods yet to be determined (e.g., dedicated telephone line, modem, tape-to-tape exchange, and so forth).

As planned, the deployment of the ATMS will move forward in FY 91 utilizing a two-pronged, high technology-low technology approach. Under the high technology approach, the systems architecture for the ATMS will be developed. An ISP utilizing CASE tools will be created in order to provide architectures for effectively integrating the cross-site computer applications into a distributed functional architecture. In addition, a functional requirements document for the ATMS program will be created utilizing CASE tools to define process decompositions and will be accomplished during FY 91. A DOE-wide hardware analysis for evaluating a distributed system approach versus a central host computer design for the ATMS will also be conducted. A prototype EIS to make transportation information immediately available to TMD executives will be initiated under the high technology approach. Also scheduled for development in FY 91 is an ATMS Standards and Procedures Document as well as an implementation plan for the 1990's.

The primary thrust of the ATMS low technology approach is to provide day-to-day automated support to those performing transportation management activities. The low technology approach to the implementation of the ATMS program will concentrate on delivering micro-based software tools to the field office and contractor elements of the DOE organization as soon as possible. Currently available government or commercial transportation management software packages that have an identified potential utility to the ATMS program will be distributed to selected DOE sites. A pilot project location(s) will also be specified to implement the prototype programs. This pilot project approach, at one location where a field module is completed, is the standard method for implementing a national system.

This field module is then to be replicated site by site across DOE. Furthermore, the development of initial EDI capability between the central ATMS database, the carriers, and site locations will be established during the low technology approach.

A DOE-wide ATMS Task Force has recently been formed to provide guidance and establish policy direction for the implementation of an integrated ATMS. The Task Force, comprised of individuals from several major DOE field office locations, will report regularly to the DOE Manager, Transportation Operations and Traffic Headquarters. It is the goal of the ATMS Task Force to get as many contractor and DOE field office locations as possible moving forward together as a unified team towards the successful implementation of the ATMS program.

The need for an ATMS program at the DOE national level is not a perceived need, but one that is instead very real. As the DOE moves ahead during the decade of the 1990's, it is going to require more timely information to accomplish its mission of energy research and development, continued production of special nuclear materials for defense purposes, and effective environmental management and site restoration.

An integrated DOE transportation system is needed to provide DOE transportation and environmental management executives the needed tools and information to assist in the accomplishment of their very important mission. The task of the ATMS program is to develop and deploy this transportation information system at the national and site level. The ATMS will assist TMD to move from the current "islands of automation" environment to one of an integrated system capable of providing a seamless flow of information throughout the TMD infrastructure.

CONCLUSION

ATMS program system architecture is being developed to support the vast majority of TMD operational and informational requirements for transporting hazardous materials (including radioactive materials) and non-hazardous materials utilized in the day-to-day operations of the DOE plant facilities. The ATMS program will also provide updated shipment status information of materials en route, including the locations of radioactive and hazardous waste shipments. The capability to perform required management reporting and administrative functions, such as the prepayment auditing and payment of freight bills, will also be possible. Ultimately, it is envisioned that a DOE or contractor traffic manager would be able to perform virtually all basic and repetitive activities via automated tools provided by the ATMS program.