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EXPERIMENTAL TEST CONCEPT FOR A CARGO DATA INTERCHANGE SYSTEM (CARDIS)
Volume I: Text

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16. Abstract

This report includes the recommended CARDIS experimental test system functional capabilities. It identifies the CARDIS functions that are inherent to an information exchange capability and optional systems which are required by the transportation related industries.

The criteria to evaluate the various system functions selected for implementation by test participants are included as are the CARDIS test objectives.

Volume I contains the CARDIS test concept, functional analysis, and test objectives.

Volume II contains the details on CARDIS functional modules.

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PREFACE

Volume I of Computer Sciences Corporation's report on the CARDIS concept is concerned primarily with developing a test concept that can be used to evaluate various functions that are associated with a CARDIS-compatible computer facility. The three categories of CARDIS functions identified include those functions that perform basic operations required to transmit data between transportation industry participants, functions that are common to all, and functions that perform specific user operations required only by various segments of the transportation industry.

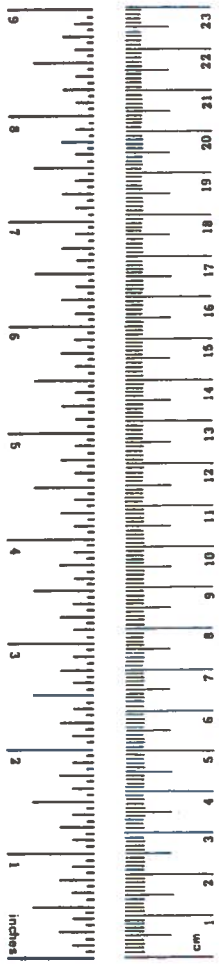
Volume I contains all of the test CARDIS concept information and recommendations.

Volume II is methodological in character and may be consulted to obtain details of CARDIS functions. Volume II includes the analysis and rating criteria of some candidate CARDIS functions.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

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SECTION 1 - SUMMARY AND CONCLUSIONS

1.1 INTRODUCTION

This report is the result of work performed by CSC staff members in completing the CARDIS, Phase II, Contract between CSC and the Department of Transportation. Generally, the report reflects a further definition of the CARDIS concepts developed by:

1. Staff review of the CARDIS Phase I reports prepared by CSC, NCITD, and TDCC; and European reports on transportation documentation
2. Industry and transportation meetings on documentation and communication
3. Review of reports published by the Economic Commission for Europe (ECE) and other international organizations
4. Numerous meetings with members of DOT CARDIS Coordinating Committee and ad hoc CARDIS Test Plan Committee
5. Analysis of data processing industries and communication networks.

Although some effort has been made toward further development and definition of CARDIS concepts, the main thrust of this report is to describe an experimental CARDIS system and to develop a rational program of testing that will test the validity of the claims that have been advanced in support of a domestic and international data exchange system to serve the needs of the trade and transportation community.

1.2 BACKGROUND

The CSC Phase I CARDIS report, dated March 1975, contains three widely divergent and basic concepts as alternatives for either an experimental or operational CARDIS system. Briefly, the three concepts are:

1. A simple circuit-switching communications network linking user-controlled data bases

2. A more advanced message-switched data communication network that links user-controlled data bases supplemented by a limited amount of specialized CARDIS software

3. An all-encompassing central data base for use by all parties to the trade and transport process.

This latter concept of CARDIS would include the storage of all data needed to support all the transport functions, the storage of all user application programs, and the processing of all data included in the data base. The report concluded that existing computer and communications technology could support any of the three concepts.

The TDCC Phase I CARDIS report contained descriptions of the message formats recommended to transmit data needed to support the various functions included in the shipper/carrier transportation process. Message formats for air, ocean, rail, and truck modes are included, which support the services of freight forwarders, banks, insurance, equipment leasing companies, and government agencies. The report also contains a compilation of recommended methods of coding the various data elements used in the message formats.

The NCITD Phase I CARDIS report contains a listing of the documents used in international trade and the various elements of information included in each of the documents, together with information about the source and use of each data element. NCITD, by survey of its membership, assigned a priority rating to each international trade document. Priorities must now be established for the CARDIS functions which are needed to produce the necessary documentation required by the domestic and international trading community.

Other reports germane to the CARDIS program were reviewed. These included reports from COSTPRO of Canada, American Trucking Association, Inc. (ATA), Association of American Railroads (AAR), and reports published by the Economic Commission for Europe (ECE).

Many of the systems and concepts outlined in these reports are in the formative stage and are, therefore, subject to change. For example,the INTERFACE program

being pursued by England and several other European countries, appears, in its present form, to be oriented to the electronic exchange of data between human participants. This approach is not completely compatible with the concept of direct computer to computer interchange of data as contemplated for CARDIS. Current system specifications will provide for the flow of data from the CARDIS system to INTERFACE without human intervention. However, the reverse flow may present some difficulties in this regard; and, unless conversion programs can be developed to perform this function, countries using INTERFACE will be at a disadvantage in communicating to CARDIS.

1.3 THE CARDIS NETWORK

CARDIS is also evolving. The CSC staff analyses of the aforementioned studies, and discussions of the CARDIS Test Committee and CARDIS Coordinating Committee of DOT, leads us to the following basic conclusions about CARDIS:

> Much of the information to be processed by any future CARDIS facility is of vital interest to the parties involved and has a commercial value. Therefore, there is at least some potential for improper use of any system organized around the concept of a single or a limited number of data bases. In addition, the catastrophic failure of such a system would create business problems almost beyond the scope of human understanding.
>
> On the other hand, there are numerous problems associated with a simple circuit-switching network. These problems extend far beyond the more obvious difficulties created by the technical incompatibility of the many different types of computer and communications hardware in use today. With sufficient incentive, such problems can be solved where the number of communicants is limited. On a generalized, international basis, however, this problem becomes insurmountable. In addition, circuit-switched communications require an active circuit between sender and receiver during the time required for message transmission. This, necessarily, presupposes the availability of a connection at the time desired and an

operating computer facility at both ends of the line. On a global basis, given the problems of time zone differences, "normal" business hours, equipment down time for maintenance and repair, and circuit availability, circuit-switching appears to have little to offer. For these reasons, a communication system based upon the message-switching concept that allows the sender and receiver of a message to operate independently of each other--not only in terms of operating flexibility but in terms of equipment compatibility--seems to be the most viable approach.

The first two conclusions lead logically to the third: that the CARDIS distributed data base concept is the most viable approach. Future design and development effort should be directed towards linking user-controlled data bases with a message switching communications service that utilizes any one or more existing or future communications common carrier licensed by the FCC to transmit computer readable data or any value added network that processes and transmits data.

1.4 THE CARDIS USER

CARDIS users will have access to the network via a "CARDIS COMPATIBLE" Computer-Communications facility. The actual configuration of these network interfaces will vary according to the needs of the user. For example, a company may choose to design its own software module as an interface between the corporate computer center and the CARDIS network. Other users, for various reasons, may be using a local timesharing computer facility for their continuing data processing activities. In these instances, the timesharing company might be asked to develop a CARDIS interface capability.

During the course of this study, CSC personnel identified five different categories or types of CARDIS-compatible facilities which are described in detail in Paragraph 2.2. As noted previously, these interface capabilities can be operated by a company for its own use, by a timesharing facility for its customers, or by some Government agency such as a port authority, Customs Office, or any other agency

with an interest in trade or transportation. The technical configuration of each CARDIS interface will vary according to the needs of the user. However, the one common characteristic of each such facility will be the ability to exchange data between that facility and any other CARDIS-compatible facility without manual manipulation of the data.

1.4.1 CARDIS Concept Outline

Figure 1-1 illustrates the three basic relationships that exist between CARDIS and the users. The numbers (1), (2), and (6) represent users that operate in-house computer facilities, including a CARDIS software interface. These users are connected directly with either a value added or data communications network offering CARDIS services. Number (8) represents a user that operates an in-house computer facility but chooses to have a local data processing company provide interface to CARDIS. Number (7) represents a user that prefers to use the services of a local data processing company for both internal and external data processing.

Both CARDIS and non-CARDIS messages may be processed through this arrangement. For example, if a manufacturer wants to communicate between his various production facilities, there is no need to adhere to CARDIS standards; communication can take place as the sender and receiver agree to some common system for coding and formatting data. CARDIS standards have been developed to facilitate the free flow of trade and transportation data among all users of CARDIS.

As an example of how CARDIS works, consider the following:

> "Mass-Production Exports" (1) uses an in-house computer system to monitor the production, inventory, order entry, accounting, and physical distribution activities of the company. Internal data processing standards govern the coding, filing, and handling of all data. To allow connection with CARDIS, the company has developed a CARDIS interface software package.
>
> Whenever a shipment is to be arranged, internal software is used to select appropriate data elements from the corporate data base (or to accept the

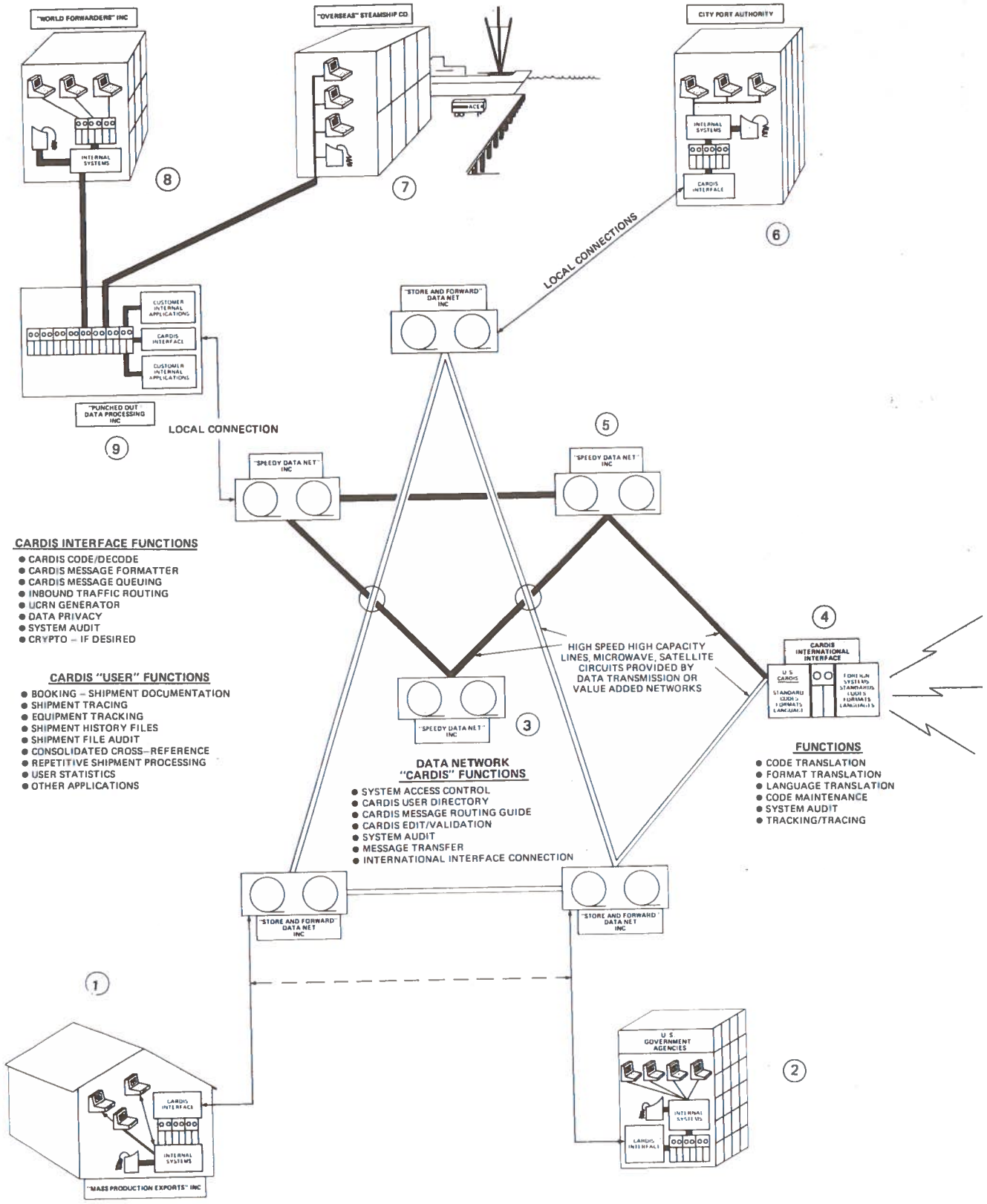


Figure 1-1. Basic CARDIS/User Relationships

data from a data terminal). These data elements are then passed through the user-transparent CARDIS interface to translate corporate codes to CARDIS standard codes and to arrange the data into the appropriate CARDIS message format. If desired, the CARDIS interface may be designed to encrypt outgoing data when additional security is needed.

The CARDIS interface assigns a Unique Consignment Reference Number (UCRN) to the shipment and places the message in an outbound queue in accordance with a priority assigned by the shipping department.

Store and Forward Datanet Inc. (3) is contacted with a coded password which identifies the sender and prevents unauthorized access to CARDIS. The message is passed to Store and Forward Inc. who then routes the message to World Forwarders (8) via Speedy Datanet Inc. (5). Speedy Datanet passes the message to World Forwarders via Punched-Out Data Processing Company (9) who provide CARDIS interface services. After the incoming message has been translated into World Forwarders' data record formats, the data is passed to World Forwarders for internal processing.

The same basic procedure is used to pass information from World Forwarders to the Overseas Steamship Company (7) ; by Overseas to pass outbound manifest information to U.S. Customs (2) ; to City Port Authority (6) ; to the overseas offices of the steamship company, and to foreign customs authorities via the International CARDIS interface (4) where translation to foreign data standards occurs.

1.5 MEASURING THE COST/BENEFITS OF CARDIS

Much has been said about the apparent CARDIS cost/benefits and the need for data to support a cost/benefit analysis of the CARDIS system before committing substantial resources for research and development. In our view, the present stage of CARDIS does not provide support for any detailed technical or economic conclusions

about the future prospects for electronic transfer of transportation related information. It is clear that electronic data transmission of all types of business information is growing at an almost explosive rate. Data communications technology, satellite communications technology, computer-controlled communications scheduling, and routing technology are changing the economics of data communications on almost a daily basis. The rapid growth of business use of this new technology on a routine basis would seem to support the idea that there is an underlying and positive cost/benefit ratio in this new approach. If that is so, logical extrapolation would seem to indicate that the same benefits would apply to the transmission of transportation related business data.

Meanwhile, the cost of manually prepared transportation documentation continues to increase. The 1971 DOT/NCITD Study "Paperwork or Profits" estimated that the 18 million U.S. foreign trade shipments generated paperwork costs of about 6.5 billion dollars or 7.5 percent of the value of the items shipped. Some transportation specialists have estimated that CARDIS could reduce the cost of documentation preparation by 40 to 60 percent. Since 1971, the value of U.S. foreign trade has more than doubled, which would seem to indicate that the cost generated by trade-related paperwork now exceeds some 20 billion dollars or more than 35 percent of the gross income of American Telephone and Telegraph, a company that provides communication facilities and networks that serve many millions of individuals and all the industries in the United States, including the transportation-related industries.

The CARDIS communications network would only require an insignificant part of the data transmission capability available from AT&T, MCI, and all of the other communication companies.

In 1974, there were some 300,000 business firms in operation in the United States. Six percent, or about 20,000 firms, regularly export commodities. Of this number, 250 companies account for about one half of all exports. Based on this, it is apparent that CARDIS will serve a relatively small number of subscribers. Even if all business firms in the U.S. interface with CARDIS, the number of subscribers would require fewer than 10 percent of the number of telephones in the Washington, D.C.

metropolitan area. The C&P Telephone Company, a system containing more than 7 million telephones, makes a reasonable profit with annual revenues of less than 1.5 billion. CARDIS is attempting to resolve a 20 billion dollar communications problem which needs fewer than 4 percent of the communication nodes included in the C&P system. It is obvious, therefore, that significant savings will accrue to CARDIS' users. Although CARDIS will extend to foreign countries, it will be a small system in comparison. At this time there are no reliable estimates of either development or operating costs for CARDIS. CARDIS will require research and experimentation to obtain the basic information needed to form the necessary operating and economic value judgements. However, the information available justifies proceeding with this necessary program of research.

1.6 CARDIS STANDARDS

Computer to computer data communications normally require both parties to use compatible equipment, communication protocol, identical data element codes and message formats.

It should be noted that CARDIS is intended for a whole community of users, many of whom already use computers in their day to day operations. There is a variety of computer hardware, software configurations, and communications techniques already being used by potential CARDIS users.

The use of existing data communications services for the transmission of CARDIS data will allow communication between users of dissimilar equipment. A network, however, cannot solve the problem of dissimilar data element codes and message formats. Without some agreement on these matters, data received via the CARDIS network would be meaningless.

In the United States, TDCC has contributed greatly to the creation of a common standard for coding and formatting transportation-related data. SITPRO has been working to develop similar standards in England. Groups of experts in the fields of transportation, data processing, and international data standards have been convened

by the ECE to study the creation of international data coding and formatting standards that can be used to transmit trade and transportation-related data.

CSC's review of the various documents and studies concerned with this matter leads to a conclusion that the establishment of international standards in this area may be years away. Different commercial customs and practices, legal environments, levels of technical development of computers, communications technology, and even national preference and pride, can slow this work. However, the lack of a single set of international standards for coding and formatting CARDIS data need not delay or halt development of a CARDIS system for the United States. It is technically possible to build an "international (software) interface" to convert U.S. data element codes and message formats to those used in another nation. Therefore, the natural conclusion derived stipulates that the United States should proceed with the development of CARDIS and anticipate the development of necessary software conversion programs to interface with foreign systems.

1.7 CARDIS TEST

Considerable effort has been expended by both Government and industry in the United States to bring CARDIS to its present state of development. Progress has been made towards eliminating unnecessary trade documents and the simplification and standardization of those trade documents still considered necessary. Some data standards have been developed to facilitate the transmission of trade data. Computer and communications technologies have been examined to determine if these rapidly developing technologies can contribute towards attainment of the goals of CARDIS. The ability to transmit data between two computer facilities of differing design via a communications network is already well established and is common practice in the commercial sector. The goal of the CARDIS test is to determine if a system can be developed to extend this interchange of data to include all industry participants.

In addition, CARDIS functional benefits must be measured using the criteria listed in Paragraph 4.4 to more accurately evaluate the substantial benefits which will be derived from CARDIS participation. Other long term benefits will be more difficult

to access. Computer systems of the future will be designed to take advantage of CARDIS, more industries and Government agencies will participate, additional countries will have interface capabilities, other CARDIS improvements will be developed, and operations personnel will become more efficient in processing data via CARDIS.

To date, most CARDIS-related progress has been in developing conceptual plans. It is apparent that future progress in the establishment of a viable CARDIS program will depend on a realistic test of present CARDIS concepts. There is a need to determine whether the data codes and message formats that have been developed will be capable of processing data in the operational environments. Tests must be conducted to determine if the concept of distributed user-controlled data bases can interface with the proposed CARDIS network, if existing data communication networks can be integrated, and whether the concept of an international interface network is valid.

Other tests must be conducted to evaluate security and privacy concepts that have been developed to determine if they are, in fact, valid. The economies of CARDIS are still rather elusive; the capital and operating costs must be determined by tests. Once it is proved that CARDIS can generate a positive cost/benefit ratio, demonstrations, backed up by solid evidence in the form of statistical reports must be disseminated to the private sector and Government agencies to convince them of the opportunities available through the CARDIS program.

However, all of the preceding, which are key to the future of CARDIS, depend upon a well conceived and well executed program of testing, evaluation, and system refinement. These basic CARDIS test concepts are described in Section 4.

1.8 CSC CARDIS TEST CONCLUSIONS

CSC firmly believes that the testing of CARDIS as a concept must begin now. Significant work already completed by CSC, DOT, NCITD, and TDCC has defined many of the features that must be a part of a communications network needed by the transportation industry. Other organizations, including IMCO, ISO, ECE, ATA, and AAR, have developed standard data codes for selected data elements and standard formats for many of the documents required by private companies and Government agencies.

Many of the candidate test participants in the United States already have developed computer systems that perform necessary functions such as equipment control, manifest preparation, dock receipts, bills of lading, accounts receivable, and cargo booking systems. The dilemma that these companies now are faced with is that they do not have the ability to transmit this data, which is already in computer readable format, to any other company or Government agency. And yet, the technology to perform them exists. There are extensive communications networks throughout the entire trading world which utilize transoceanic cables, satellites, and sophisticated communication switching centers that can transmit data at rates ranging from 6 characters per second to over 1200 characters per second. There are many different terminals which can be used to enter and/or receive data from the CARDIS network. For instance, there are CRTs, serial printers, line printers, and various types of minicomputers or intelligent terminals.

The transportation industries and shippers must now develop and test message formats and establish transmission conventions which will enable them to communicate much of this information directly between computers. In fact, several companies have already made such agreements on an isolated basis. In effect, they have developed their own version of CARDIS. The only problem is that these companies must develop a separate CARDIS system that has unique characteristics with each company they deal with. This is an impossible task and in the long term will prove impractical.

CSC is convinced that it is imperative for DOT to take the lead to develop one standard CARDIS convention for processing data which can be implemented in any computer facility or commercial communication environment. Thus, one set of standard codes, message formats, and transmission techniques will enable data interchange whenever necessary. The detailed CARDIS system specifications can only be developed through iterative testing for several reasons. First, the industry test participants must be identified and contacted to determine what their needs are and to establish their priorities for testing each of these functions. Secondly, the

CARDIS test will be a modular system test. The initial CARDIS test site will include only those functions that are necessary to receive data from one site, store it until the addressee is available to receive the data, and then transmit it on to its final destination. Other functions may then be added as determined by the participants in a modular fashion during later phases of the test development program.

Other aspects of CARDIS modularity include the concept that initially the test network will probably include selected shippers, carriers, and freight forwarders. As testing progresses and the systems check out, additional test participants will be invited to interface with the CARDIS test center, thus extending the transmission of data into other carrier facilities, Government agencies including Customs and the Bureau of the Census, and other transportation and trade related activities.

The next obvious step in the progression of CARDIS testing would be to transmit the data to foreign countries. There are several operational systems, such as LACES in London Airport, SOFIA at Paris airports, and the French TRIM system which is proposed for the ports of Marseilles and Le Havre. Other countries are in various stages of developing systems which should eventually be capable of interfacing with CARDIS.

The CARDIS test concept's three dimensions of modularity are:

Number and categories of participants

System applications

Geographic area, i.e., countries who will participate in the later stages of testing.

We believe that CARDIS will ultimately be defined through the test program as various functions are tested and developed to economically meet the needs of the transportation industry.

SECTION 2 - CARDIS CONCEPT DEFINITION

2.1 CARDIS TEST FACILITY

The development of a test CARDIS experimental system concept should employ the modified distributed data base concept originally developed in the CSC's Phase I CARDIS Report. The "Multiple CARDIS" concept will provide a communications capability for each of the participants involved in the many aspects of the transportation industry. This communication capability will vary significantly in complexity and sophistication in the applications available to each user. CARDIS must be versatile in design so as to be capable of processing data from virtually every type of terminal.

A CARDIS computer facility might be run by a single company such as an ocean carrier, railroad company; or a freight forwarder; or the CARDIS facility could be operated by a commercial timesharing company.

The CARDIS participants can be categorized into two major groupings; namely, the CARDIS operator who has access to a CARDIS compatible facility which is capable of processing the data received in some way, and the CARDIS user who has a simple transmit/receive device which is only capable of entering data into, or extracting data from, a CARDIS facility. In this report, we will be dealing primarily with those participants who have the ability to automatically process data, and thus can provide some additional service to the participant in the form of data edits, management reports, and other system applications.

Within the participating CARDIS organizations with access to computers, there is a wide range of data processing and communication transmission capabilities. Some personnel will access the CARDIS network via remote batch processing computers while others will interrogate computer facilities utilizing high-speed interactive terminals. However, this will not have a significant impact on the design of CARDIS, as the same processing can occur in the highly sophisticated facility as in the modest small computer facility, depending on the cost justification of each system application. These CARDIS facilities may be located within participating member facilities, in commercial environments, or operated as a subsidiary company owned by several organizations. In any case, one of the objectives of the CARDIS program is to encourage

industry to establish these facilities throughout every segment of the transportation industry. The initial CARDIS test phase might require seed money provided by the Government. However, after the significant cost savings which will accrue to CARDIS' participants are demonstrated, private companies can be expected to develop additional CARDIS modules which will enhance the exchange of information, increase customer service, simplify trade procedures, and greatly expand the number of CARDIS users.

Currently, the means for encouraging implementation of CARDIS systems for data interchange facilitation is through the development of a set of standards to define interchange parameters. Although security aspects of data transmissions are a concern, existing computer networks have been designed which provide the user with a high degree of security. Those participants who utilize their own computer facility will have absolute control of their data. Those participants who use commercial time-sharing facilities must rely on the integrity of the commercial facility. However, if data is disclosed to nonauthorized personnel, the economic factor of lost business will cause the closure of that facility. Past studies indicate that data transmitted via computers is safer than using conventional methods.

In resolving some of these issues, we will postulate some assumptions about a future CARDIS system and then attempt to determine where these assumptions lead with respect to the development of a set of CARDIS standards. These assumptions include:

1. Participation in CARDIS is voluntary.
2. CARDIS standards will be self-policing in that they will enable each participant in the transportation industry to communicate with each other. In other words, compliance with CARDIS standards will be economic in origin.
3. The purpose of the CARDIS standards are two-fold:
    a. To enable participants to interchange data efficiently by automated means

b. To assure a minimum level of service adequate to meet the needs of the shipping industry and to protect system clients

4. CARDIS standards will be applicable to each category or function which is included in the specific CARDIS-compatible computer facility. Different categories of CARDIS facilities will be available throughout the United States

5. The CARDIS designation will have to apply to systems which vary with respect to capabilities, size, and specific hardware and software.

2.2 CARDIS SYSTEM CATEGORIES

Five levels of CARDIS compatible facilities have been identified to date. The key to defining a level (to be interpreted for standards application) is to categorize the number and diversity of clients served by the system. The implication would be that the broader the clientele, the more comprehensive the standards must be to protect the public interest.

The following operator categories are not intended to be definitive. Thus, the emphasis is on the scope of public participation, with the operator category used to exemplify a representative industry entity which might wish to provide CARDIS services.

2.2.1 Category I

There will be some CARDIS participants who will operate in a limited environment. These companies include the small company which may employ only one or two personnel, and yet require access to the CARDIS network. They will have a read/write capability, but will not be able to automatically process the data using any type of computer device. These facilities will not be addressable by other CARDIS users since they will not have the ability to store data in machine readable format which could be accessed automatically by others.

2.2.2 Category II

This CARDIS category pertains to the single client situation where the shipment records and other data are completely under the control of the system user. The prime example of such systems is a company which maintains an in-house system and wishes to directly participate in data transmission and other services offered as common CARDIS features.

Since this CARDIS category will not generally provide services for the public, the liabilities which would accrue would be to the operator of the system. Hence, there is little need to be specific concerning such aspects of system operation as security and data integrity. Naturally, those aspects of the CARDIS operation which impact on other CARDIS participants involved in the update process of various shipment files should be considered as a precondition for interfacing with CARDIS. This includes security of the companies' files from malicious or inadvertent destruction of data and disclosures of data to unauthorized personnel not directly involved in operations or processing of the shipments. And, obviously, the computer facility must be capable of formatting data messages in recognizable CARDIS structures for processing by other facilities.

2.2.3 Category III

Category III systems are designed to serve a limited set of users. For example, a forwarder, broker or other transportation oriented company enters into specific contracts with clients to utilize a specific computer facility. One has to assure, in this instance, that clients data are duly protected to a greater extent than would be the case for the second category. However, since the community of clients would be limited, and operate within the framework of established relationships, the assurances and security aspects could be more a function of mutual trust and respect.

2.2.4 Category IV

Category IV would include systems or service facilities which serve a diverse set of users. Although these may all be from the same industry segment, the fact

that the relationship may now be two levels (CARDIS center to user and user to client), it becomes incumbent upon the supplier of CARDIS services to more stringently protect the individual interests of systems users. Category IV facilities must provide sufficient security between files or even data elements within a record. Some data elements and files will have built-in levels of security because they can be created to be "read only" or "write only" files.

The Category IV CARDIS facilities would provide users with the ability to access various transportation-oriented application programs which could perform functions such as equipment control, document preparation, data editing, accounts payable/ receivable, order entry, and other industry related functions.

2.2.5 Category V

Category V is considered the most general category, encompassing systems operated by Port Authorities and Industry Associations. It is assumed that these systems may, in fact, also harbor many of the common services for other CARDIS systems such as information files and gateway communications interfaces. As such, CARDIS standards will be most comprehensive for these systems.

2.3 GUIDELINES FOR CARDIS

Table 2-1 contains a partial listing of representative performance guidelines which express the degree to which each of the CARDIS categories should be able to function. For instance, in an on-line access conversational mode, Categories I and II might operate in conversational mode at the discretion of the facility, Category III should be accessible by their customers, and Categories IV and V must be accessible by all shipping personnel.

In other aspects of CARDIS operations, it may be necessary to provide a wider range of interface capability as an assurance of service quality for clients. This will include the ability to receive data froma wide range of terminals using different transmission characteristics such as transmission rate, type of code, and on-line as opposed to batch mode transmission.

Table 2-1. CARDIS Facility Options

Performance Guidelines	CARDIS User Category				
	I	II	III	IV	V
1. SYSTEM CHARACTERISTICS					
Type of Operator (typical)	User	Shipper	Forwarder	Service Center	Port Authority, Industry Assoc.
Industry Participation	Could be one man operations	Could be limited to single shipper	To client group	Trucking, Rail, Ins. etc.	Broad
Carrier Participation	Limited	Limited	Limited	Could be high	All carriers
Shipping Industry Participation	None	Virtually none	All shipping community	All shipping community	All shipping community
2. DATA INTERCHANGE STANDARDS					
Format for Messages	All shipping community	All shipping community	All shipping community	All shipping community	All shipping community
Data Element Codes	All shipping community	All shipping community	All shipping community	All shipping community	All shipping community
Formats for Reports, i.e., U.S. Standard Master	Limited shipping	Limited shipping	Limited shipping	Limited shipping	All shipping community
3. ON-LINE ACCESS					
Conversational Mode	Facility Option	Facility Option	Limited shipping community	All shipping community	All shipping community
Entry, Update	Facility Option	Facility Option	Limited shipping community	All shipping community	All shipping community
Inquiry	All shipping community	All shipping community	All shipping community	All shipping community	All shipping community
Message - Interchange	All shipping community	Optional	All shipping community	All shipping community	All shipping community
Report Generation	Facility Option	Facility Option	Facility Option	Facility Option	All shipping community
Documentation Preparation	Facility Option	Defined Set	Defined Set	Defined Set	Defined Set
4. AVAILABILITY FOR ACCESS					
Planned - Stored Inquiry		24 hours	24 hours	24 hours	24 hours
Conversational Inquiry	Variable	8 hours	12 hours	24 hours	24 hours
Maintenance Outage	48 hours/month	24 hours/month	24 hours/month	8 hours/month	8 hours/month
Fortuitous Failure - % avail (max time to repair)	50% 8 hours	85% 4 hours	90% 4 hours	95% 2 hours	99% 1 hour
5. SECURITY					
Systems Data Protection (against loss	Not applicable	Optional	Redundant backup	Redundant backup	Redundant backup
File Access: Read		Optional	Optional	All shipping community	All shipping community
File Access: Change		Optional	Optional	Provisional	Provisional
Access Logging		Optional	Limited	All shipping community	All shipping community
Programmer/Operator Access			Protected	Protected	Protected
Transmission Security		Optional	Operator/User option	All shipping community	All shipping community

Table 2-1. CARDIS Facility Options (Continued)

Performance Guidelines	CARDIS User Category				
	I	II	III	IV	V
6. GRADE OF SERVICE					
Probability of Immediate Access	Gradually Higher	Gradually Higher	Gradually Higher	Gradually Higher	Gradually Higher
Transaction Delay (Comm)	Depends on Comm Mode - should be uniform for all systems.				
System Response Time (by function)	Uniform - Lesser transaction rates for smaller systems should compensate				
7. COMMUNICATION ACCURACY					
Allowable Message Error Rate	Uniform requirements for all systems				
8. DATA STORE CAPABILITY					
Number of Data Elements	Sufficient for operator	Sufficient for operator	Tailored to client needs	Most if not all	All Data Elements
Time in Active Store		Optional - has to be interfaced with user	By client and legal demand	Full CARDIS retention	Full CARDIS retention
Legal Retention Period	Uniform in accordance with statutory requirements				
9. INTERFACES					
a. Industry Systems Banking (Swift)	Via other centers	Optional	Some interface (could be manual)	Full interface as required	Full interface
Train II	Via other centers	Optional	Via other centers perhaps	Direct or via other centers	Direct
Other	Via other centers	Optional	Indirect via other centers	Most relevant systems	Complete
b. Overseas	Accomplished generally via the CARDIS gateway				Can serve as a gateway
Laces					
Sofia					
Trim					
Clear					
Inspect					
P.O. Hamburg (COMPAS)					
10. BILLING	Not applicable	Not applicable	In line with CARDIS audit procedures		
11. STATISTICAL REPORTS (USER)	Optional	Optional	Limited defined set	Full CARDIS requirements	Full CARDIS requirements
12. STATISTICAL REPORTS (GOVERNMENTS)	Generally obtained from required reports on individual shipments				
13. CODE MAINTENANCE	For local needs	For local needs	For client needs	For client needs	Complete (Ref.)
14. EDITING/OPERATOR ASSISTANCE	None	Optional	Capability to be available as an as-needed basis		
15. DATA VALIDATION	None	Required			

The other interface capabilities would be between CARDIS and existing domestic and international systems such as TRAIN II, SOIS, LACES, SOFIA, TRIM, COMPAS, etc. By allowing for this variability through categories of CARDIS, the standards to be developed and tested can become a flexible tool for defining the CARDIS environment.

An additional part of the ongoing development effort is directed toward evaluating functions for inclusion as a part of the CARDIS concept. To the extent that these additional functions will be incorporated, the standards envelope will have to be broadened to cover aspects of operation as well as interface. An approach to this area might be the inclusion of optional sections specifying attributes of the various applications if they are included at a given CARDIS facility, leaving the decision for implementation to the operator based on evaluation of the market potential and economic justification of each candidate system.

2.4 CANDIDATE CARDIS SYSTEMS

The list of candidate CARDIS systems was developed in Phase II based on CARDIS and transportation functional requirements identified by CSC, NCITD, and TDCC. Those included are selected applications which are recommended for the initial testing period. The following list cannot be considered exhaustive. However, it is hoped that the many additional systems which relate to the many transportation related industries will eventually be tested.

1. Electronic Data (Message) Transfer

   Implies providing the means for electronic transmission of shipping data now handled by means of document transfer.

2. Foreign and Domestic Interface

   Implies:

   Clearing points for foreign traffic
   Assembling messages for foreign printout and/or direct data entry
   Providing overseas centers for interface where necessary

LACES, CLEAR, INSPECT, SOFIA, TRIM etc. perhaps treated individually or by agreement.

On imports, the clearing house would have to forward to a corresponding CARDIS facility for further processing of data (perhaps with a customs intercept to assure proper filing).

3. User Interface

Provides CARDIS participants with the ability to access the network. Codes, formats, and devices should be stipulated as part of the standard. Provisions for manual interface must also be evaluated.

4. CARDIS System Statistics

Statistics on CARDIS relating to utilization, security aspects, commodities, users, and similar characteristics will be necessary to evaluate operational characteristics and for future billing functions.

5. Data Entry/Update

Ability to enter and update various data files such as code files or status files used for tracking and tracing functions.

6. Inquiry

Enables authorized users to obtain various data on shipments.

7. Shipment Documentation

One-time entry of data elements by parties to the shipment. Implies storage and retrieval of data elements and the applications software necessary to produce required documentation.

8. Shipment Tracing

Implies the capability to obtain data on status of shipments. The last several status moves will be available from any CARDIS participant.

9. Equipment Tracing

CARDIS, through each of the compatible centers, could provide information on the status and location of various types of equipment such as containers, rail cars, chasses, barges, aircraft, etc.

10. Booking Module

Provides freight forwarders and/or shippers the ability to reserve available space on various modes of transportation.

11. Manifest Preparation

Implies assembling an index by carrier vessel and/or flight number (rail, etc.) so that when the vessel is ready to embark, all pertinent shipment records can be accessed to build a manifest; some tie-in with the booking function may be anticipated. Although a carrier responsibility, CARDIS facilities could be used to serve this need via the carrier interface.

12. Shipment File Audit

Requires continuous evaluation of the data base(s) for inactive records, static files, and inconsistency. This function could include management reports and reports to users concerning files which are candidates for deletion or otherwise show lack of activity or other erratic behavior.

13. Shipment History File

Implies tracking all data entries and updates to permit reconstruction of files in the event of contention on the part of parties to the shipment.

14. Repetitive Shipment Processing

Many shipments are repetitive, e.g., between the same shipper and consignee. A simple code could be used to access repetitive files which would contain addresses, commodities, etc., thus saving time and improving accuracy.

15. Title Transfer

Data on title bills of lading could be transferred between participating banks via CARDIS.

16. Code File

Many data element codes have been established by domestic and international organizations. Updates of these codes could be maintained in a CARDIS compatible facility which would be available to all users.

17. Cross-Reference File

Since containers, trucks, rail cars, barges, etc. are capable of holding many different shipments and since most updates only will report the equipment movements, cross-index reference files will be needed to associate shipment bills of lading with the appropriate piece of equipment.

18. User Statistics

Data on CARDIS participants' utilization of various systems will be tallied. Thus, system modifications can be made based on factors including utilization rates, error conditions, and similar data. Eventually, billing procedure will access this data.

A detailed description and evaluation of each of these functions is included in Volume II Appendix A.

SECTION 3 - CARDIS TEST FUNCTIONAL ANALYSIS

3.1 GENERAL

The shipping community that utilizes the CARDIS network will increasingly use data communications and data processing to facilitate data interchange between interested parties. The provision of electronic data processing facilities for use by various elements of the industry will afford the potential for automating a number of functions associated with processing shipment data. These will aid in the transfer of information, automate the actual preparation of documents still required, and afford a wide range of services to the industry.

The CARDIS experimental program will provide the framework for development, implementation, and evaluation of applications. Many of the functions (aside from those strictly associated with data transfer) are optional in that they do not impact on the ability of CARDIS to speed data transfer. However, provision for the inclusion of these functions may be necessary in that the services offered will encourage the user participation so necessary to providing an economic base for systems support.

The facilities to be developed in the CARDIS environment to serve basic data interchange needs will exhibit wide variations in their specific functions or services they provide to the user community.

During Phase I, CSC, TDCC, and NCITD developed a series of functions suggested for incorporation into CARDIS. In many cases, the provision of these functions will impact directly on the operation of the system itself, in that communications, record keeping, documentation, etc., will be shaped by the services CARDIS can provide. Other functions which have been proposed are more in the nature of services which can aid the shipping community in their operations, but which are not absolutely essential in defining the CARDIS environment. While one would ordinarily relegate these to the "nice to have" category, these services may, in fact, provide the necessary impetus for many users to avail themselves of CARDIS services. As such, they

must be considered both with respect to the benefits which could ensure from their development and their potential impact on system implementation.

3.2 CARDIS FUNCTION ANALYSIS

A detailed analysis of candidate CARDIS test functions was prepared by CSC. Much of the comparative analysis was based on subjective parameters. This CARDIS functional analysis was prepared primarily for study purposes based on methodology thought to be most representative of actual transportation conditions.

The detailed analysis of CARDIS functions is not considered an integral part of the CARDIS concept included in this volume but is made available in Volume II for those who are interested in pursuing the subject matter in greater detail. However, those primary CARDIS functions included in this volume are considered to be central to CARDIS. A brief description of these functions is given in Paragraph 3.3.

3.3 PRIMARY CARDIS FUNCTIONS

In the CARDIS program, transportation-related functions such as documentation preparation and system-related functions such as data transmission have been treated as one group. However, in selecting a group of functions for the further development and test of CARDIS, it is important to isolate those functions that provide the central framework or foundation of CARDIS. Using a top-down approach to system development, these technical system-related functions may be treated separately in outlining the specifications of a system capable of performing the transportation task.

Using the top-down approach to system development, systems-related functions have been evaluated as being central to CARDIS if they perform a necessary function that is a core requirement to CARDIS operations. Thus, the user interface function is considered central to CARDIS even though it does not perform any management functions or produce any reports. At this point it may be appropriate to review each of these CARDIS system functions in more detail.

3.3.1 User Interface

Some form of user interface is prerequisite to CARDIS. Without some method of getting data into or out of the system, CARDIS does not exist. The user interface will include, among other features, techniques for data validation and edit; code conversion; message formatting, queuing and addressing; Unique Consignment Reference Number (UCRN) generation; inbound message routing; and a data privacy module.

3.3.2 Domestic and International Interface

The viability of CARDIS, to a substantial degree, will depend upon how well it can be implemented without disrupting the numerous technical commercial relationships that already exist between the users and providers of electronic data transmission services. Given the domestic environment, a practical approach might be to foster the development of a series of data network interfaces that would allow the transmission of CARDIS data over and between various commercial data networks without difficulty. From a technical standpoint, this is not a problem. From a business standpoint, there may be some initial reluctance until the potential for CARDIS-related business is understood.

Internationally, the interface problem is more complex due to the added complications of different data codes, message formats, and language preferences. On the international diplomatic level, considerable effort has been devoted to the creation of a unified (or harmonized) system of data codes and message formats to facilitate the transmission of trade and transportation data across national boundaries. Although this work continues, completion still lies some years in the future. In this environment, it seems that a generalized CARDIS data exchange system can best be realized by providing an interface to translate the different data codes, message formats, and languages used in the various systems.

3.3.3 Electronic Data Transfer

Electronic data transfer is the basic reason for the existence of a data transmission network or value added network. The ability to route a message from the

sender to the address specified is inherent in the network. So, although this function is indispensable to the proper functioning of CARDIS, the ability exists.

3.3.4 Code File

The proper functioning of CARDIS relies on the use of various codes to describe commodities, carriers, geographic places, and other information essential to trade and transportation. It would not be realistic to expect a static system of codes by changing the various codes used in CARDIS. This function is essential to the operation of CARDIS, since, without such a capability, information transmitted would be unintelligible to the recipient. The task could best be handled by making available to the users of CARDIS a computerized file of the currently effective codes.

3.3.5 CARDIS System Statistics

The proper management of CARDIS will require some ability to determine what is happening, some ability to audit system operations, and an ability to use the data to manage the system effectively. It would appear that little would be needed in this area, except that developed by the operator of each data network; although there may be some need to audit access to code maintenance files, international interfaces, and other specialized areas.

3.4 SECONDARY CARDIS FUNCTIONS

Between the system-related functions and the transportation or user-related functions of CARDIS are several functions that do not conveniently fit into either category.

3.4.1 Data Entry/Update and Inquiry

Used in connection with CARDIS, these functions pre-suppose an ability to directly access data files controlled by another CARDIS user. Also implied is at least a certain amount of on-line, interactive data manipulation. Under certain specialized and limited circumstances, this kind of activity will probably occur; however, the two functions are not essential to the effective functioning of CARDIS.

3.4.2 Shipment Tracing and Equipment Tracking

With the expansion of intermodal movement of trade, there is also a greater need for the intermodal handling of information--especially for that limited amount of information needed to trace the location of any particular shipment and/or the related transporting equipment. Currently, each mode addresses this situation uniquely. Some tracking and tracing systems are more effective than others. One common characteristic seems to be that the commercial relationship between the shipper and the originating carrier is maintained.

CARDIS could offer an improved and more effective method of tracking and tracing for the transportation community if such a capability is desired. Properly designed, the service could be performed without disturbing the present commercial relationships between carrier and shipper. Essential data privacy could be protected by limiting the data elements contained in the tracking and tracing functional module. As with data entry, update and inquiry, the functions of tracking and tracing involve a considerable amount of data interchange; but are not essential to the effective functioning of CARDIS.

There are other CARDIS modules listed in Paragraph 2.4 that could be implemented at CARDIS-compatible facilities. This list of applications is by no means to be exhaustive. There are many other transportation-oriented applications which could be developed, provided they prove economically feasible.

SECTION 4 - CARDIS TEST DEVELOPMENT

4.1 CARDIS TEST OBJECTIVES

Although the CARDIS goals and objectives differ somewhat between the test and the operational phases, they both should ultimately result in the development of an automated communication system which will enhance the flow of data required by participants in the transportation industry to reduce industry-related costs, increase the effectiveness of data interchange, and expedite shipment deliveries. To accomplish this important CARDIS goal, several additional limited experimental CARDIS test plan objectives have been identified which should be helpful in guiding the following ongoing efforts.

4.1.1 Identify Problem Areas

Industry test participants must identify the problem areas that they are most interested in automating before the test program can begin. Test system specifications can then be developed which address them. Refinements to this plan will be made based on iterative testing.

4.1.2 Concept Validation

The principal function of the CARDIS test program is to test the effectiveness of the basic CARDIS concept. This will require personnel to design and develop techniques for testing the many different functions that have been and will be proposed by the transportation-related industries, both domestically and on an international basis. Each test function will be evaluated using the following evaluation criteria.

4.1.3 Standards and Agreements

One of the ultimate goals of the CARDIS program is the development of standards which will enable all participants, both in Government and industry, to exchange data pertaining to the control and movement of freight on an automated basis and with a minimum of complexity. These standards include, inter alia, message formats, communication networks, data element codes, security and privacy procedures, and

input/output formats. A significant amount of work has already been accomplished in identifying required standards by national and international organizations. The standards which have been proposed to date must now be validated in test operations. Those standards that prove to be cost-effective and acceptable will then be used as the basis for negotiating agreements between trading nations and individual organizations.

4.1.4 Relative Cost Analysis

Because of the complex nature of commercial transportation, it is very difficult for companies involved in the transportation industry to identify all costs associated with the movement of freight. Therefore, it is essential that parallel tests be conducted to compare the costs incurred utilizing CARDIS and current manual methods of producing the necessary documentation needed to ship commodities in the domestic and international market place. Some of the benefits which will accrue to shippers and carriers must be extrapolated because it may be impossible at this time to measure the savings which will accrue to participants in the CARDIS program. Some of these savings will be reduced interest payments on freight, increased utilization of equipment, elimination of duplicate entry of data, streamlined processing procedures, reduced pilferage and theft, reduced insurance costs and the ability to transmit data in machine readable format between all participants and Government agencies.

4.2 CARDIS TEST BENEFITS

There are other benefits which will accrue to the CARDIS program participants as the testing progresses. The three identified thus far include operational acceptability, future CARDIS development, and industry impact.

4.2.1 Operational Acceptability

An anticipated benefit is the establishment of the operational acceptability of CARDIS. Personnel involved during the development of systems are more responsive to using them in their day-to-day operations.

4.2.2 Future CARDIS Development

After the successful implementation of each CARDIS application, a study should be conducted to examine the impact that the implementation of the operational application will have on the overall CARDIS program. A determination should be made to identify additional functions which could be developed at minimal additional costs that could access the data made available in the new data base. For instance, a container yard control system could easily be developed utilizing a data base structured for an equipment control system; or a dock receipt system could be implemented utilizing the data base developed for a booking system.

Some of the specific questions that must be answered during the post-evaluation are:

1. What problems or opportunities were identified by CARDIS users?
   a. Cost problems
   b. Personnel problems (job security, training)
   c. Legal problems
   d. Technical and operating problems (hardware, software, etc.)
   e. Potential opportunities identified for major change to corporate organization/cost structures
   f. What changes are recommended for future CARDIS developments?
2. For the CARDIS system, what problems surfaced that will require changes in concept, hardware or software?
3. For the CARDIS system, what useful opportunities were identified for further research and development?
4. Does the CARDIS system enable users to accomplish functions not normally possible with conventional information (document) exchange?

4.2.3 Industry Impact

The CARDIS test applications should be designed to test selected methods for transmitting data between CARDIS compatible facilities. Those data element codes which were most effective could then be recommended for use by all transportation-related industries. Similarly, message formats, edit validation checks, message transfer rates, terminal characteristics, and other aspects of CARDIS compatible facilities could be standardized to increase the CARDIS network effectiveness.

4.3 CARDIS TEST PHILOSOPHY

To facilitate the execution of the tests and the analysis of data derived from them, the tests should be started with the minimum meaningful combination of participants and functions, then expanded progressively in phases. Countries requesting participation in the initial phase of the CARDIS test should select similar categories of participants, i.e., shippers, freight forwarders, carriers, and Government agencies, and develop the ability to process transportation-related data which would be transmitted to them via CARDIS.

4.3.1 Parallel Test Procedures

Initial tests are to be carried out in parallel with existing cargo data procedures. At an advanced stage of testing, it is conceivable that the "protective fall net" of current paperwork can be removed. At least some of the participants must agree that the cargo can move from shipper to consignee on the test data alone, letting the usual paperwork catch up later, when desired.

4.4 TEST CRITERIA

There are two major sets of test criteria which apply to the CARDIS program; those that apply to CARDIS network operations and those that apply to functional aspects of system applications that are available at CARDIS compatible facilities.

4.4.1 CARDIS Network Design

The experimental CARDIS system is to be designed using the following seven performance criteria. The experimental system test results are then evaluated against the criteria found in Paragraph 4.4.2.

1. Availability - Is the CARDIS system accessible at all times; if not, what are the wait factors?
2. Delays - What delays are incurred by hardware limitation, communication networks, software, etc.?
3. Recovery - What must be done to recover from hardware/software malfunctions?
4. Security - How safe is the data from unauthorized disclosures, malicious destruction, etc.?
5. Response time - Time it takes for the CARDIS software/hardware to respond to a transaction.
6. Training - How complex is the system and what amount of training is required?
7. Error Control - How are software/hardware and data errors detected and what procedures are available to correct them?

4.4.2 CARDIS Application Criteria

To date, six primary criteria have been selected to evaluate the effectiveness of CARDIS system applications that are being tested. This list probably will be modified later to meet any unique requirements of some applications. They are:

1. Cost - Identify the costs involved in test development and evaluation and, when possible, anticipated operational costs.

2. Speed of Shipments - Does the system speed up the delivery of freight?

3. Performance - Are the end products produced in a timely manner so as not to impede deliveries?

4. Errors - How are errors detected and corrections handled?

5. Adequacy - Are the end products adequate for the intended purpose or can improvements be made?

6. Documentation - Does this application eliminate the need for any freight documentation?

4.4.3 CARDIS Fundamentals

There are several assumptions which will impact on the CARDIS test phase. These assumptions will impact on the future course that CARDIS will take. They are the basic necessities required to achieve the CARDIS goal.

1. Data will be coded and transmitted in format recommended by TDCC. Part of this activity will be transparent to the user.

2. CARDIS should emphasize data exchange between user-controlled data bases to enable users to perform selected trade and transport-related functions described in the May 1975 NCITD Phase I report and in the July 1975 TDCC Data Interchange Report.

3. CARDIS must provide an acceptable level of data security and privacy. There should be means for auditing use of the system for security and management.

4. The data transmissions between participants will use existing communication networks. AT&T and COMSAT probably will provide the major system transmission capabilities but other systems utilizing microwaves, lasers, and other technology will not be excluded. Of course, if a participant used a value added network or a commercial computer time-sharing center that can interface with the CARDIS network, they will be included.

5. CARDIS will serve Government and private needs and will connect diverse large and small user systems. CARDIS software must provide effective service to all potential users.

6. CARDIS is intended to operate in the U.S. domestic and international environment. CARDIS software must provide an effective interface between the U.S. network and similar systems operated in other nations.

4.4.4 CARDIS Transaction Analysis

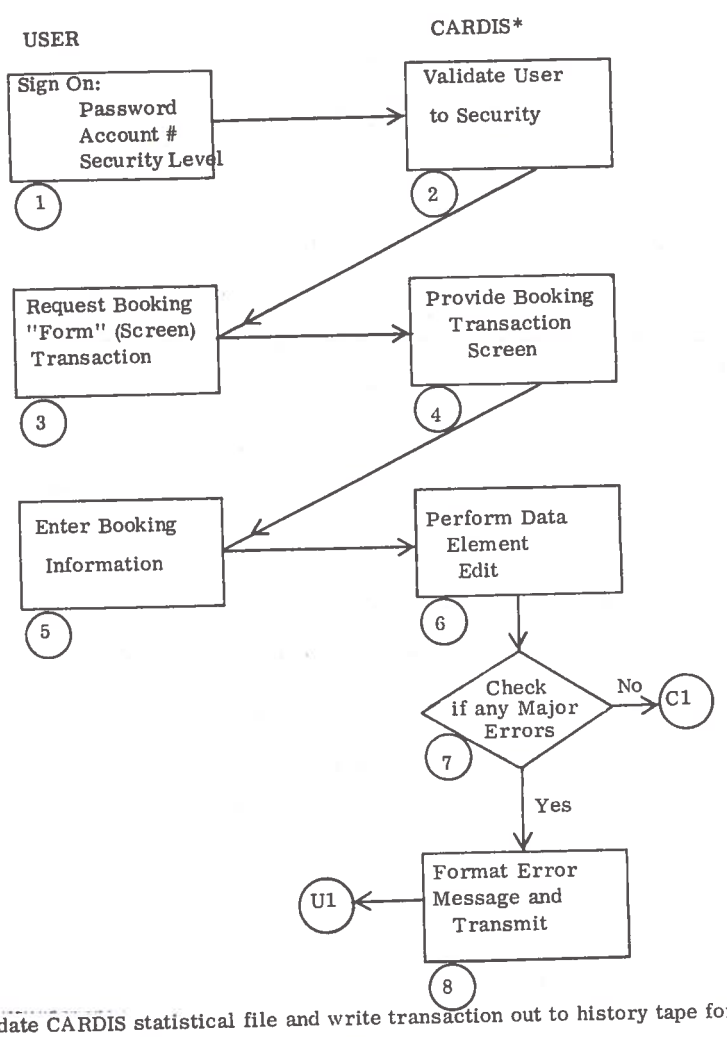
A simplistic flowchart of CARDIS functional processing is provided in Figure 4-1. Of course, the data flow will differ somewhat in each of the different categories of CARDIS facilities which will reflect the specific needs of each user. The following example reflects the current CARDIS test facility and network philosophy. The user, in this case, refers to the originating CARDIS test participant. The addressee represents the participating carriers and the data flow reflects the processing of a booking transaction.

The assumption made in the following example is that the user will process this booking transaction from a remote CARDIS compatible facility using a CRT device.

Many of the functional actions or processing could take place in either the user's facility, or at a commercial time sharing facility which would then be referenced as a "CARDIS facility." In the following example, the "user" has access to a timesharing computer and the "addressee" utilizes his own in-house computer. Both facilities are assumed to be CARDIS compatible.

Each of the processing steps which are involved in the sample booking process illustrated in Figure 4-1 is explained as follows.

(1) The user will dial the commercial timesharing center and enter the appropriate password(s), account number, and indicate the required security code applicable for that particular facility.



*Update CARDIS statistical file and write transaction out to history tape for each CARDIS access.

Figure 4-1. Test CARDIS Functional Flow (1 of 4)

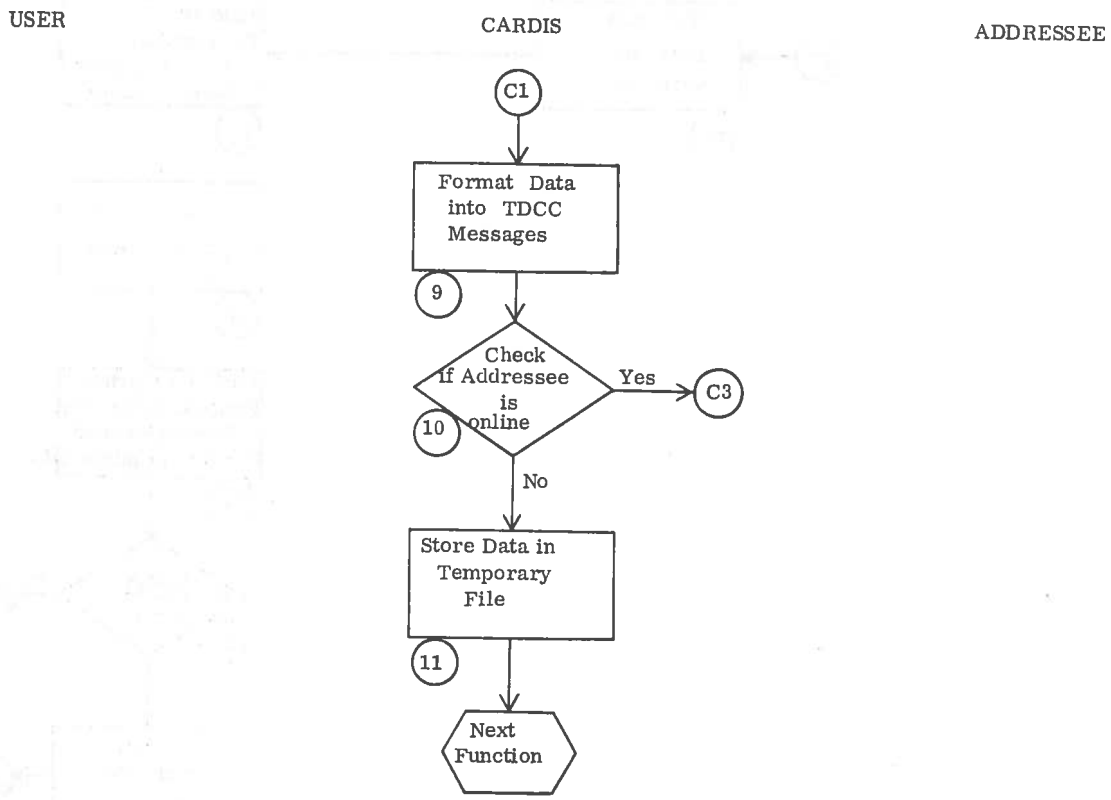


Figure 4-1. Test CARDIS Functional Flow (2 of 4)

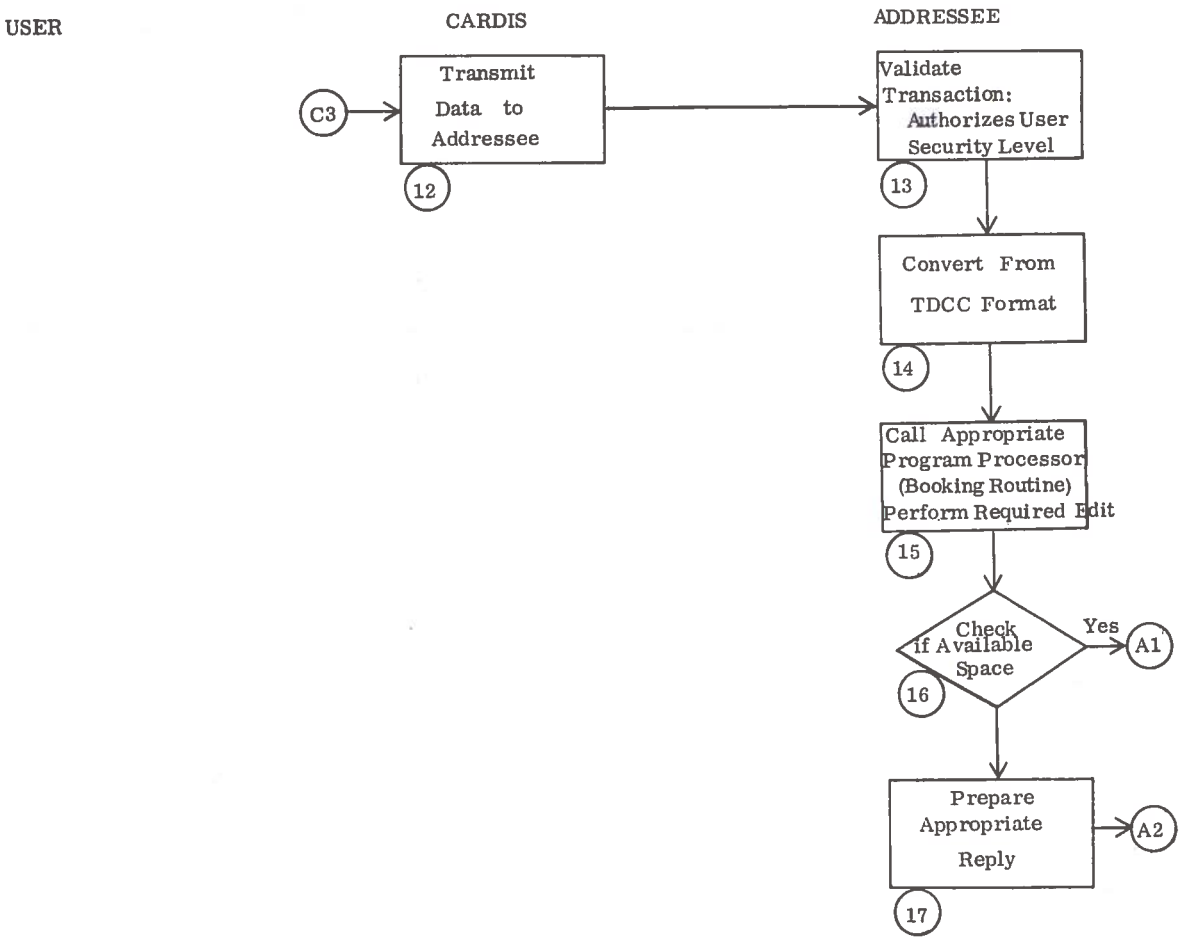


Figure 4-1. Test CARDIS Functional Flow (3 of 4)

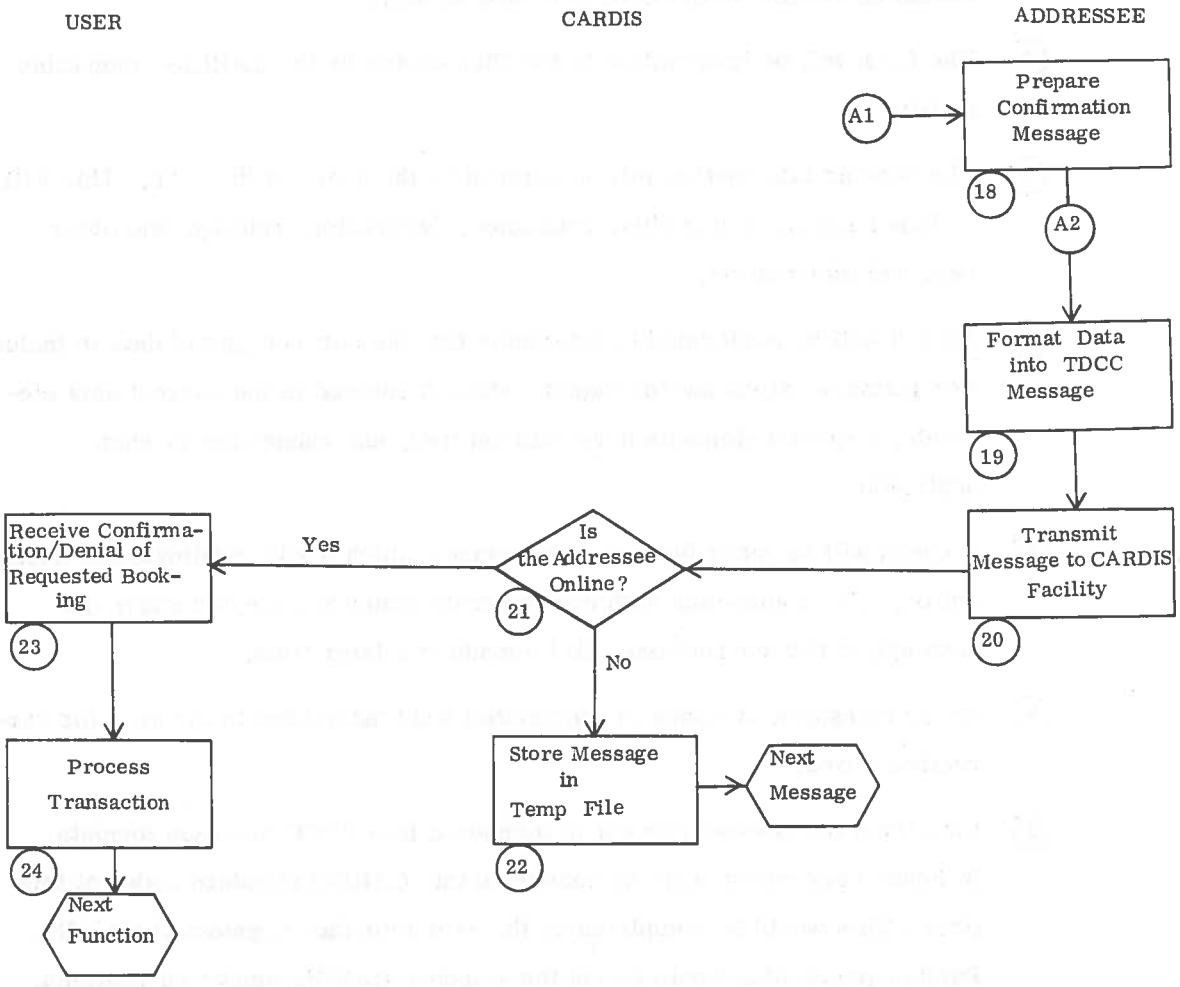


Figure 4-1. Test CARDIS Functional Flow (4 of 4)

(2) The CARDIS compatible facility will authenticate the user password and will log in the user. This data will be entered in CARDIS statistical file.

(3) The user will request a "booking form" transaction from the CRT. This should be similar to the U.S. Standard Master.

(4) The form will be transmitted to the CRT device by the CARDIS-compatible facility.

(5) The booking information will be entered by the user via the CRT. This will include shipper, commodity, consignee, destination, routing, and other required information.

(6) An edit will be performed to determine that the correct type of data is included. For instance, alpha and/or numeric data is entered in the correct data elements, required elements have data entered, and range checks when applicable.

(7) A check will be made for any major errors which would invalidate the transaction. The transaction with minor errors could be accepted under the assumption that corrections will be made at a later time.

(8) Error messages or codes are formatted and transmitted to the user for corrective action.

(9) Data from the booking request is formatted into TDCC message formats. In-house user codes could be converted into CARDIS standard codes at this time. This would be completed by the user interface segment of CARDIS. Further processing would be via the standard CARDIS functional systems. The transaction would be written onto the Shipment History File at this time.

(10) The CARDIS facility would check if the addressee's facility was on-line or would check if the message was to be routed to another CARDIS compatible facility closer to the addressee, in which case that facility would perform the continuing functions.

(11) If the addressee's CARDIS compatible facility was not available to accept data, the message would be stored in a temporary file and a status file would be updated to reflect that a message was in storage for the addressee. No further action would occur until the addressee requested the message be sent.

(12) The message would be transmitted to the addressee's facility as the result of a query for any CARDIS messages by the addressee or because the addressee's facility was in a receive mode when the message was ready to be sent.

(13) The addressee's CARDIS compatible facility would receive the message and validate the user as being authorized to send messages to that particular facility. Then the security level would be checked to confirm that the user is cleared to transmit the particular transaction type and receive appropriate responses. This would normally relate to various queries on shipment status requests or transactions which would affect any data files.

(14) The CARDIS message will be converted from the TDCC format into the appropriate format of the addressee's record layout. Codes could be converted from CARDIS standards to in-house codes, if appropriate.

(15) The relevant systems application program would then be read into core to process the transaction. Any appropriate edits could be made at this time. For instance, if a query on a shipment status were received, a check could be made to determine if the shipment was in the possession of the addressee; or, if a booking request for a specific vessel/voyage was being made, that the vessel actually belonged to the addressee and was scheduled to stop at the required port.

(16) The booking application system, in this case, would check if space were available.

(17) If space were not available, appropriate actions could be performed. A message could be prepared for the company's marketing personnel, alternative vessel voyage data could be provided, or any other appropriate action deemed necessary by the addressee's company. In any case, skip (18).

(18) Prepare confirmation message.

(19) Convert message into TDCC format, replacing in-house codes with CARDIS codes when appropriate.

(20) Transmit message to the CARDIS compatible facility that services the user. Write the message on the Shipment History File.

(21) The receiving CARDIS compatible facility which services the user will determine if the user is on-line. If the user is on-line, skip (22).

(22) If the user facility is not available to receive the message, it will be stored in a temporary file and a status file will be updated to reflect that a message was in storage for the user. Any further processing of the message would then be temporarily suspended.

(23) The user will receive the message from the CARDIS compatible facility and convert the message from the TDCC format to the user format. Any appropriate edit checks on data elements will be made at this time.

(24) The appropriate user application program will be activated to process the returned data. The resultant information will be displayed on the user's CRT. At the same time, appropriate user data files will be updated to reflect the status of the booking request and could automatically trigger a request for containers, trucks, barges, or any other equipment needed by the shipper.

The preceding example is a viable technique for the interchange of data between participants in the CARDIS program. Many of the listed functions could be performed at several different locations within the network. However, steps (10) through (13) will be a function of the CARDIS network. The final configuration of the test CARDIS network

design will be made by those companies and agencies selected to participate in the development phase of the test CARDIS program and Department of Transportation personnel.

The booking function presupposes an on-line CARDIS application. Actually the booking function can realistically operate in a batch mode environment for a large segment of the transportation industry with acceptable delays of 2 to 24 hours. The input data transactions can be entered from users' facilities via paper tape, card readers, directly on a computer to computer basis, or any combination of these techniques.

Processing of the transactions by the addressee at the destination facility could be nothing more than grouping messages by transaction type in data base files for "off-line" processing at night or when required by the addressee personnel.

Some companies require manual intervention in decision processing. For instance, a railroad company might allow automatic booking confirmations for 80 percent of the available flat cars. However, for the final 20 percent of the flat cars, marketing personnel would like to selectively allocate the remaining cars for priority movements.

CARDIS will be flexible in design for both the testing phase and when it becomes operational. The detailed characteristics of each CARDIS node or compatible facility will be dictated by the economic benefits and customer or user requirements. The only restraints that will be imposed on CARDIS' participants are the CARDIS data element codes, CARDIS message formats, and possibly some communication network limitations. These restraints will apply only when data is being exchanged between participants who do not belong to the same company or agency.

Current plans call for domestic and international CARDIS interface programs which will convert CARDIS formats to selected other existing system formats such as SOFIA, LACES, CLEAR, TRIM, RAILBOX, and SOIS. The interface program will function to accept data from these systems and convert it into CARDIS message format.

4.5 TEST ADMINISTRATION AND CONTROL

Tests of the CARDIS system will require the cooperation of test participants in the public and private sectors. A series of agreements must be concluded; internationally between governments, domestically between the several departments of the Executive Branch, and between Government and commercial interests who will participate in the test. Administrative details and funding arrangements must be completed. A list of U.S. and foreign government and commercial participants must be selected. A specific test configuration of hardware must be developed. A test plan and scenario must be generated and specific computer software must be designed, developed, debugged, and evaluated.

A standard operating procedure (SOP) for conducting tests must be established. The SOP should stipulate the methods for logging the different test environment conditions, test data used, test parameters or options, and the final test results. Then procedures should be developed which describe what steps should be taken to effectively evaluate the test and how to establish future testing.

There is ample evidence of substantial domestic and foreign interest in participating in a CARDIS test. International political and commercial interests are involved, since there is some concern that the U.S. will develop CARDIS to serve our national interests and then attempt to coerce the rest of the world to conform.

Funding limitations and the problems generated by a large-scale experimental program are sufficient reasons for limiting the scope of the initial CARDIS test concept to a practical and workable level. This, however, increases the need for foreign participants or observers to be informed of the test activity. In the same vein, there appears to be a need for an information program to train participants, publish test scenarios, increase interest of the shipping community in CARDIS, and make test results available to the various international bodies and U.S. Government agencies.

4.6 CARDIS COMMITTEES

CSC proposes that three committees be organized to handle each of the industry-related functions required to develop programs such as CARDIS that affect such a large segment of commerce. The three proposed committees would be an Industry Advisory Committee, a Test Evaluation Committee, and an International Liaison Committee.

4.6.1 Industry Advisory Committee

The Industry Advisory Committee should be composed of high level officials from industry and DOT. Their responsibility would be to review and evaluate the results of CARDIS testing and to ensure that the required information and resulting reports meet the needs of the industry. This committee would also be in a position to provide guidance in expanded CARDIS testing, identifying those operational and management functions that they feel should be automated within the CARDIS concept.

The Industry Advisory Committee probably would meet about every six months. The bulk of their work could be conducted via the U.S. mail service or by telephone.

It would be very beneficial to the CARDIS program if Mrs. Judith Connor, Assistant Secretary for Environment Safety and Consumer Affairs, would chair this committee. Mrs. Connor would provide a significant amount of "visibility" within industry and would provide a background of computer system design and development knowledge which few executives have.

4.6.2 Test Evaluation Committee (TEC)

The TEC would include members from TES, TST, TSC, the contractor responsible for developing Phase III test system programs, and industry representatives actively involved in developing segments of the CARDIS test. TEC would be convened following DOT's commitment to proceed with the test program. Their prime responsibility would be to develop a program for testing CARDIS modules, evaluating technical aspects of the program, and selecting future test modules. TEC members would be

responsible for preparing the basic ground rules for testing, commit national resources for test support, make the necessary national administrative and commercial arrangements required to test modules, develop and approve test criteria, write standards for evaluating test results, develop an outline scenario for the test, and update the test scenario to reflect necessary modifications indicated by past test results.

4.6.3 International Liaison Committee (ILC)

The CARDIS ILC, consisting of interested but nonparticipating countries, could be organized within the framework of the Economic Commission for Europe (ECE). Representatives on this committee would be sent periodic reports of CARDIS test activities. They could comment on the test results, provide alternate solutions to problems encountered, and provide test data from interested organizations from within their country. These same members could be instrumental in selecting future test applications.

CSC recommends that this committee not be formed until the CARDIS test program is well underway and after the scope of international participation has been resolved.

The ILC members would be responsible to institute action at the highest levels of Government and commercial industries within their country and to solicit their cooperation in CARDIS evaluation. They would be asked to organize a CARDIS committee within their country which could be used to exchange information pertaining to CARDIS impact on the various facets of the transportation community. Each committee would include representatives from Government, shippers, and carriers.

4.7 SCOPE OF PARTICIPATION

If the CARDIS test results are to be meaningful and useful in charting the future development of this approach to reduce transportation information exchange costs, the test must be relevant, not only in terms of what is to be tested, but in terms of the level of participation. The ability to transmit information from one computer facility to another of different design via a communications network is already well established and, in fact, in common practice in the commercial sector. What has not been

established is the ability for intercompany and interindustry computer to computer communications interaction on a scale and variety required by the transportation industry. Within single companies and, in a more limited sense, within relatively small segments of a few industries, the information exchange between computers is operational. Certain freight forwarders and custom house brokers are currently transmitting certain required reports to the U.S. Census Bureau; however, in this case, the data being transmitted is used for statistical purposes only and there is no urgent need for data to be used to move a shipment through the transportation pipeline. Data transmission of certain operating, traffic, and financial information between U.S. railways and between railways and their industry associations is increasingly being accepted as a common business practice. In the cases cited, however, there is a high degree of standardization in the hardware and software being used by those involved in this kind of data exchange, and most utilize a circuit switching arrangement of direct connection between the two installations.

4.7.1 CARDIS Test Environment

Eventually, CARDIS is intended to operate in an environment involving literally thousands of users throughout the world, using a wide variety of computer and communications hardware. The CARDIS test program will evaluate the basic categories of computer terminals and communication modems that are anticipated to be used at a majority of facilities. Recommendations can then be made to standardize the hardware characteristics for CARDIS compatible centers.

The initial CARDIS test will be simplistic in design and include only those computer programs needed to permit the exchange of data among selected participants involved in the movement of cargo. Since many of the candidate CARDIS test participants already have automated many systems such as container yard control, payroll, accounts receivable, and documentation preparation systems, it would be superfluous to recreate these functions within the CARDIS program when a simple interface program that reformats the data will suffice.

Gradually, CARDIS will be expanded to perform additional functions that are selected for implementation by industry and Government personnel. Eventually CARDIS should also be capable of providing users with accurate up-to-date codes for selected data elements and be able to provide tracking and tracing information on shipments. However, CSC staff members feel that most system applications will be outside the CARDIS network and operate at user computer facilities or in a timesharing environment. These systems would use CARDIS to transmit the data to appropriate locations.

By using the iterative testing technique for evaluating CARDIS modules, the CARDIS network developed will be the most cost-effective in the transportation environment. The initial information to begin development test programs is now available, therefore, any extended delay will be to the detriment of the people involved in commerce.

4.7.2 CARDIS Test Concept

CARDIS experiments will test current concepts to determine whether such a generalized data exchange process can work at all, identify the costs and productivity of the system being tested, and determine the direction of future development work on CARDIS. Since the major number of problems appears to be organizational and procedural rather than technical, it is apparent that there is need for something more than a minimal amount of domestic/international shipper, forwarder, carrier involvement if the test results are to be realistic and useful.

The problems, complexities, and expense of conducting international tests are known, as well as the conscious need to generate a body of meaningful test results that will provide useful answers to the questions being asked about CARDIS. As with many similar questions, the final scope and duration of the CARDIS test will probably be a compromise of the several divergent interests--a balance between funds and test complexity on the one hand and the desire for adequate test results on the other.

So as not to introduce unnecessary complexities, the test should be limited to those activities directly or closely related to the transportation documentation process. For example, while there is a recognized need to test the electronic exchange of bill of lading information, the test need not include an active interface with the banking industry's electronic fund transfer system. Because the lack of customs documentation can stop the release of goods awaiting clearance in port, CARDIS tests should interface, at least to some degree, with U.S. and foreign customs processing systems. For somewhat similar reasons, CARDIS tests should include an appropriate interface with at least one airport and one seaport in each of the nations involved in the test.

4.7.3 CARDIS Participants

To avoid implications that the U.S. is developing CARDIS unilaterally, and to generate a more representative body of test results, the tests should be gradually expanded to include two of our major trading partners. This would enable data to move between the other two nations in addition to the United States--in a business and technical environment completely independent of U.S. influences. Handling data between the United States and two different foreign nations would provide a more useful test environment for evaluating the future of CARDIS.

CARDIS planning to date has been designed to serve the needs of both large and small shippers, carriers, and freight forwarders. It seems reasonable to include a representative number of each type of potential CARDIS users in the test program. In the case of the carriers, each major mode of transportation should be represented.

4.7.4 CARDIS Participant Selection Criteria

As previously noted, the natural limitations of cost and unnecessary complexity gives rise to certain pressures to limit the number of test participants while the need for representative test results generates a desire to increase participation in the test series. To get maximum results from the funds allocated, certain criteria should be used to select candidates for the test program; such criteria to include, inter alia:

1. Size of firm
2. Involvement in export or import trade with foreign nations included in test
3. Degree to which company uses computers and data communications
4. Level of systems personnel skills
5. Desire to participate and commit resources to the test
6. Anticipated volume of data transmissions.

4.8 CARDIS TEST SYSTEM CONFIGURATION

The hardware and software requirements which will be utilized in the test phase will vary significantly between participants both by design and from necessity. Each CARDIS system tested must be evaluated to determine the computer and peripheral hardware equipment needed to test all functional aspects.

Each category of CARDIS test participants may use different kinds of computer equipment and terminals. However, basic hardware interface criteria, to be determined later, will be established to minimize the complexity of data exchange.

The minimum computer facility should include a central processor, storage devices, a printer, and the ability to send or receive data in machine readable format from one or more remote terminal devices.

Most of the commercial timesharing centers that operate in the U.S. have the ability to receive and transmit data from a variety of terminals using different transmission rates. One or more of these facilities could be used as a store and forward CARDIS message facility, since they normally have a significant number of direct access mass storage devices which would be available on a flexible basis. This does not preclude participants in the CARDIS test program from exchanging data directly with one another. However, if the hardware/communication network is not compatible, the commercial timesharing center could facilitate the exchange of data by accepting data at one rate and transmitting to the addressee at another.

The technology and hardware devices needed to transmit data between facilities is available today. Most of the larger timesharing facilities have communication concentrators, minicomputers that are used as "front-end" devices to handle data transmissions, and access to leased lines, communication satellites, and WATS lines. Any or all of these devices can be made available to CARDIS users as dictated by volume of data and user requirements.

Response time will vary by type of CARDIS compatible facility and the transaction being processed. But even for those functions which are often thought of as on-line, applications such as booking, shipment status, etc.; processing can occur in a batch mode environment without detrimental effects. The actual response delay acceptable will depend on the mode of the carrier, type of transaction being processed, time remaining in the shipment cycle, and other factors.

All of the technical requirements of CARDIS are available today. It is now time to select participants, prepare final test system specifications, and implement the test CARDIS program.

REPORT OF INVENTIONS

After a diligent review of the work performed and the reports produced under this contract, it is believed that none of the results are inventions or discoveries. However, the work performed under this contract has produced new and original concepts for a CARDIS Experimental Test System as briefly described in Paragraphs 1.4.1, 2.1, 2.2, and 2.4 of this report. This concept has been designed to include the basic needs of the various facets of the transportation industry.