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Physics, Computer Science & Mathematics Division

AN ANALYSIS OF RATION CHECK ISSUANCE AND RECONCILIATION SYSTEM DESIGNS

Donald Austin

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An Analysis of Ration Check Issuance and Reconciliation System Designs

Donald Austin

Computer Science and Applied Mathematics Department
Lawrence Berkeley Laboratory
September, 1979

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Analysis of System Designs for an RCIR System

Preface

This report is an overview of a series of studies carried out for the Department of Energy's Economic Regulatory Administration relating to the Standby Gasoline Rationing Plan. The goal of these studies was to attempt to bracket several important parameters in a computer based Ration Check Issuance and Reconciliation system. The analysis carried out in this report is not intended to represent a rigorous statistical analysis of factors. The cost estimates, lead times, etc., in the various studies are only rough guesses based on as much hard information as was available at the time. Feasibility, rather than actual cost estimates, was the major focus of this study. Many of the numbers used in assessing various system designs must be considered as "ball park" estimates and should not be taken too literally.

The primary usefulness of this report is in the relative estimates among various candidate systems, and in defining the important factors to be considered in selecting one system for further investigation. Many important issues remain unresolved, such as acceptable levels of fraud and costs, but at least the candidate systems have been parameterized in terms of these issues and can be compared on the basis of those parameters.

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Executive Summary

A. Background

The purpose of this study is to determine the feasibility of implementing a gasoline ration check issuance and reconciliation system (RCIR) that is capable of providing ration rights to individuals and commercial firms within 45 days of the declaration of gasoline rationing. The RCIR system is one of 16 components of the Standby Gasoline Rationing Plan, albeit one of the most important in terms of impact on the public.

The methodology for this study employed three teams developing the design and information background for three system architectures, viz.:

A decentralized system in which each state would handle some of the functions of the RCIR system and the government would handle the rest.

A centralized system in which all RCIR functions would be handled by a single government agency on a large computer system.

A distributed system in which ten regional centers with interregional communications would handle RCIR functions.

These three options represent increasing use of modern computing and communications technology, which implies longer lead times and higher risks, but also the possibility of improved effectiveness, more flexibility, and lower costs in the long term.

The decentralized system was based on a ten-state survey carried out by Booz-Allen & Hamilton, Inc. This survey built upon previous surveys carried out for DOE by American Management Sciences, Inc.

The centralized system design was developed by a team from the Computer Sciences Division of the Oak Ridge National Laboratory of Union Carbide. This design was based in part on a study by R. L. Polk and Company and carried the analysis of system requirements further by considering several functions of the RCIR not adequately covered in the Polk report. This part of the study included an interview with Polk personnel and computer modeling of software performance characteristics relevant to the RCIR system.

The distributed system design was developed by a team from the Computer Science and Applied Mathematics Department of the Lawrence Berkeley Laboratory of the University of California. That design concentrates on the use of on-line verification and registration functions distributed to ten regional centers. The analysis of communications requirements for a distributed system was augmented by a joint AT&T and Pacific Telephone design of a network configuration.

B. Structure of the Report

This report contains an analysis of the three separate but related studies. Details of various components of the systems are contained in those reports. Only some of the issues covered in those reports are analyzed here

due to the large number of combinations of alternate scenarios. Most of the effort in this analysis is concentrated in the operational aspects of the systems. The implementation problems are widely different, and very difficult to compare.

Chapter I describes the background, general assumptions and methodology employed in the study. In Chapter II, the development of a conceptual model of RCIR functional requirements is described. Chapter III gives a brief overview of the conceptual system designs and contains a module by module comparison of the systems. Chapter IV summarizes the cost estimates for the components of the system. A rather qualitative cost/risk/benefit assessment is developed in Chapter V. Appendix A contains a description of the existing Social Security Administration system for comparison purposes. Appendix B contains a bibliography of material related to this study.

C. General Observations

The operating characteristics of the candidate systems are widely different, especially in the areas of implementation time, effectiveness, risks, and fraud prevention. The only method for comparing systems appeared to be in terms of scenarios describing the conditions and intended purposes of a rationing system. The scenarios developed in Chapter V were aimed at clarifying the conditions under which a particular system would be the most desirable. The scenarios range from a short-term, emergency situation (in which existing states' facilities would be used) to long-term "permanent" regulatory situations (in which a large scale development effort might be justified).

In terms of costs, it is evident that the fixed costs of functions outside the RCIR system will dominate the various RCIR system designs by factors ranging from 4 to 20. This implies that, given the right circumstances, the determination of which system design to implement is not heavily weighted toward operating expense of the RCIR system.

D. Summary of Results

In an emergency situation, with a short lead time and a short expected lifetime of a rationing system, either delegation of authority to individual states or contracting with R. L. Polk and Company would be the simplest and cheapest method of implementing this particular plan. One would expect a rather large amount of fraud and errors, but that would presumably be tolerable for the short period. The Polk system would be of higher quality in the beginning, since most of their files have been extensively edited over the years.

In a longer term, regulatory situation with an indefinite lifetime expected, the centralized and distributed systems would offer much more flexibility and lower error rates. Either system could be phased in over a period of one to two years, gradually taking over the functions performed either by the states or by R. L. Polk and Company.

For the purpose of implementing a RCIR based on a NVRF, the advantages and disadvantages of the three architectures can be assessed in terms of the following criteria:

Implementation Time: How long would it take to implement an effective

RCIR based on existing technology?

Operating Costs: What are the costs for operating the RCIR system, not counting the fixed costs outside the system design considerations?

Quality of the Database: To what extent could duplicate entries be resolved, ineligible records be deleted, and new entitlements be established?

Privacy of Individuals: To what extent could individual privacy be ensured, regardless of future government actions?

Reliability and Redundancy: To what extent could the system function effectively in the advent of a failure of system components? To what extent could some components provide backup capability to other system components?

Responsiveness to Change: How easy and efficient would it be to institute new algorithms for check distribution, individual allocation, and other possible changes required from experience in operating the system?

Fraud Detection and Prevention: To what extent can the system safeguard against multiple or fraudulent registrations, forgery, counterfeiting, etc.?

The following table summarizes a qualitative comparison of the three system designs. This table is based on an interpretation of the more detailed analyses in Chapters IV and V, which were based on the reports listed in the bibliography in Appendix B. It should be noted that all cost figures, implementation times, transaction rates, etc. are rough estimates made on the basis of very little firm data, and should be treated as comparative figures only.

Comparison of System Architectures			
Characteristic	Centralized	Distributed	Decentralized
Implementation time	Medium(1.5 yr)	Long(2 yrs)	Short(<1 yr)
Operating Costs	Medium(<$20M)	High($17-63M)	Low($15M)
Quality of Database	Good	Excellent	Poor
Privacy of Individuals	Poor	Medium	Good
Reliability/Redundancy	Fair	High	Poor
Responsiveness to change	Good	Good	Poor
Fraud Prevention	Fair	Good	Poor

Executive Summary

The detailed conceptual systems designs are covered in the individual reports from each of the three study teams. In particular, the various subsystem components are described in detail in the ORNL report. The LBL report details only those aspects of each module relevant to the on-line verification and registration functions, with the assumption that the batch mode operations will be essentially the same as in the ORNL report.

I. Introduction

A. Background

The purpose of this study is to determine the feasibility of implementing a gasoline ration check issuance and reconciliation system (RCIR) that is capable of providing ration rights to individuals and commercial firms within 45 days of the declaration of gasoline rationing.

The Gasoline Rationing Task Force was established by the Deputy Secretary of the Department of Energy in March, 1979 to perform all pre-implementation tasks associated with gasoline rationing as described in the Department of Energy's Standby Gasoline Rationing Plan (SGRP). The Task Force developed a detailed management plan to guide government and contractor efforts in designing a gasoline rationing system. The management plan divides the rationing system into 16 subsystems:

* Allotment Planning
* Check Production
* Ration Check Issuance and Reconciliation
* Coupon Production
* Coupon Distribution
* Ration Banking Operations
* Federal Organization
* State and Local Roles
* Allocation Program Interface
* Exchange Market Operations
* Adjustments and Appeals
* Audit and Enforcement
* Management Information systems
* Public Information
* Program Management
* Readiness Maintenance and Termination

A separate work package was developed for each subsystem that includes objectives, a description of effort, specific tasks and associated schedules, estimated resource requirements, issues and constraints, interdependencies

with other subsystems, and performance indicators.

Due to the potential complexities of creating an automated system for the Ration Check Issuance and Reconciliation (RCIR) subsystem, the Task Force Director requested that a study be undertaken, beginning in May, 1979. The primary focus of the study is a vehicle-based plan in which ration rights are provided periodically to owners of registered vehicles, as reflected in the files of the states' Department of Motor Vehicles. The details of the plan are described in the various volumes of the Standby Gasoline Rationing Plan which was submitted to Congress in March, 1979.

Although the plan was not approved by the House of Representatives, it was decided to continue this study in order to provide a technical feasibility report that could support the implementation of a similar plan in the future, should the need arise. It is likely that any check-coupon based rationing plan will be based on the concepts embodied in this study, and will require the creation and maintenance of a mailing file that is computerized, national in scope, capable of handling approximately 150 million records in a timely manner, provide security and privacy safeguards, and be continuously updated to reflect changing conditions. Since the potential for fraud and error is so great in any such system, safeguards must be built in from the beginning.

The philosophy underlying this study is that a rationing plan should function solely to allocate a limited resource fairly, taking into account exceptional cases of need. The impact on the general public should be as small as possible. The rationing system should be able to respond rapidly to changing conditions and be responsive to human needs, with a minimum of bureaucracy and paperwork. It should not infringe on individual privacy or freedom. It is recognized that any government bureaucracy is generally viewed with some distrust by the public, and that a gasoline rationing system has the potential to become a large bureaucracy. The current situation - in which long lines are forming at gasoline stations, ad hoc schemes are being imposed locally (such as the odd/even rule) to alleviate the crisis, and availability is uncertain - constitutes an unfair "rationing" system in which no individual is assured of rights to any amount of gasoline. In light of a national policy to reduce oil imports, reduce pollution, and develop new sources of energy, the implementation of an effective and efficient rationing plan demands serious investigation.

It is the intent of this study to define as many technical parameters of a RCIR system as possible, and to determine the costs, risks, and benefits of various alternative systems. This study has not, and could not have, resolved all of the political issues involved, but it has attempted to identify many of these issues.

B. Assumptions

This study is based on the Standby Gasoline Rationing Plan documents presented to Congress in March, 1979. A set of assumptions were adopted from interpretation of those documents and from several background studies which had been carried out prior to May 1, 1979 - the beginning of this effort. This assumptions are listed below.

(1) A two-tiered method using ration checks and ration coupons will be used, in order to provide a method for fraud detection through reconciliation processes.

(2) Ration check issuance will be based on a "file" of names and addresses national in scope. This "file" must contain other information as well, depending upon the details of the plan (e.g., vehicle identification numbers or driver's license numbers). The "file" may be centralized, distributed, or decentralized, but there must be some provision for the detection and elimination of duplicate and other ineligible entries and for timely updating for new entries.

(3) Input data for this file can be obtained in a timely manner from the states' Departments of Motor Vehicles, at least for the initial phase.

(4) The file will be used to print ration checks for mailing to approximately 150 million individuals and commercial firms.

(5) There will exist on the order of 40,000 Coupon Issuance Points (CIPs) where these ration checks can be exchanged for ration coupons upon presentation of a valid vehicle registration form along with other identification.

(6) There will exist on the order of 4,000 Registration and Coupon Issuance Points (RCIPs) where non-recipients and new vehicle owners can apply for ration rights. The RCIPs will collect all the information required to establish a record in the registration file for subsequent mailings.

(7) There will exist a ration check reconciliation system for reconciling cashed checks and providing information for audit, enforcement, and allocation procedures.

(8) The response time (i. e., time elapsed between declaration of rationing and availability of coupons) should be less than 45 days. The system should support a phased distribution plan which spreads the work load evenly over the CIPs and RCIPs.

(9) Ration checks will be issued periodically during the rationing period, based on an allocation scheme that estimates the amount of gasoline available during the period.

(10) The Ration Check Issuance system must be flexible enough to provide for various allotment schemes, such as a state-based scheme or a ZIP code based scheme. It could not support arbitrary allocation schemes, however, such as one based on historical usage by individuals.

(11) Non-receipt of ration checks, due to changes of address, transfer of vehicles (new, used, and junked), and lost or stolen checks, should be kept as low as possible to avoid confusion and crowding at RCIPs.

(12) There will be widely advertised penalties for fraud.

(13) The "file" mentioned above, called the National Vehicle Registration File (NVRF) in the published plan, will be structured to contain the minimum amount of information about individuals, and would be used solely for the purpose of issuing ration checks and monitoring the rationing system. Security and privacy issues will be carefully considered and monitored.

C. Description of Effort

The study was conducted by staff from the Department of Energy, the Lawrence Berkeley Laboratory of the University of California (LBL), the Oak Ridge National Laboratory of Union Carbide's Nuclear Division (ORNL), and Booz-Allen & Hamilton (BAH).

The combined effort was directed toward the following activities:

Identification of key issues, both technical and political;

Evaluation of prior studies and other relevant documents;

Surveys of the capabilities of states, Federal agencies, and commercial firms to implement various parts of the plan;

Development of minimum and enhanced conceptual system designs, including several alternative approaches;

Assessment of data acquisition and maintenance techniques required to build a NVRF;

Assessment of key subsystems of the RCIR system;

Evaluation of interface requirements between subsystems of RCIR and between RCIR and a gasoline allocation system, the states' DMV systems, the U.S. Postal Service, and any management information systems.

D. Methodology

The methodology employed a parallel effort by the three teams (LBL, ORNL, and BAH) to gather information from states, Federal agencies, and commercial firms, develop a conceptual model as a working basis, and develop conceptual systems designs based on the knowledge gained from background materials, interviews, and general research activity. Computer modeling of some of the subsystems provided insight into system parameters required for handling large files. Interviews with personnel from other organizations provided insight into existing systems that handle similar large workloads on a regular basis. Close cooperation with staff from the Economic Regulatory Administration of the Department of Energy provided insight into the intent of the plan, political issues which had been addressed previously, and current interaction with Congress.

E. Summary of Tasks

(1) Review background materials to gain an understanding of the details of the Plan and to determine the need for additional studies in areas not adequately covered.

(2) Establish conceptual models of Ration Check Issuance and Reconciliation (RCIR) systems to provide a baseline for the study. The models were based on supportable assumptions for each module, and the interface requirements for each module were explicitly defined. Each module was

the starting point for a conceptual system design - therefore the technical and political issues affecting each module were identified and resolved, as far as possible, before initiating a system design.

(3) Establish data element requirements by conducting a thorough study of the Plan. Each data element must be described precisely, and a list of uses for that element developed, along with some indication of priority. The list of data elements formed the basis of the study of state DMVs. A precise description was necessary for the development of function specification of various subsystems.

(4) Determine data element acquisition methods by conducting interviews with state DMV personnel and with R. L. Polk and Company personnel. From the data requirements list, data deficiencies were determined and the capabilities of the states to provide these elements were determined. The final product of this task is a characterization of the states' abilities to provide current, accurate vehicle registration information to the NVRF processing center. In evaluating the state systems for deficiency correction, the following factors were considered:

Upgrade of state system using either state or contractor personnel;

Willingness of state to participate in the upgrade and continuing data acquisition exercise;

Capability of state to participate in the upgrade and continuing data acquisition exercise;

Alternative methods for obtaining vehicle registration data;

Capability of state file update system and possibility for upgrading that.

(5) Develop conceptual system designs for each module in the conceptual model. LBL developed a distributed system design, ORNL developed a centralized system design, and BAH developed a decentralized system design based on the assumption that the states could handle the job independently. These systems designs form the basis of a detailed technical feasibility evaluation in a later task. They also provide a basis for the evaluation of existing Federal, state, and commercial systems. The system designs specify possible implementation strategies (e.g., manual or semi-automated) for each of the subsystems. Practical questions of file sizes, throughput requirements, and compatible interfaces were addressed at this stage.

(6) Develop functional specifications for each subsystem, considering file sizes, file structures, software implementation issues, and communications requirements. These specifications determine the scope of effort and hardware which would be required to implement various system alternatives, and were the basis for the cost/risk/benefit assessment.

(7) Develop a cost/risk/benefit assessment by considering the functional specifications and the overall system requirements for getting ration

checks out in a timely manner, detecting fraud, and providing information to other rationing components (e.g., allocation, audit, enforcement).

(8) Assess hardware and software availability by matching the functional specifications developed above with vendor supplied specifications to provide input to the cost/risk/benefit assessment.

(9) Document the recommended system configurations to provide the basis for later issuance of a Request for Proposal, if required.

II. Conceptual Model

A. Introduction

A conceptual model is a set of interconnected modules which describe the functions of the system. Each module consists of a set of inputs, a set of functions performed on those inputs, and a set of outputs. The purpose of creating a conceptual model for the RCIR system is to provide a basis for conducting the investigation. Once a conceptual model has been agreed upon, further study is directed toward expanding each module into a system design in which greater functional detail is determined. Each system module can then be expanded in explicit detail, and the design parameters can be identified and changed, if necessary, to provide a detailed implementation scheme. The original modules of the conceptual model may change their functions as the design process proceeds from the general to the specific. However, at each step in the process, the three components of each module must remain explicitly specified - the inputs, the functions performed by the module, and the outputs.

B. Module Descriptions

The conceptual model for the RCIR system is depicted in the ORNL report. Each module will be described in terms of inputs, functions, and outputs.

1. Data Acquisition Module

The Data Acquisition Module provides at least the initial data sources for the NVRF. Inputs are the states' DMV files, augmented where possible by other sources such as the Title files used by some states to maintain individual records. This module is defined to consist of one or more processing centers equipped to receive, account for, and ensure completeness of the data sets. This could be a continuing operation, as the states send in updates on a regular basis; or, it could be a one-time function, with updates being generated entirely from other modules in the system. The outputs from this module include the complete set of vehicle registration files for building the NVRF and perhaps some feedback to the state DMVs to assist them in correcting their files.

— Inputs

State DMV files
Auxiliary information from other sources
Updates to state DMV files

— Outputs

Complete data set for 50 states and D.C. to NVRF

— Function

Receive, account for, and manage data input from states, and provide complete data set in machine readable form for the NVRF processing module. This may require data entry for states which cannot provide machine readable inputs.

2. Data Integration/NVRF Module

The Data Integration module creates and maintains the National Vehicle Registration File (NVRF) using the data sets provided by the Data Acquisition module. Validation and correction of the records takes place in this module, using such techniques as ZIP code matching, VIN validation, duplicate detection and resolution, and other error correction techniques. This module is responsible for integrating all sources of information for maintaining the highest quality NVRF possible. Correction files can be provided to the state DMVs, if those organizations desire to use these files for updating their records. Security and privacy issues must be resolved in this module.

-- Inputs

Data sets from the Data Acquisition module
Updates and corrections from Data Acquisition, RCIP, and Reconciliation modules

-- Outputs

the most current NVRF to the Ration Check Address File Module
Correction files to the states

-- Function

Maintain and validate the NVRF for the production of address files for Ration Check Address File module.

3. Ration Check Address File Module

This module uses the most current NVRF to produce the address files for the Ration Check Production module. The NVRF records are used to create files with only the information required for ration check printing and mailing and reconciliation. These records are sorted as required for optimal handling by the USPS. The task will probably be handled over a period of 20 days in order to spread the work load of the USPS, the CIPs and the RCIPs over a period of time. It may be necessary to generate a unique identification code for ration check reconciliation in this module.

-- Inputs

The most current NVRF
The allocation algorithm

-- Outputs

Address files to be sent to the Ration Check Production module and to the Reconciliation module

-- Function

The primary function of this module is to create address files used

for the printing and mailing of ration checks. Facilities for sorting the address files into proper sequence and providing staged address file subsets of a short period (20 days) are required. The address files are also used for ration check reconciliation, and may require the generation of a unique identification code for that purpose. This module also calculates the number of gallons allocated to each individual and prints it on each ration check, using a prescribed formula based on variables like vehicle category, state, or ZIP code.

4. Ration Check Production Module

The Ration Check Production module prepares the actual printed check on preprinted, controlled stock. The ration check may be a single or multiple form post card, a self-mailer, or a check to be stuffed into an envelope. Whichever form is used, this module is responsible for maintaining a stock, controlling that stock, printing the checks as required and delivering the checks to the Mailing module. The address files will already be sorted appropriately, so that mechanical sorting of the printed checks will not be necessary. It may be the case that pre-encoded check numbers (using MICR or OCR techniques) will have to be read and recorded on the address files by this module for reconciliation purposes, in which case that function would not be done in the Ration Check Address File module.

— Inputs

Ration check address files
Preprinted paper stock for ration checks

— Outputs

Batches of printed checks to be sent to the Mailing module

(Possibly) An updated address file with encoded check numbers to be sent to the Reconciliation module.

— Function

This module produces the printed ration checks, sorted into proper order, ready for mailing, handles all the required accounting for the paper stock, and possibly provides the Reconciliation module with the accounting files.

5. Mailing Module

The Mailing module receives batches of presorted checks from the Ration Check Production module, performs accounting functions, and prepares the appropriate bundles to be delivered to the USPS. Nondeliverable checks will be returned to this module for handling. Close coordination with USPS will be required to minimize the work load on the postal delivery system.

— Inputs

Batches of printed checks from Ration Check Production

— Outputs

Batches of sorted checks to USPS
Nondeliverable checks to Reconciliation module

— Function

Handle the accounting and control functions associated with delivery of ration checks in properly sorted and packaged bundles to the USPS, including accounting for nondeliverable checks for reconciliation.

6. Coupon Issuance Points Module

The Coupon Issuance Points (CIPs) are responsible for exchanging valid ration checks for negotiable ration coupons. Because the coupons can be traded for money on the white market, the CIPs must be capable of the usual money-handling procedures, as is done in banks, post offices, etc. It is assumed that the CIPs will require identification consisting of a valid vehicle registration, a driver's license, and perhaps some other identification as well. Cashed ration checks are sent to the Reconciliation module daily or weekly. Procedures may require the stamping of the vehicle registration for to prevent fraudulent use in the RCIP module. The various tasks possible for CIPs include a wide range of activities, but it is felt that the CIPs should have simple procedures and should be easily accessible - on the order of 40,000 CIPs are being considered.

— Inputs

Ration checks, vehicle registrations, and other identification from entitled individuals
Controlled stocks of ration coupons

— Outputs

Ration coupons to individuals
Ration checks returned to reconciliation module

— Function

Exchange valid ration checks for ration coupons, performing the usual money-handling accounting and control procedures.

7. Registration and Coupon Issuance Point Module

The Registration and Coupon Issuance Point (RCIP) module provides for the issuance of ration coupons to entitled individuals who did not receive ration checks through the mail. This includes new car buyers, people whose check was lost or stolen, people who have moved without leaving a forwarding address, etc. It specifically does not include the issuance of supplemental rations - that is assumed to be handled by other modules outside the scope of this

study. Because the NVRF is initially expected to have an unacceptable level of errors, the over-the-counter issuance of ration coupons to entitled people should be a relatively painless affair, not too different from cashing a legal ration check received in the mail. The RCIP will be responsible for registering the non-recipient for the NVRF to ensure that subsequent ration checks will be mailed to the right address. Thus the RCIPs will feed updates and corrections back to the Data Integration module. There is a wide spectrum of activities possible for RCIPs, ranging from the simple gathering of filled out forms which are then mailed to Reconciliation, to the sophisticated verification of entitlement via remote terminals to an on-line reconciliation system and/or physical inspection of the vehicle. Clearly the RCIP will have to perform all the functions of the CIPs in addition to the registration function.

-- Inputs

Vehicle registrations and other identification from individuals
Controlled stocks of ration coupons

-- Outputs

Ration coupons to individuals
Registration forms to Reconciliation and/or Data Integration/NVRF

-- Function

Registration of entitled individuals for the NVRF and issuance of ration coupons over the counter, including all the functions of the CIPs.

8. Reconciliation Module

The Reconciliation module provides for detailed ration check reconciliation, duplicate payment detection, fraudulent check alteration and replication detection, and update information for the Data Integration/NVRF module. A report (or file) is sent to the Audit/Enforcement module for handling exceptions. The reconciliation procedure involves matching cashed checks with mailed checks. In cases where mailed checks are cashed and RCIP registration exists for the same vehicle, Audit/Enforcement is notified of a possible fraud. In cases where mailed checks are not cashed after a certain period, that record may be removed from the NVRF under the assumption that the vehicle no longer exists, or at least no longer requires ration rights. The reconciliation process is the only mechanism for detecting and reducing fraud.

-- Inputs

Ration Check Address File
Nondeliverable checks
Cancelled checks
RCIP registration forms

-- Outputs

Update/correction files to Data Integration/NVRF

Exception cases to Audit/Enforcement
(Possibly) Usage data to Allocation

— Function

Reconcile cashed checks with mailed checks and provide fraud detection and NVRF updates and corrections.

The Audit/Enforcement and Allocation modules are outside the scope of this study. Only the interfaces to the Reconciliation module need concern us here, and the fact that the Allocation module provides input to the Ration Check Address File module for determining the number of gallons allocated to each individual according to the allocation algorithm.

This conceptual model for the Ration Check Issuance and Reconciliation (RCIR) system is complete. When each module is expanded into a conceptual system design, some of the functions may migrate from one module to another. For example, it may be more effective to combine the CIPs and the RCIPs and simplify the registration procedure, in order to have broader coverage for non-recipients. If this were done, the Reconciliation module would have to be enhanced considerably to provide for reliable fraud detection, and the error rate for handwritten registration forms filled out by applicants would be considerably greater than in the more sophisticated procedure using on-line data entry and edit techniques. The point is that this conceptual model provides a basis for considering these aspects of the problem as separate entities, with well-defined input, functions, and outputs.

III. Conceptual Systems Designs

A. Introduction

The conceptual model defines several functional modules by their inputs, functions, and outputs for each phase of the RCIR system. The next step requires that each module be expanded into system components that interact with each other in performing the functions of that module. At this design level tradeoffs among various alternatives can be analyzed. Design alternatives include choices between manual and automated operations and among architectural options of the system components. The architectural options are whether a particular system component will be centralized, distributed, or decentralized.

For the purpose of this study, the following definitions will be used:

A centralized system is based on a single (large) database that is controlled and maintained by a single authority. The database is kept consistent and accurate by virtue of having the entire database available in one system.

A distributed system is based on a set of databases controlled and maintained by a set of homogeneous authorities. This set of databases is kept globally consistent by virtue of intersystem communication mechanisms. Generally, each system is considered identical in function, responsibility, and authority, with a high degree of cooperation among the systems.

A decentralized system is based on a set of databases controlled and maintained by a set of autonomous authorities. This set of databases need not be kept globally consistent, due to the lack of efficient intersystem communication mechanisms. Generally, each system is totally independent of the others, but each performs a similar (but not necessarily identical) function. Authority and responsibility for system details is not rigidly defined, and autonomy is rigidly protected.

Examples of the three architectures:

(1) Centralized System - the Social Security Administration (SSA)

In the SSA system, the entire database is maintained on a large computer system located in Baltimore. Updates from field offices are sent to the central system to be processed in batch mode. On-line access to this database is provided over a telecommunications network for data entry and database query functions. This system is described in detail in Appendix A.

(2) Distributed System - The Internal Revenue Service (IRS)

In the IRS system, ten regional centers maintain portions of the database for local query and data entry operations. A master database is

maintained at a center in West Virginia using updates sent from the regional offices to the main center (on magnetic tapes shipped through United Parcel Service). The IRS system lacks an efficient intersystem communication mechanism necessary for a modern distributed system, but otherwise is performs as a workable model.

(3) Decentralized System - the States' Department of Motor Vehicles (DMV)

The 51 (states and D.C.) DMVs provide a model for a decentralized system. Although each state performs a similar function, there is little controlled interstate activity. Some states voluntarily cooperate in exchange of vehicle registration data for interstate transfers, and others do not. There is little uniformity of data elements maintained, update techniques, or procedures for data capture and validation. Since the states are autonomous, there is no mechanism to ensure any level of compatibility among systems. This is not intended to be critical of the DMVs, since there was no intent in creating a uniform system in the first place. It serves to illustrate the distinction between decentralized and distributed systems.

The three systems designs are somewhat difficult to compare on a module by module basis because of the different design decisions about which function to include in which module. In this chapter the designs are assessed according to the following criteria:

(1) Cost, in terms of manpower, facilities, equipment, and other expenses.

(2) Time required to implement a module, excluding the usual administrative delays in procurement of computer equipment.

(3) Effectiveness - a functional relationship expressing the ease and timeliness of obtaining ration rights and the probability of error.

(4) Risk - the probability of implementing a particular module at the projected cost, in the projected time, and at the projected effectiveness level.

Cost estimates are based on 1979 prices for equipment as quoted by major vendors. Personnel costs are based on government rates, assuming 100% add on to base salaries for burden and overhead. No consideration has been given to quantity discounts or early delivery premiums.

Time estimates are primarily software development time. Current government procurement procedures and manufacturers' delivery schedules are extremely unpredictable. Those delays in some cases could overlap development time, and in other cases simply delay development.

The level of effectiveness is a qualitative judgment. At one end of the spectrum one could issue coupons to anyone who requested them, causing a situation where ease of obtaining rights is very high but the error rate would be equally high, totally canceling the desired effect of a rationing system. At the other end of the spectrum, one could require that each vehicle be physically inspected each quarter by trained DMV personnel in order to qualify the owner for ration rights. In this situation, it would be very difficult to

obtain ration rights but the error rate would be very low. The long delay could make the system unworkable, again cancelling the effect of a rationing system.

Risk is primarily a function of software development requirements, reliance on new or exotic technology, and effort required to train personnel to operate a new system. Modules based on existing operating systems, applications packages, and network protocols are much more likely to perform as designed than those based on new development of complex software. Risk is generally a function of cost, time, and effectiveness, expressed qualitatively.

B. Data Acquisition Module

The states' Departments of Motor Vehicles (DMVs) are the original sources of data for Vehicle Identification Numbers (VINs), license plate numbers (LPNs), and driver's license numbers (DLNs). Although these state agencies do an adequate job of fulfilling their legislated functions, they are largely ill-equipped to take on the additional tasks involved in operating an RCIR. The state files are generally not currently suitable for additional functions required by the Standby Gasoline Rationing Plan for the following reasons:

(1) Vehicle registrations are renewed annually in most states; thus some of the files are up to one year out of date.

(2) Driver's licenses are usually renewed every four to seven years, so those files are even more out of date.

(3) States which do not mail vehicle registration renewals have poor quality address information.

(4) There is currently little incentive for ensuring accuracy of VINs.

(5) Sophisticated methods for address correction, ZIP matching, and VIN correction are beyond the capabilities of most state systems.

(6) Each state has its own vehicle classification scheme (designed for taxation), and none of the state schemes match the categories specified in the SGRP. Various definitions of vehicle weight are used which are difficult to match.

(7) Fuel type is not captured in many states.

(8) States with a staggered registration renewal policy have a small fraction (approximately one twelfth) of the capacity required to handle a total mailing in one month.

(9) The VIN correction program offered by R. L. Polk and Company is not capable of correcting the serial number portion of the VIN. While this is not important for vehicle recalls, it is extremely important for gasoline rationing.

According to the BAH analysis of a sample of ten states, if the states were delegated gasoline rationing authority, it would be necessary for DOE to perform the following tasks:

Provide direct assistance to those states not yet automated (e.g., Idaho), or not sufficiently automated (e.g., Kentucky, Alabama) to handle the mailing function.

Relax the vehicle classification rules to permit the states to use their own categories as they now exist.

Establish a central "data exchange" for interstate transfers.

Coordinate this activity with the Department of Transportation (DOT), the Department of Justice (DOJ), and the state DMVs.

Work with state legislatures to change DMV laws in states which do not comply with the minimum requirements of the rationing plan, such as using standardized VINs.

The BAH analysis of California's DMV concluded that approximately $4.2M would be required to augment staff, facilities, and equipment, including $2.35M for a contractor survey of vehicle owners designed to upgrade the accuracy of existing files. California already has a relatively sophisticated system on dedicated computers, with OCR input, monthly mailing of renewals, and 149 DMV offices distributed around the state. BAH's analysis indicated that costs appeared to be approximately linear in the number of vehicles. It is unlikely that the linear relation would hold for all states - especially those which share computing facilities with other agencies. The above cost estimates are superficial at best, and pertain only to a short term rationing situation. The proper method of evaluating a state DMV upgrade program is through a joint task force of staff from DOE, DOT, DOJ, and representatives of the state DMVs.

R. L. Polk and Company have been working with DMV files for over 50 years. Their cost estimates should be the most reliable for the data acquisition function since they have economic incentives for improving the quality of their files. They stated that their existing files are very good for 35 states, fair for the others except for the lack of California vehicles over 10 years old. In the pre-implementation phase, a test mailing would improve the accuracy of state DMV files and give a more reliable estimate of the error rate.

Polk's cost estimates for the pre-implementation phase were used in the Regulatory Analysis, in addition to an estimate of $120K per state for upgrade activities. The total cost for this phase was estimated at $8.9M.

In a centralized system, state DMV files and updates would be received periodically at a central site and be processed through sophisticated editing and updating programs designed to detect errors in VINs and addresses. It would be possible to develop LPN editing programs based on the various systems for assigning those numbers, but that would require a large development effort and a mechanism for tracking changes to the states' systems. Since LPNs are considerably shorter than VINs they are inherently more accurate and such a development effort would probably not be justified.

If DLNs are used, Polk's software would be of little help. The addresses on driver's license files are likely to be from four to seven years out of date.

Initial Data Acquisition Costs			
	BAH	Polk	ORNL
Time	<1 yr	1 yr	1.5 yr
Startup	32.4M	8.9M	14.4M
Standby	0	1.4M	4.6M
Operating/quarter	0	1.7M	4.6M

Comments: The BAH analysis was based on a ten state survey, and California was used as a model state for time and cost estimates. Some states would require longer than two years if left to their own resources.

BAH included a contractor survey for gathering missing data elements, at an estimated cost of $2.3M for California. National costs were calculated by extrapolating linearly from California, which has 11% of the registered vehicles. There was no analysis of the effectiveness of such a survey.

BAH assumed that, after upgrading state DMV systems, data acquisition would continue at that level with no further support.

The R. L. Polk and Company costs are incremental costs, which take advantage of their current operation.

The ORNL analysis for centralized operations assumed a pre-implementation phase of 18 months, with a linear build up of personnel during that period. The total cost was estimated at $14.4M.

Conclusions

The estimates for this module are the most unreliable. Data acquisition costs are strongly dependent upon which scenario is in effect, which unique identifier is required, how much states are willing and/or able to do, and how much lead time there is.

Attempting to use a database or a system for a purpose not foreseen in the original design is an extremely risk-prone venture. Most of the effort expended in developing systems and databases is aimed at optimizing them for their designated purpose - usually to the exclusion of auxiliary or ancillary purposes. It is especially difficult when a particular system is to be used for orthogonal purposes, and maximally bad when the purposes are directly contradictory. In this case, using vehicle registration files for taxation and for granting of ration rights is an example of directly contradictory purposes, and the reconciliation of the database will most likely be a difficult,

expensive, and marginally successful operation.

Other regulatory functions, such as safety and emission recalls of defective vehicles, tracing of stolen vehicles, and gathering statistical data on transportation and energy use, provide positive incentives for upgrading and standardizing DMV functions. In a strong regulatory environment, and an uncertain rationing situation, major peripheral benefits could accrue from interagency cooperation. That is, even if rationing is never put into effect, upgrade of state DMV functions could have a positive benefit to society, and the money could be considered to be well spent.

Creating allocation schedules and entitlement rules without considering the side effects on existing government functions is not a practical strategy.

C. Data Integration/NVRF Module

Building and maintaining a national file containing information on 150 million individuals is well within the capabilities of modern computing techniques. The major problems are in data acquisition from the state DMVs and the RCIPs. The differences in the three system designs for this module are:

A decentralized system would have a much larger error rate, unless a centralized clearinghouse could be made effective for interstate exchange of data. Even then the differences among state systems would cause uneven performance in updating the 51 separate files.

The centralized system would have much cleaner files by ensuring elimination of duplicates, address correction by ZIP matching, and VIN correction techniques. A significant lag would still remain due to the proposed method for collecting paper forms from RCIPs and integrating these updates with the original file by maintaining a large key entry staff and operation. Errors in VIN, addresses, etc. could not be easily corrected in this operation, and many people would have to return to the RCIP and fill out the forms again.

The distributed system supports on-line updates from RCIPs, which gives several major advantages. First, updates can be verified at entry time (real time ZIP matching and VIN checking). Second, errors can be corrected while the registrant is still present, providing a much more accurate source of information. Third, much of the key entry staff is not needed, so key entry errors from handwritten or typewritten input forms are eliminated to a great extent. Fourth, the updates are instantaneous, eliminating the "soft" fraud (see Chapter III G) of multiple registration.

The batch mode operations involving state DMV transaction files are similar in all systems because the distributed system must have adequate capacity for handling high transaction rates during business hours, leaving plenty of extra capacity during off hours for batch mode updates, sorts, etc. The only extra capacity required in the distributed system involves extra disk storage capacity not required for transaction handling.

In order to compare the centralized system design with the distributed system design, the Data Integration/NVRF module must be broken into subsystems. The software development effort for batch mode operations will be the same for both designs. Operations staff will be fewer for each regional center because of the smaller amount of batch work, but there are ten regional centers so the total operations staff will be larger. There is a large initial software development cost for the transaction software for on-line CIP and RCIP operations.

For the centralized system, the total costs of implementation include a large surge of data entry contracts in the first quarter. The data entry function requires a large staff of key entry operators not required in the distributed system. These functions are discussed in the analysis of the CIP/RCIP/Reconciliation modules. The costs for implementation, first quarter, and subsequent quarters are estimated to be:

Implementation (18 months)	$7.9M
First Quarter	$19.0M
Subsequent Quarters	$6.2M

For the distributed system, ten centers operating 21 shifts per week would require more operators and systems support staff - at least four people per shift, or 20 people per center, for a total of 100 operators and 100 systems support staff. Assuming the ORNL figures of $30K/yr and $50K/yr respectively, the quarterly operations costs would be $2M/quarter.

The hardware costs for the distributed system include lease/maintenance costs for computer centers. Costs for terminals and communications are covered in the CIP/RCIP/Reconciliation module discussion. These cost breakdowns are illustrated in the following table, where the Worst Case Normal and Best Case Normal scenarios were taken from the LBL report.

Hardware Costs for the Distributed System					
		Worst Case Normal		Best Case Normal	
Component		Purchase	Maint/mo	Purchase	Maint/mo
CPU	CIP	5.0M	17.4K	1.5M	5.3K
	RCIP	1.1M	3.9K	.33M	1.2K
Disk	CIP	6.1M	36.8K	6.1M	36.8K
	Spare	1.5M	8.2K	1.5M	8.2K
	Batch	1.1M	5.1K	1.1M	5.1K
Tape		1.5M	12.5K	1.5M	12.5K
FEP		2.5M	21.1K	1.6M	13.7K
Total		18.8M	105K	13.6M	82.8K
Lease/ quarter	48 mo. payout	1.175M		.85M	

In the following table, it has been assumed that the distributed system software development costs an additional 120 man years, at $50K per man year. Also it is assumed that the communications costs in the implementation phase are only 10% of normal operating costs over the 18 month implementation phase. The large surge of key entry operations assumed during the first quarter has been included in the implementation costs for the centralized system.

Cost Estimates for Data Integration/NVRF (Contracting and quarterly lease costs in $millions)						
	Implementation (18 mos)			Operations/quarter		
	ORNL	WCN	BCN	ORNL	WCN	BCN
Personnel	4.8	10.8	10.8	.6	2.0	2.0
Equipment	3.1	7.1	5.1	.5	1.2	0.9
Total	7.9	17.8	15.9	1.1	3.2	2.9

Conclusions:

It is difficult to estimate the cost savings which might be expected by having reduced errors and "soft" fraud in the distributed system case. These costs are better reflected in the Reconciliation module and the RCIP module. It is probable that the NVRF will be much more accurate and current with the use of on-line updates, and this should also provide for a much more flexible system, responsive to changes in allocation and entitlement rules.

D. Ration Check Address File Module

Given the sophisticated systems required for the other modules, address file generation is a minor part of any system costs. The ORNL design estimated only $100K per quarter for generating the address files, and the LBL design assumed that address file generation is absorbed in normal sorting and maintenance operations. The BAH estimates were based on the cost of computer time, which is totally absorbed in the lease/maintenance costs used in the other modules.

E. Ration Check Production

The BAH analysis estimated that a contractor could handle the printing and handling of checks for approximately $1.8M per quarter. The ORNL analysis assumed an in-house operation, which would cost about $1.4M per quarter. LBL assumed either would be adequate. From the Regulatory Analysis, the cost for producing the paper checks was estimated at $3.3M per quarter, so this module is not a major effort in any case.

F. Mailing Module

The cost of mailing is primarily in postage costs, which vary from $13.6M per quarter for postcards (at $.09 each) to $20M per quarter for stuffed envelopes. Clearly, a single mailing (or an annual mailing) of semi-permanent instruments, like plastic credit cards with embossed letters and magnetic strips, will be advantageous if rationing continues more than a few quarters. There is, however, a serious problem in calling upon industry to produce these instruments in a short period of time.

G. CIP, RCIP, and Reconciliation Modules

It is convenient to analyze the CIP, RCIP, and Reconciliation modules together, since it is in these modules the greatest contrast between a centralized and a distributed system emerges. Actually the important distinction between these system designs is not so much whether the system is centralized or distributed, but rather whether check verification, registration, and reconciliation are handled immediately, as in an on-line system, or at some later time, as in the batch system. It is in these modules where the greater costs and risks of higher technology systems can lead to greater effectiveness, lower error rates, and reduced fraud potential. For this analysis, the fixed costs associated with labor intensive operations will be distinguished from the variable costs, which go toward automating some of the functions.

Fixed Costs

The manual operations involving check cashing, coupon handling, daily teller close-out procedures, etc., will probably not vary much in either system design. The Regulatory Analysis estimated the CIP fixed costs to be $81M/quarter. The ORNL analysis bracketed that figure with a range of $32M to $130M/quarter. For this analysis the $81M figure will serve.

The manual operations of RCIPs will include all the operations of CIPs and in addition, a teller must either fill out a registration form or check a form filled out by an applicant. It is estimated that approximately 10% of entitled people will have to register at RCIPs each quarter. Each transaction at an RCIP will take up to twice as long as a CIP transaction, so the manual RCIP operations will cost about 20% of the CIP operations, or approximately $16.2M/quarter. The Regulatory Analysis estimated RCIP costs to be $14.2M/quarter. The ORNL analysis bracketed this figure with a range of $6M to $22M/quarter. Clearly it is expected that a more careful procedure would take longer but result in fewer errors and hence in fewer reregistrations. The $14.2M/quarter estimate will serve for this analysis.

In the Reconciliation module, undeliverable checks will have to be entered into the reconciliation database. Taking again an estimate of 10% of each quarter's checks to be returned, that portion of the ORNL analysis yields approximately $0.1M/quarter fixed costs for reconciliation.

The question of Federal Audit and Enforcement must also be addressed, since that function is directly related to the amount of fraud to be dealt with. The Regulatory Analysis estimated Audit and Enforcement would cost $14.7M/quarter for auditors, investigators, attorneys, etc. The LBL analysis makes a distinction between "hard" fraud, such as counterfeiting, wiretapping, etc., which is done by "professionals", and "soft" fraud, such as registering more than once, which is done by "basically honest citizens". Using estimates from the Secret Service, the Social Security Administration, and a 1976 Department of Justice study, the costs for dealing with fraud are estimated to be:

Soft Fraud: $22.5M to $45M per quarter

Hard Fraud: $13.7M to $86M per quarter

For the purpose of this analysis, Federal Audit and Enforcement fixed costs are assumed to be the minimum estimate for hard fraud, or $14.7M/quarter. Even though some forms of hard fraud can be prevented by on-line verification, it is probable that as the number of cases is reduced, the cost per case increases.

Variable Costs

Centralized (or off-line) System

CIPs must bundle checks and send them by secure transport to the Reconciliation center, where they are read into the system using OCR, MICR, or key entry techniques. The Regulatory Analysis estimates the total cost of check reconciliation at $.04/check; for 150 million checks the cost is $6M/quarter. Since reconciliation of ration checks is expected to be somewhat simpler than private banking practices, the ORNL analysis estimates the total cost of reconciliation to be only $1.3M/quarter. This includes only the OCR operations and not the cost of transport and handling. An arbitrary estimate of $.01/check for secure transport adds $1.35M/quarter to the CIP operations costs.

RCIPs must bundle registration forms in the same manner as checks, so the estimated cost of transportation is $.15M/quarter. At the Reconciliation center these forms will be key entered by almost 1000 key entry operators, which is estimated to cost $5.3M/quarter.

The Reconciliation function requires entering cashed checks into the system via OCR or MICR readers, at an estimated cost of $1.2M/quarter.

Distributed (or on-line) System

CIP tellers have credit verification or transaction terminals for validating check identification. This method forces tellers to check the identification carefully by entering one or more numbers into the system. The terminal then responds with a verification number not available to the person cashing the check. Thus soft fraud is minimized. The teller close-out procedure also is validated from the transaction database, eliminating most forms of teller fraud. Since the transaction is immediately recorded in the database, reconciliation for valid checks is done immediately and the cashed checks need not be transported to a center nor reentered into the database.

The RCIP function is considerably more sophisticated for the on-line system. Intelligent terminals can prompt the teller for missing information, perform edit/verification checks immediately, and reject incorrect entries. Since this procedure is done in the presence of the registrant, errors can be easily minimized by requesting corrected information from the registrant. RCIP reconciliation on-line eliminates soft fraud by preventing people from multiply registering, even with valid identification documents. Also no forms need be transported to a center for key entry.

No additional reconciliation functions are required.

The costs for the on-line system are for terminals and communications. From the LBL analysis, two scenarios were specified, based on the number of working hours and peak loads. These two scenarios are:

Worst Case Normal (WCN)	60,000 CIP terminals 22,000 RCIP terminals
Best Case Normal (BCN)	17,850 CIP terminals 6,670 RCIP terminals

WCN is one shift (7.5 hrs)/day, 5 days/week, peak 4 times average.

BCN is two shifts (12 hrs)/day, 5.5 days/week, peak 2 times average.

The AT&T study assumed CIPs would be located at post offices, some on private lines, some dial-up, and that RCIPs would be located at regional centers with WATS lines for calling in registrations from CIPs.

Given these assumptions, the costs for the on-line system is represented in the following tables:

Terminal Costs for the Distributed System					
		Worst Case Normal		Best Case Normal	
		Purchase	Maint/mo	Purchase	Maint/mo
Terminals	CIP	24.0M	240K	7.1M	72K
	RCIP	66.0M	440K	20.0M	170K
Total		90.0M	680K	27.1M	242K
Lease per quarter	24 mo. payout	11.25M		3.39M	

To these costs must be added the communications costs from the CIPs and RCIPs to the regional centers, and between the regional centers. These costs are represented in the following table, based on the two normal scenarios from LBL and from the communications study done by AT&T.

Communication Costs for Distributed System (Quarterly Costs in $Millions)						
	WCN		BCN		AT&T	
	CIP	RCIP	CIP	RCIP	CIP	RCIP
Interregional	.018	.018	.013	.013	.095	.095
Regional	6.7	6.7	2.3	2.3	36.34	6.14
Total Quarterly	6.72	6.72	2.31	2.31	36.43	6.24

Using these estimates, the costs of the two systems can be compared. To summarize the fixed costs:

Fixed Costs for Manual Operations (Quarterly operating costs in $millions)	
CIPs	$81.0
RCIPs	$14.2
Reconciliation	$ 0.1
Hard Fraud Enforcement	$14.7
Total Fixed Costs	$110

To these costs must be added the variable costs for the RCIR modules.

Variable Costs (Quarterly operating costs in $millions)					
Function	Item	Centralized	Distributed WCN	Distributed BCN	Item
CIP	Data Entry	1.2	3.0	0.9	Terminals
	Transport	1.35	36.3	2.3	Communications
RCIP	Data Entry	5.3	8.25	2.5	Terminals
	Transport	0.15	6.7	2.3	Communications
Total		8.0	54.25	8.0	
Soft Fraud		22.5	0	0	
Total	Variable	30.5	54.25	8.0	

Conclusions

(1) The fixed manual costs are bound to be several times the variable costs, and these figures do not include the cost of producing, printing, storing, and distributing coupons.

(2) The cost estimates for fraud prevention and enforcement are probably not very reliable, but they are a major tradeoff for the on-line system.

(3) Communications costs are the most sensitive and significant for on-line systems. These estimates were made from a heuristic model in the LBL study; the AT&T study used their existing network model and a detailed configuration based on actual population distribution and placement of USPS Sectional Centers and branches.

IV. Summary of Costs

The implementation costs vary considerably according to system design. Initial data acquisition cost estimates range from $8.9M to $32.4M. Implementation of the Data Integration/NVRF module was estimated to cost between $2.4M and $17.8M. The initial costs for training CIP and RCIP personnel were estimated to be around $10M. These costs cover the large majority of the implementation phase, are extremely rough estimates, and represent a small portion of the overall costs. In this analysis it was convenient to move as much of the cost into the operations phase as possible, primarily to expedite the comparison of various systems.

The comparison of costs among the various systems designs is somewhat deceptive due to the widely different operating conditions and effectiveness of the designs. However, it is instructive to consider these estimated costs in judging the relative importance of the functional modules in operating the RCIR system. In the following tables the "fixed" costs of other modules from the Standby Gasoline Rationing Plan Regulatory Analysis are shown without further analysis. The operating costs for the RCIR modules are derived in the preceding sections and from the LBL, ORNL, and BAH reports. The absolute cost figures represented here are probably not very accurate; however, the relative costs for various subsystems are expected to be fairly reliable.

Fixed Operating Costs (from the Regulatory Analysis) (Quarterly costs in $millions)	
Coupon production	32.9
Check stock production	3.3
Postage	20.0
Public Information	8.0
Management and Administration	5.7
Manual CIP Operations	81.0
Manual RCIP Operations	14.2
Federal Adjustment and Appeals	4.7
Federal ration banking	65.0
Federal Audit & Enforcement (Hard Fraud Cases)	14.7
Total	249.5

The Regulatory Analysis also estimated that state and private industry costs would be $455.3M per quarter.

Variable Operating Costs for RCIR Modules (Quarterly costs in $millions)					
	States (BAH)	Polk	Centralized (ORNL)	Distributed WCN	Distributed BCN
Data Acquisition	0	1.7	4.6	4.6	4.6
Data Integr./NVRF	0.5	1.7	1.1	3.2	2.9
Address Tape Prod	0.1	0.1	0.1	0.1	0.1
Check printing	1.6	1.3	1.4	1.4	1.4
CIP	2.6	2.6	2.6	39.3	3.2
RCIP	5.5	5.5	5.5	15.0	4.8
Reconciliation	4.9	0.7	1.3	0.1	0.1
Total Variable	15.2	13.6	16.6	63.7	17.1

The cost of audit and enforcement for "soft" fraud would apply to all but the Distributed systems - i.e., an additional $22.5M to $45M per quarter might be incurred in fraud detection for the first three designs in the above table.

Comments:

(1) Some of the figures used in the BAH analysis had to be reinterpreted to conform with the module subsystems in which fixed costs were broken out from variable costs. These estimates are very unreliable and are presented here for comparison purposes only.

(2) The same reinterpretation of cost estimates applies to some of the R. L. Polk figures as well. It is particularly important to note that the Polk report was based on slightly different assumptions that the later analyses by ORNL.

(3) The ORNL estimates are probably the most realistic in light of the fact that they used existing price schedules and detailed design parameters in their study.

(4) In general, the imprecision of the rules and conditions under which any of the systems would be implemented does not permit valid comparison of costs across the board, as may be implied by this table. Each system design does a different overall function, in terms of error rates, fraud levels, effectiveness, etc.

V. Cost/Risk/Benefit Assessment

A. Definition of Parameters

The methodology for this study employed three teams developing the design and information background for three system architectures, viz.:

A decentralized system in which each state would handle some of the functions of the RCIR system and the government would handle the rest.

A centralized system in which all RCIR functions would be handled by a single government agency on a large computer system.

A distributed system in which ten regional centers with interregional communications would handle RCIR functions.

These three options represent increasing use of modern computing and communications technology, which implies longer lead times and higher risks, but also the possibility of improved effectiveness, more flexibility, and lower costs in the long term. To put these options in perspective, five scenarios will be described which help define the different features of each system design. The parameters describing the scenarios are defined as follows:

(1) Lead time - the time required to implement a system.

(2) Error rates - the rates which cause entitled individuals to not receive their allotments promptly.

(3) Fraud levels - the ease with which ration checks may be forged, counterfeited, or obtained illegally.

(4) Impact on other agencies - the extent to which the system negatively impacts the missions of other agencies, implying that DOE would have to provide funding or other assistance to the impacted agencies.

(5) Exclusiveness to gasoline rationing - the degree to which a system could not be useful to the mission of other agencies who might be expected to provide support or other assistance.

(6) Costs - the operating costs of a system

(7) Risks - the probability that a system design will not be implemented as specified and meet the design goals. In general, systems requiring off-the-shelf hardware and software, and little training of personnel is low risk; a design requiring implementation of relatively new components and special training of personnel is high risk. In either case, a system requiring the management and administration of a complex environment is also high risk.

(8) Privacy - the extent to which private information about individuals or organizations could be made available to unauthorized (i. e., for purposes not related to gasoline rationing) agencies.

(9) Inflexibility - the extent to which the system can not be quickly and easily changed to meet different requirements, such as new allotment

schedules or new entitlement rules.

(10) Permanency - the appropriateness of a system for a long term rationing system. Low values indicate that a system is appropriate for a short term program which is expected to be temporary. High values indicate a system is appropriate for a continuing government rationing program, similar in nature to the social security and income tax programs.

In terms of these ten parameters, a set of five scenarios has been created to emphasize the different features of various system designs which depend upon the conditions under which gasoline rationing might occur. The scenarios cover a range of situations from short term emergency conditions to a long term regulatory rationing program.

The cost analyses in the various scenarios can not be considered very reliable. There are so many unknown details in any project this large in scope that a single factor could easily override all the others. The cost estimates do provide a fairly reliable estimate of relative operating costs for comparison among system designs.

The five scenarios represent on decentralized case, two variants of the centralized case, and two variants of the distributed case. The distributed system which consists of all 50 states operating standardized DMV offices and having full interstate communication capability has not been analyzed in detail in this study. The scenario does make an interesting comparison with the others, however, so the values of the ten parameters have been estimated from experience alone.

Given a detailed set of conditions and rules for allotment and entitlement, these scenarios should be useful in completing a final design. Of course, various combinations of these scenarios are possible too, such as starting with R. L. Polk and Company during an emergency and later converting to a government run system.

B. Scenarios

Scenario 1:

Emergency situation, short lead time for implementation;

High error rate implies that the rules can not be rigidly enforced so people can obtain ration rights promptly;

Fraud prevention is not an important issue because the rules are fuzzy and not rigidly enforced;

Impact on other agencies, such as state DMVs, USPS, Treasury, commercial banks, is great;

Benefits to other agencies is not a consideration;

Costs should be minimized because of the temporary nature of rationing;

Risks should be kept low because the system has to work quickly;

Privacy is protected because existing files are used by state agencies;

Flexibility is not important;

Permanency is not relevant.

Recommendation: Delegate rationing authority to states, with as much Federal assistance as necessary for contracting the mailing, CIP, RCIP, and reconciliation functions to appropriate firms or agencies. The rules would have to be relaxed since states do not have the same vehicle categories as the DOE plan, and multiple registrations are not always detected.

The BAH analysis indicates that this plan would be negligibly cheaper than the DOE Regulatory Analysis indicated. Primarily, the major costs are in coupon production, postage, and CIP/RCIP personnel. It would have a major impact on the DMVs and may be of some benefit to them and to the Department of Transportation (DOT) and the Department of Justice (DOJ) if enough Federal assistance were forthcoming. At any rate, if the onset of rationing is entirely uncertain, any action in this direction could be of benefit to some ongoing programs.

Scenario 2:

One year lead time, but capable of a short term response at 25-30% error rate;

Error rate would decrease over a year to about 10-15%;

Fraud prevention capability would increase to a level similar to that seen with Treasury checks;

Impact on other agencies would be minimal;

Exclusiveness to rationing is moderate because of commercial uses and because vehicle recall files would be improved;

Costs are minimized by commercial value of the system;

Risks are low because of existing operation;

Privacy could be jeopardized by the creation of a national file containing information on individuals;

Inflexibility would be severe if entitlement rules changed from vehicles to individuals;

Permanency is not an option due to commercial nature of the system.

Recommendation: Contract with R. L. Polk and Company to upgrade their existing system by acquiring missing data, cleaning up their non-commercial files (old cars, states with privacy restrictions), and acquiring additional

resources. Polk's cost estimates did not include CIP and RCIP operations or reconciliation - costs which greatly exceed the NVRF costs anyway. Polk would have the highest quality short term response if the rules (vehicle categories, fuel type) were to be strictly interpreted. However, if entitlement rules were changed to driver's licenses or social security numbers, Polk would be of no help at all. The Federal privacy rules do not apply to a commercial company, but Polk already has to deal with restrictions from 15 states.

Scenario 3:

Eighteen month lead time;

Error rate 10-15%;

Fraud prevention at Treasury levels;

Impact on other agencies minimal;

Exclusiveness to rationing moderate;

Costs are not a major constraint;

Risks are moderately high;

Privacy could be jeopardized but legislative safeguards could protect privacy, as for Social Security, Internal Revenue Service;

Inflexibility would not be a problem because of government control;

Permanency is expected.

Recommendation: The centralized system designed by ORNL would be appropriate if rationing were viewed as a long term situation requiring continuing government control. Risks are somewhat higher than in Scenario 2 because of the lack of experience in this area, but they are nevertheless minimized by the specification of existing data entry techniques and a standard hardware/software configuration. The costs are reasonable for a large government operation. The error rates and fraud prevention level will probably never improve much due to the manual handling of registration forms and checks, the long time delays between execution and detection of fraud, and the large number of people required to run the system.

The ORNL design is fairly detailed and complete, and could be used as the starting point for an implementation plan. It would create an obsolete system in the not too distant future, however.

Scenario 4:

Two years lead time to implement;

Error rate approaches less than 5%;

Fraud prevention potential must be very good - all "soft" fraud eliminated, "hard" fraud minimized;

Impact on other agencies moderately high because of the introduction of new technology into USPS or DMVs;

Exclusiveness to rationing is low because of the adaptability of the system to similar uses;

Costs are appreciable compared to previous scenarios;

Risks are high because of use of relatively new technology;

Privacy is somewhat better protected by regional autonomy;

Inflexibility is not a problem because of the flexibility of the updating system;

Permanency is expected.

Recommendation: The distributed system designed by LBL would be appropriate if rationing were declared a long term regulatory situation. Modern techniques for on-line database query and update should expedite rationing functions, eliminate "soft" (or casual) fraud and make "hard" fraud (counterfeiting, wire-tapping) much more difficult. The risks are much higher than the previous scenarios because of relatively new technology, special training of personnel, and distributed management functions. Privacy can be protected a little better by having only regional databases with personal information - vehicles can be tracked across regions, but individuals don't have to be. The on-line registration function provides the most flexible system because new data elements can be captured over a period of time before allotment and entitlement rules change.

The impacts on USPS acting as CIPs and RCIPs would be great because of the introduction of new technology into a largely manual system. The benefits may also be great because of the impact of electronic mail in the near future. The costs trade-offs between manual and automated functions are negligible except for communications costs, which are estimated by LBL and AT&T to be between $18M and $200M per year. These costs are comparable to the other costs in the DOE Regulatory Analysis.

Scenario 5:

Two to four years lead time;

Error rate could approach 5%;

Fraud prevention moderately good;

Impact on DMVs maximal;

Exclusiveness to rationing is low - benefits to DOT and DOJ are con-

sidered important;

Costs are high;

Risks are high because of new technology, widely distributed and autonomous management, large training requirements;

Privacy can be fairly well protected by state autonomy;

Inflexibility is severe because of state DMV mission;

Permanency is not a prerequisite because of other uses.

Recommendation: In the situation where rationing is not expected for several years but planning can begin soon, an effort to upgrade the state DMVs to a standard level and provide for interstate exchange of information could be the optimal strategy. Since the Department of Transportation is interested in upgrading for vehicle recall campaigns, and the Department of Justice is interested in improving the tracing of stolen vehicles, the state upgrade program could have broad support from these agencies. The flexibility for gasoline rationing is limited to DMV-related data elements - e.g., a change from vehicle number to driver's license would be easy, but a change to social security number would be beyond the scope of the system. Risks would be highest of all because of state autonomy, large training costs, new technology, and the difficulty of heterogeneous systems interconnection techniques.

The costs have not been estimated for a fully connected 50 state network in this study. In order to better understand the problems and costs involved in such a plan, a task force should be established which includes knowledgeable personnel from DOE, DOT, DOJ, AAMVA, and state DMVs.

C. Analysis of Scenarios

In this section a method of analysis supporting the conclusions drawn in the previous section is developed. The method is quite straightforward:

(1) Characterize each scenario by assigning a "percentage of importance" to each parameter;

(2) Rank each system design relative to each parameter;

(3) Treat the scenario analysis table as a table of weights, and apply these weights to the relative ranking table for the system designs.

The parameters have been selected so that low values are "better" than high values in the relative ranking. Tricky assumptions in this analysis are:

Exclusiveness to rationing is the inverse of benefits to other agencies, so a low value implies greater values to DOT, DOJ, etc.

Risks are low in some cases only if the rules of allotment and entitlement are relaxed.

Permanency is low if the system can be dismantled easily - low values of permanency are arbitrarily assumed to be a virtue.

Analysis of Scenarios

Factor	Scenario One	Two	Three	Four	Five
Lead Time	30.0	20.0	15.0	10.0	5.0
Error rate	5.0	7.5	12.5	17.5	15.0
Fraud level	2.5	5.0	10.0	20.0	15.0
Impact	2.5	10.0	15.0	15.0	2.5
Exclusiveness	1.0	2.5	5.0	5.0	30.0
Costs	22.0	30.0	10.0	5.0	2.5
Risks	2.5	10.0	5.0	2.5	1.0
Privacy risks	22.0	2.5	10.0	7.5	14.0
Inflexibility	2.5	2.5	12.5	15.0	12.5
Permanency	10.0	10.0	2.5	2.5	2.5

These values, chosen rather arbitrarily, give a "profile" of each scenario in terms of the relative importance of each parameter. Graphic displays of these profiles are in Appendix C, and give a much more natural representation of the scenarios, since the actual values assigned are not important.

In a similar exercise, the five system candidates are ranked according to the ten parameters in the following table.

Analysis of System Designs					
Factor	Decent-ralized	RL Polk	Central-ized	Distributed Regional	States
Lead Time	1	2	3	4	5
Error rate	5	4	3	1	2
Fraud level	5	3	3	1	2
Impact	5	1	1	4	5
Exclusiveness	5	4	3	3	1
Costs	2	1	3	4	5
Risks	3	1	2	4	5
Privacy risks	1	5	4	3	2
Inflexibility	5	4	3	1	2
Permanency	1	1	5	5	3

The Scenario table can be thought of as a table of weights, representing the relative importance of each parameter for each scenario. Applying these weights to the System Design ranking table gives an indication of the appropriate choice of system design for each scenario.

Table of Weighted Values					
Scenario	Decent-ralized	RL Polk	Central-ized	Distributed Regional	States
One	18	25	33	36	38
Two	26	19	29	36	41
Three	33	28	27	27	32
Four	40	32	28	23	28
ive	38	41	28	23	19

The smallest coefficient indicates the preferred system design for each scenario. The relative sizes of the coefficients indicate the "distance" between the alternative designs.

This analysis should not be taken as a rigorous mathematical exercise, since all the numbers were generated on a "best guess" basis, taking into consideration the estimates from the three reports, previous experience in system designs, and general intuition. The analysis technique, however, could give a reliable decision making tool if the numbers could be made more valid.

Appendix A. Existing Operational Systems

A. Introduction

In order to determine some baseline parameters for the various system architectures, several Federal agencies and commercial firms were contacted who appeared to be operating large scale systems similar in nature to the requirements of an RCIR system. Among the characteristics of interest are:

* Large (several million records) databases used for periodic mailings to individuals

* On-line data entry and database query systems

* Controlled environments requiring security and privacy safeguards

* Telecommunication systems supporting widely dispersed users

* Reconciliation procedures for fraud and error detection

* Trained personnel performing these various functions, and personnel with expertise in the various areas of interest

* Possibly some excess capacity to handle some portion of the RCIR system functions on an emergency basis

The organizations surveyed for this study include:

* Ten state DMV organizations

* Moore Business forms, Inc.

* R. L. Polk and Company

* The Social Security Administration

* The Internal Revenue Service

* The Secret Service

A representative description of one of these existing systems, as applied to an RCIR system, is given in the following section. It is important to note that this description is solely in terms of the characteristics relevant to this study. This description should in no way be considered as an analysis of the effectiveness of the system in doing the job it was designed to do, which is in many ways entirely different from the functions of the RCIR system. This analysis can not be construed as any sort of critical statement about the design, implementation, or operational effectiveness of the surveyed systems.

It should also be noted that each of the people interviewed were extremely helpful and candid in providing the information requested. It would not have been possible to gather these baseline statistics without the full cooperation of the personnel at the surveyed agencies.

In the discussion an attempt has been made to interpret the surveyed system in terms of the conceptual model adopted for this study. In some cases this works quite well, while in others, the model must be strained somewhat to provide the proper perspective for systems designed to do something entirely different. It is hoped that the uniform view, based on the conceptual model, will assist in understanding the relevance of the operational parameters to this study.

B. The Social Security Administration System

The Social Security Administration (SSA) runs a large, centralized system for administering its programs, which includes the retirement system (Title II) and the Supplemental Security Income (SSI) system covering some forms of welfare cases. The survey of SSA consisted of telephone interviews with three SSA senior people and a one-day site visit to the Baltimore complex. The site visit was arranged by Charles Ryan of the Systems group, and included interviews with staff in telecommunications, database management, on-line systems, and check issuance. A variety of documentation was supplied which described operating functions and costs, error sources and rates, and other interesting technical details. The SSA people were very cooperative and informative in assisting with this study.

It is emphasized here that this section describes the SSA system only as a comparison to the manner in which a RCIR system might be implemented. The study is not directed to how well the SSA system performs the job it was designed to do, but rather how existing operations might reflect on the implementation of the various modules in the RCIR model. There should be no implications drawn from this study as to the operation of the SSA system per se.

a. Data Acquisition Module

For the purpose of this study, all data acquisition is carried out in the Data Integration and Registration modules. The Data Acquisition Module, responsible for acquisition of the initial database, has effectively disappeared for the SSA system and need not be discussed further.

b. Data Integration/NVRF Module

This module is well developed in the SSA system and constitutes the major computerized component of the system. The SSA system can be divided into two major components: (1) a batch mode system for processing updates to the large Earnings File (EF), the Master Benefits Records File (MBR), and the Supplemental Security Income (SSI) file; (2) an online system supporting data entry and database query functions against the Account file, the Control file, the Pre-Entitlement file and the Client Record Index.

The EF is analogous to the NVRF in some respects. It contains approximately 200 million records on the social security earning history of individuals. The records are keyed to a 13 digit unique identifier consisting of a nine digit social security number plus the first four characters of the last name, analogous to an NVRF identifier composed of VIN plus state code plus

model year, for example. New applicants are screened to detect duplicate accounts, since each person is supposed to have only one social security account. There are approximately 7.5 million new social security accounts per year, which is about the same level of activity expected from new vehicle purchases for the NVRF. The entire EF is processed about three times per week, screening new applicants and providing historical information on earnings in response to queries from the field. Approximately 250,000 duplicates per year are detected by the current algorithm, and SSA staff expressed the need for a better identify checking algorithm.

Although the size and activity level of the EF is similar to what would be expected for an NVRF, its purpose is not very analogous. A much closer analogy is the Master Beneficiary Record (MBR) file, which contains the active records for people entitled to social security benefits (called title II, for retirees, families of deceased, etc.). The MBR file consists of approximately 34 million records of active accounts containing historical data on entitled individual accounts, each of which may support up to 15 beneficiaries and up to 21 different payment claims - approximately 600 bytes of compressed data per record is allowed, with an average of 200 bytes per record. The activity on the MBR file is quite high - some 25,000 initial claims per day and some 250,000 post-entitlement transactions per day. The MBR file is totally rewritten every month is 20 segments, one per day. This activity on the MBR file is similar to that expected on a centralized NVRF. On-line data entry and database queries against the MBR file is on a different system and will be covered in detail in the Registration and Coupon Issuance Point module.

Another file on this system is the Supplemental Security Income (SSI) file, which contains records for individuals entitled to welfare (title 16) payments. This file contains approximately 25 million records distinct from those on the MBR file, and is operated with an entirely different set of rules due to legal constraints. The SSA took this function over from the states a few years ago and had problems with accuracy and currency over the years. The large amount of welfare fraud associated with this function is indicative of the scale of problems which might be expected in the RCIr system. New York and Chicago, for example, report a level of 10-15% loss of welfare checks due to theft and other forms of fraud. some of these problems will be covered in the Reconciliation module.

These three large files are handled on a completely batch mode system consisting of a triplex of IBM 370/168 mod 3 computers with four megabytes of memory each, and with 48 tape drives each. Very little disk capacity is required since the files are tape based sequential files. Specialized software utilities are used for file handling, data compression, sorting, etc. All software is written in assembly language. The entire library of SSA included over 400,000 tapes, most of which are 1600 bpi.

c. Ration Check Address File Module

The MBR file and the SSI file are the source for issuing checks to over 500 million accounts on a monthly basis. The title II recipients are maintained on an address file by the Department of the Treasury. Each month an update file consisting of about 10-15% is sent to Treasury, where ineligibles are deleted from the file. The file is divided into 10 sections by sorting on the last two digits of the social security number, which provides for a

uniform geographical distribution. This is very similar to R. L. Polk's proposal for preparing the address file in 20 sections sorted on first initial of last name. Approximately 20% of the accounts are direct deposit accounts, which go directly to banks and other financial institutions. This causes some problems when SSA wants to communicate with recipients. Treasury sorts the files by routing indicator and sends them to one of its seven disbursement centers around the country. The printing and mailing is done at the disbursement center.

d. Ration Check Production Module and Mailing Module

The Department of Treasury disbursement centers mail the checks. Moore Business Forms does direct mail of information to people who have left a forwarding address. The SSI checks are done through a separate disbursing center in Birmingham, Alabama. There is a direct link between Baltimore and Birmingham for data transmission. There are approximately 100,000 non-recipients from the 34 million title II mailings each month. These checks are returned to the SSA for further processing, which will be described in the Reconciliation module. Although the SSI (title 16) has only 4 million accounts, that system has about the same number of non-recipients. Reconciliation procedures are quite different for the two systems, however.

e. Coupon Issuance Points

The function of the CIP for SSA is served by banks since SSA checks are for money.

f. Registration and Coupon Issuance Points

The RCIP function for SSA is only the registration and information dissemination function, but it is fairly extensive and complex. The SSA maintains 1350 field offices, each of which has from 10 to 150 personnel, with an average of 30 people per office. Each office is equipped with one or more terminals online through one of two networks to the interactive system in Baltimore. There are also seven Program Service Centers (PSCs) which are staffed by 1800-2000 people each. Each of these is also equipped with online terminals and with Programmable Magnetic Tape Terminals (PMTTs). There are two types of Teleservice Centers, which have approximately 70 personnel answering telephones, referring to microfilm files, and generally relieving the pressure on the district office staff. There are 35-40 large teleservice centers, each serving large metropolitan areas (for example, the center in Laurel, Maryland serves the entire Baltimore-Washington D.C. area). There are about 30 mini-teleservice centers, which primarily front for the larger district offices. Each teleservice center is currently equipped with only a few terminals. The staff at the centers can issue queries against the database, enter initial claim information, and perform initialization of new accounts.

The on-line system to which all these offices are connected is quite complex. There are four major databases maintained on the system: The account file of completed actions, the control file of pending actions, a pre-entitlement file with accounts prefigured for people 60-65 years old, and a client record index which contains social security numbers and pointers to records on the other files. The query system may reference more than one file

to answer a query from the field. A query is entered interactively, but the answer is mailed in hardcopy form the next day as well as being printed on the terminal.

The account file is the largest database on the system. It consists of the full MBR plus the "Orbit" files, which contain updates to the MBR. Thus, a query will be passed against the Orbit files first, and if no hits are made it is then passed against the MBR. The MBR gets updated from the Orbit files on the batch-mode system described earlier. Transactions are retained online for about 100 days, and migrated on a Least Recently Used basis. The period is adjustable to account for variations in transaction rates and can vary from 90 to 140 days. Recently a mini-MBR has been created which omits most of the historical information on the full MBR, thus shrinking the record size from 600 to 180 bytes for the mean record length (the variance in record size is large). The records are variable length, and highly compressed. The TOTAL data management system is used to manage the files, using BDAM datasets with very high densities (about 90%).

The 1350 offices have 2500 terminals linked to the central system over one of two networks: the Social Security Administration Data Access and Retrieval system (SSADARS) and GSA's ARS network. SSADARS consists of seven sites distributed around the country which support a total of 19 concentrators. The concentrators support IBM 2260 protocol at 1200 Baud, provide desk calculator functions and two types of "surface" edits for data entry. The seven sites drive 9600 Baud trunk lines to the central system. The ARS network supports only 110 Baud teletypes on the GSA network. Also there are 57 Programmable Magnetic Tape Terminals in offices which handle health insurance, program service centers, and others. The PMTTs run bisynch at 4800 Baud directly to the central system.

g. Reconciliation Module

Reconciliation of Treasury checks is done through the Federal Reserve system. The SSA issues approximately 32 million checks per month and receives approximately 100,000 complaints of non-receipt. Some 60,000 of these are cleared by local auditing procedures, and the remaining 40,000 require signature verification. Of those, approximately 60%, or 24,000, were cashed improperly, and these cases are turned over to the Secret Service for investigation.

Appendix B. Bibliography

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(7) Communications Proposal, American Telephone and Telegraph Co. and Pacific Telephone Company, August, 1979.

Appendix C. Figures

Figure 1 shows the weight table for the scenarios.

Figure 2 shows the relative rankings of the system designs.

Figure 3 is a graphic representation of the scenarios shown as profiles, i.e., differences from the average values of each parameter.

Figure 4a shows the correlations between the parameters as derived from the weights assigned to each parameter for each scenario. Figure 4 shows the correlations graphically: white circles represent positive numbers, shaded circles represent negative numbers. Thus permanency and costs are positively related to lead time, and error rate is negatively correlated with lead time.

Figure 5 shows the profiles of each system design using the weights of Scenario one. It is evident that the differences from the average for the decentralized system are smaller for this Scenario.

Figures 6-9 show the profiles for the other Scenarios.

Analysis of Scenarios

	Scenario				
	One	Two	Three	Four	Five
Lead time	30.0	20.0	15.0	10.0	5.0
Error rate	5.0	7.5	12.5	17.5	15.0
Fraud level	2.5	5.0	10.0	20.0	15.0
Impact	2.5	10.0	15.0	15.0	2.5
Exclusiveness	1.0	2.5	5.0	5.0	30.0
Costs	22.0	30.0	10.0	5.0	2.5
Risks	2.5	10.0	5.0	2.5	1.0
Privacy risks	22.0	2.5	10.0	7.5	14.0
Inflexibility	2.5	2.5	15.0	15.0	12.5
Permanency	10.0	10.0	2.5	2.5	2.5

Figure 1

Weights distributed over parameters (sum to 100).

Analysis of System Designs

	Decentralized	R L Polk	Centralized	Distributed	
				Regional	State
Lead time	1.0	2.0	3.0	4.0	5.0
Error rate	5.0	4.0	3.0	1.0	2.0
Fraud level	5.0	4.0	3.0	1.0	1.0
Impact	5.0	1.0	1.0	4.0	5.0
Exclusiveness	4.0	5.0	2.0	3.0	1.0
Costs	2.0	1.0	3.0	4.0	5.0
Risks	3.0	1.0	2.0	4.0	5.0
Privacy	1.0	5.0	4.0	3.0	2.0
Inflexibility	5.0	4.0	3.0	1.0	2.0
Permanency	1.0	1.0	5.0	5.0	3.0

Figure 2

Relative rankings of system designs.

READY

Analysis of Scenarios
Profiles of the Scenarios

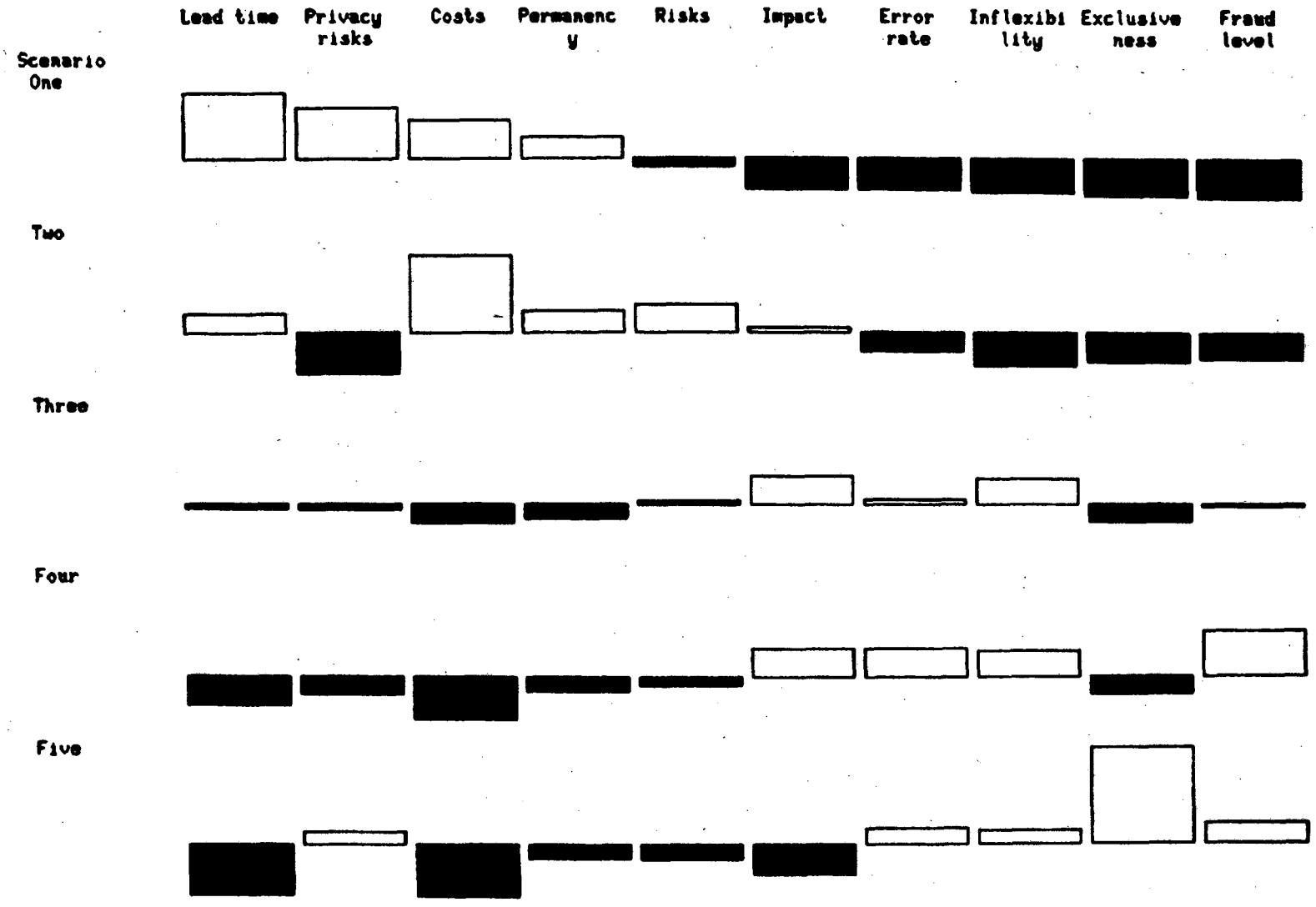

figure 3

Difference from the average.

READY

Analysis of Scenarios
Correlation among parameters

	Lead time	Permanency	Costs	Privacy risks	Risks	Impact	Exclusiveness	Inflexibility	Fraud level	Error rate
Lead time	1.0	.9	.8	.4	.3	-.2	-.7	-.8	-.9	-.9
Permanency	.9	1.0	.9	.1	.5	-.4	-.5	-1.0	-.9	-.9
Costs	.8	.9	1.0	-.1	.8	-.1	-.6	-.9	-.9	-.9
Privacy risks	.4	.1	-.1	1.0	-.7	-.7	.1	-.2	-.3	-.3
Risks	.3	.5	.8	-.7	1.0	.4	-.5	-.5	-.5	-.4
Impact	-.2	-.4	-.1	-.7	.4	1.0	-.5	.5	.4	.4
Exclusiveness	-.7	-.5	-.6	.1	-.5	-.5	1.0	.4	.5	.5
Inflexibility	-.8	-1.0	-.9	-.2	-.5	.5	.4	1.0	.8	.9
Fraud level	-.9	-.9	-.9	-.3	-.5	.4	.5	.8	1.0	1.0
Error rate	-.9	-.9	-.9	-.3	-.4	.4	.5	.9	1.0	1.0

figure 4a

READY

Analysis of Scenarios
Correlation among parameters

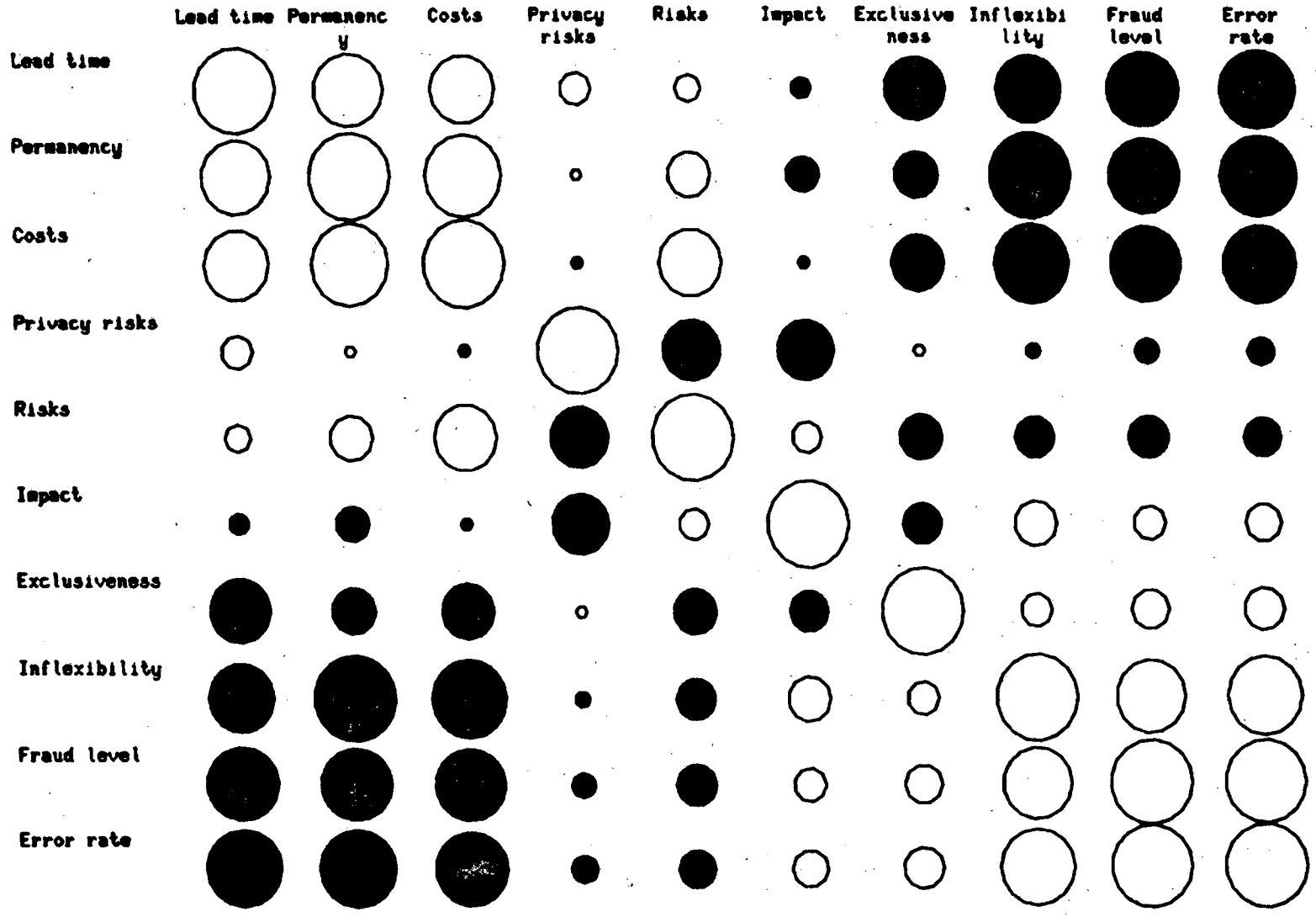

figure 4

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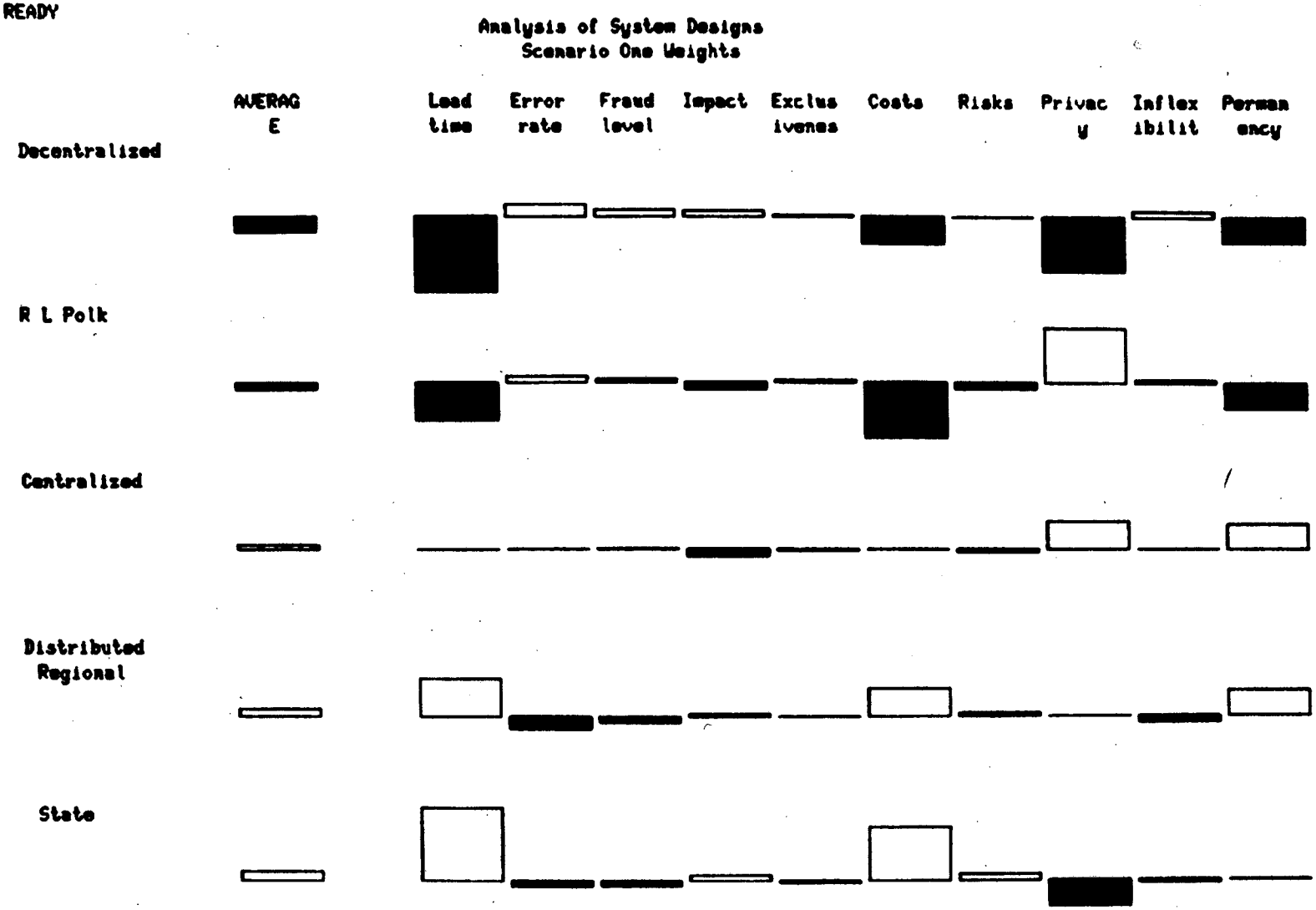

Figure 5.

Relative ranking of system designs for Scenario One.

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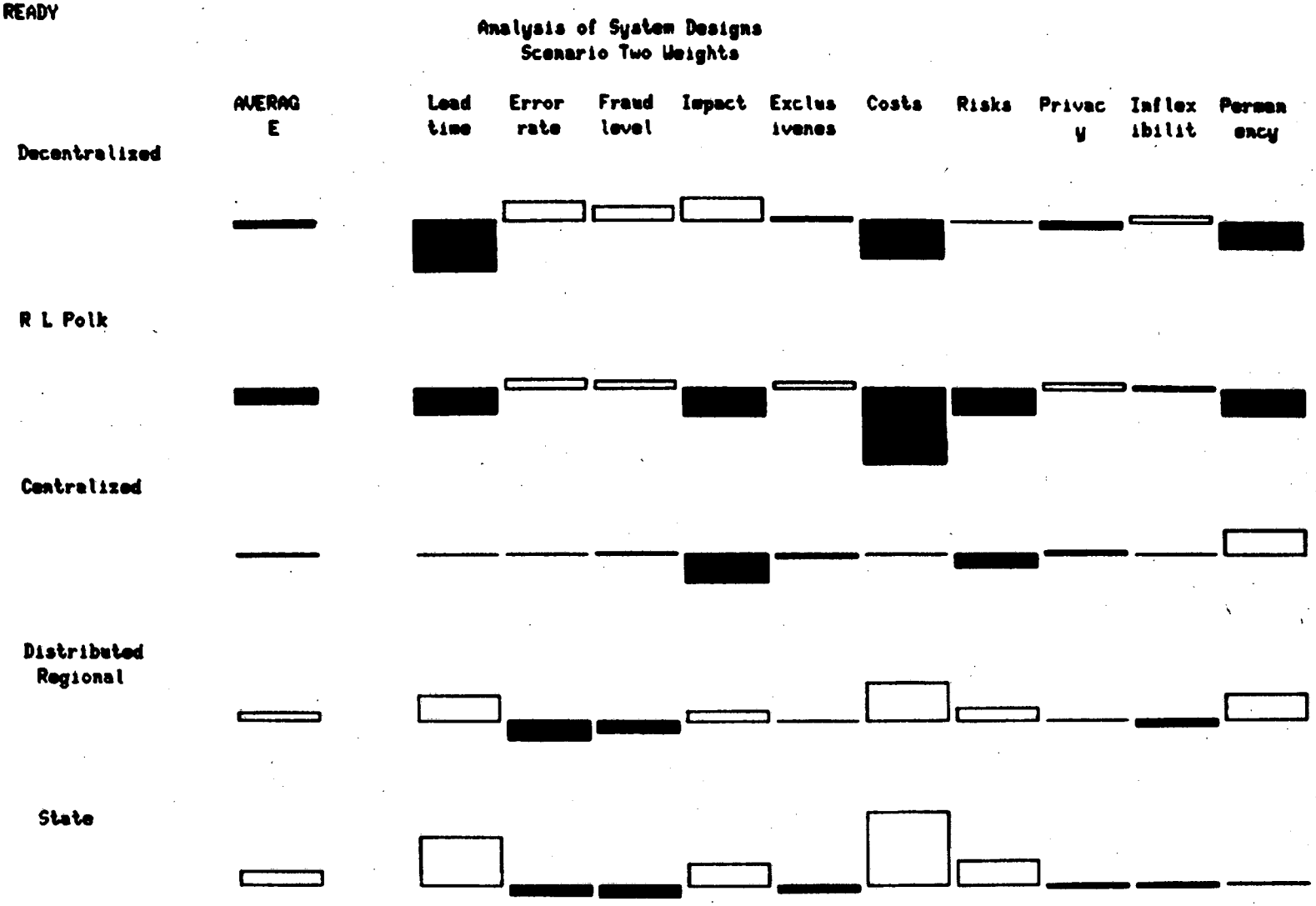

Figure 6.

Relative rankings of system designs for Scenario Two.

READY

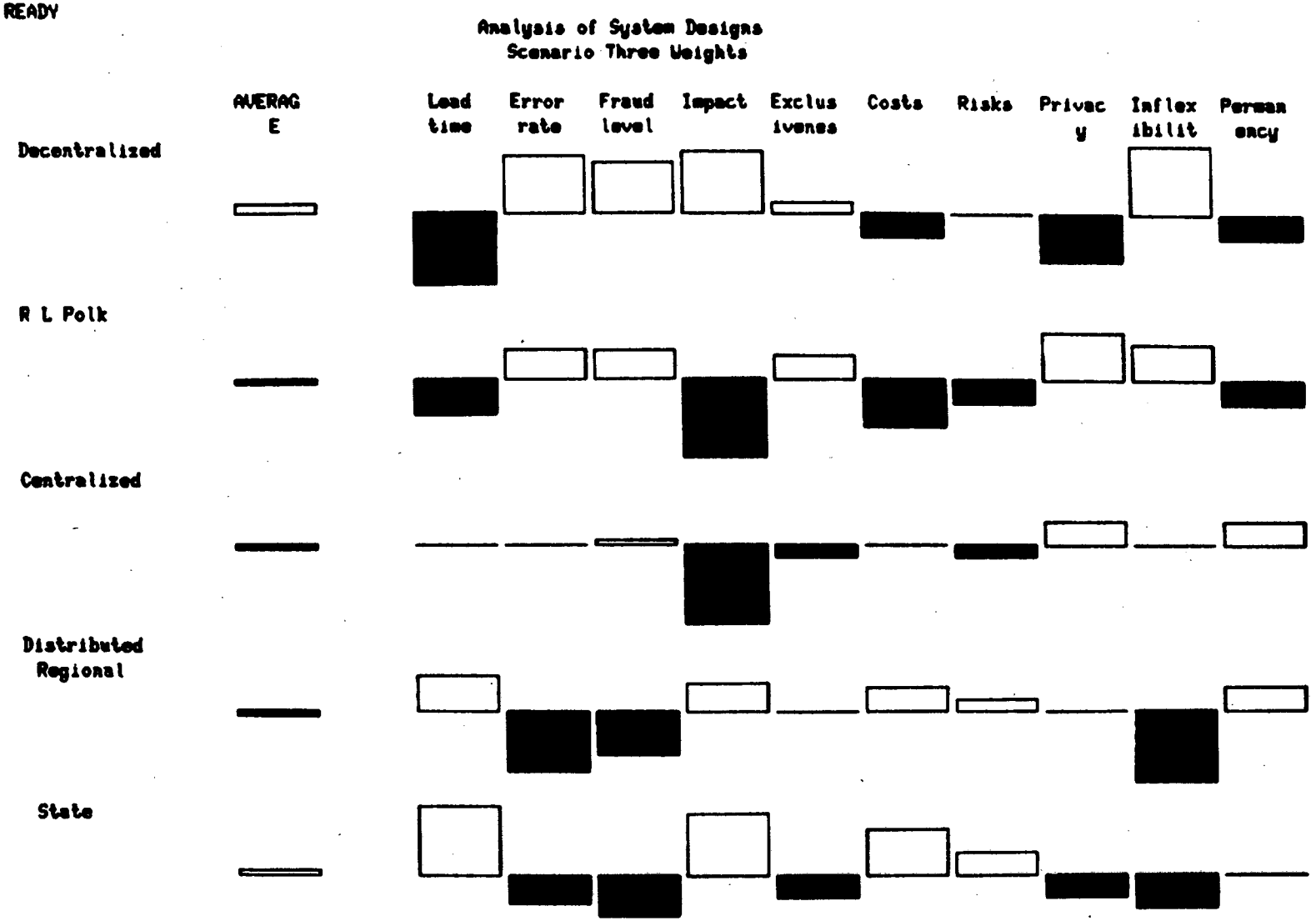

Figure 7.

Relative rankings of system designs.

READY

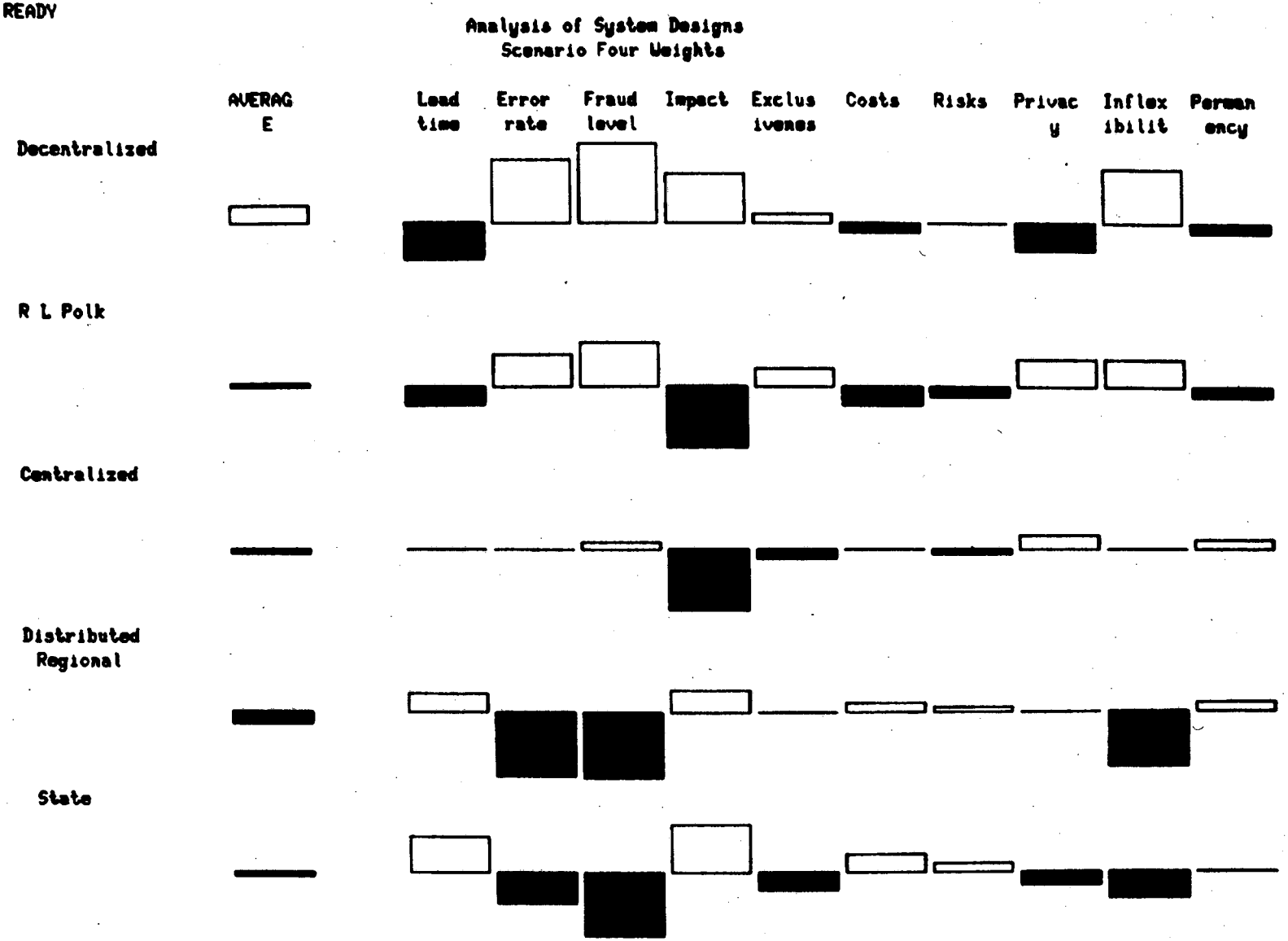

Figure 8.

Relative rankings of system designs for Scenario Four.

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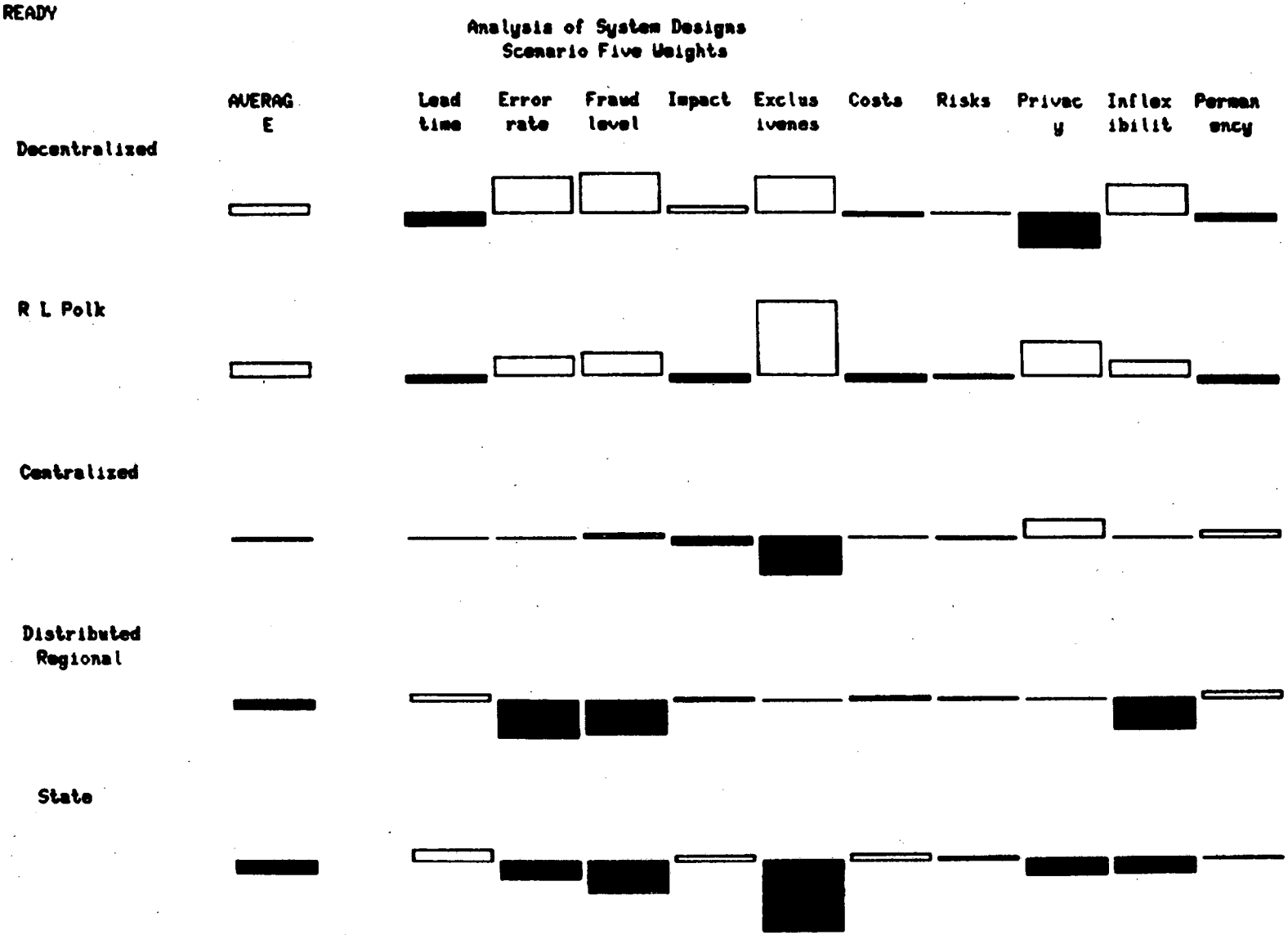

Figure 9.

Relative rankings of system designs for Scenario Five.

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