Iowa Department of Transportation

Records Management System

Indexing Standard
Document Standard
Technology Standard
Laboratory Configuration

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Iowa Department of Transportation

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Indexing Standard

June 30, 1997

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TABLE OF CONTENTS

1. INTRODUCTION

This report provides an overview of the Records Management System (RMS) Indexing Standards proposed for the Iowa Department of Transportation (Iowa DOT) by Universal Systems Inc. (USI).

1.1 Purpose of Document

The purpose of the RMS Indexing Standards document is to begin the process of developing indexing standards that will best support Iowa DOT's effort to build an agency-wide Records Management System. This document will provide a starting point for identifying indexing fields that will provide a data dictionary for Iowa DOT documents to be included in the RMS. This information will provide valuable input to the RMS vendors who will work with the Department to refine the implementation as the RMS initiative moves from pilot to production. In addition, this document will identify issues for further investigation and consideration in developing indexing standards for the agency-wide RMS. Indexing standards will provide a means to ensure that all documents entered into the agency-wide system will be accessible to users of the system in a consistent manner.

1.2 Role of the Committee

The Indexing Committee consists of a representative cross section of the Department and includes personnel from most Divisions. Maintaining this wide departmental representation will be essential for continued success in developing the agency-wide indexing standards. Extraordinary efforts must be undertaken to ensure that any proposed indexing standard will not exclude any organizational element within the Department. The primary goal of the Indexing Committee is:

> *"To develop indexing guidelines that will provide an effective information retrieval capability in an agency wide RMS or GIS".*

The activities involved in obtaining this goal include:

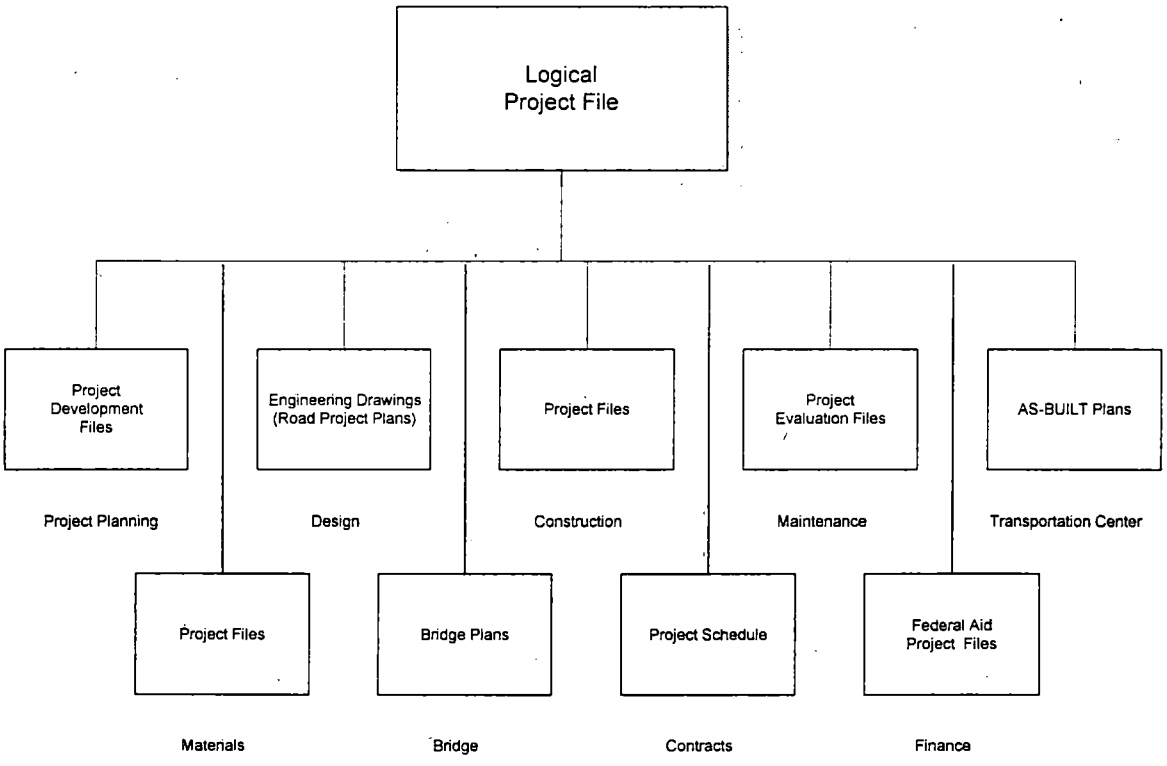
1. Identifying *potential* indexing fields for use in building data dictionaries,
2. Defining standard processes by which indexing requirements can be formed,
3. Evaluate indexing implementation choices proposed by RMS vendors, and
4. Defining standard guidelines which can be used to perform indexing operations.

While the indexing approach is one of the most critical design aspects of the agency-wide RMS, it is not critical that these standards be completed before issuance of an RFP. RMS vendors can build upon the foundation of work completed by the Indexing Committee for the development of pilot systems which will be evaluated by the Iowa DOT Document

Management Team. The Indexing Committee should work in conjunction with the Document Committee in supplying information that can be added to the Record Management Manual (RMM). The Department can then incrementally update the RMM as the individual business processes and the documents associated with these business processes are incorporated in the agency-wide RMS. The indexing standards can then be validated or adjusted as necessary based on the evaluation of RMS pilot systems.

1.3 Logical Files

With an electronic Records Management System, the Department will have the ability to create "logical" file structures that are impossible to create in a paper based system. This will be a new concept for many who view their own "project file" as the most complete project file in the DOT. Throughout the Records Management Manual, there are references to project files which are managed by different divisions and offices and therefore have different record series identifiers. What they have in common is a project number, whether it is a design, construction, or finance related record series. The following diagram depicts this concept.



Note: This diagram represents only one project related record series per office.

The indexing structure developed by the Index Committee will allow the Department to use an agency-wide RMS to: "Find all documents related to this project."

1.4 Record Series Administration

The agency-wide RMS should provide the ability to centrally administer the record series attributes of documents to be maintained in the agency-wide system. This functionality should be restricted to those individuals who are responsible for defining the indexing constructs by which documents will be managed by the system. This includes the following:

1. Creation and maintenance of all pre-defined indexing lookup tables.
2. Creation and maintenance of the hierarchical relationship between division, record series, and document types.
3. Record series, folder, or document level access controls through indexing constructs.
4. Definition of retention periods at the record series or document level within a record series.

1.5 References

The following is a list of resources used in developing this document for the Department:

- Iowa Department of Transportation, Document Management System Strategic Plan, Oct 25, 1996
- Notes recorded during Index Committee JAD workshops
- Iowa Department of Transportation Records Management Manual
- ANSI/AIIM TR40-1995: Suggested Index Fields for Documents in Electronic Imaging (EMI) Environments
- Lower Colorado River Authority (LCRA) Uniform Filing Structure (UFS) White Paper
- Department of Defense-STD-5015.2

USI is focused on recommending and assisting in the development of specific indexing needs for the Iowa DOT. It is ultimately the responsibility of the Department, and particularly the Committee, to define the indexing standards.

1.6 Definitions

The following definitions are referenced through out this document. The Indexing Committee will revise these definitions as clarifications are required through out the life-cycle of the agency-wide RMS acquisition.

Author - The originator of a document.

Custodian - The point of control for a record series. The custodian maintains the records description for a record series.

Owner - The point of control for the data in the document. The owner of the document may be considered the gatekeeper in charge of the document resulting in the current version of the document. Ownership is transferred as the document moves from office to office, while the custodian remain the same.

Agency-wide Index Building Blocks (elements)

Data Fields - Informational data related to a document or group of documents that are not directly related to finding a document such as custodian or a system defined Document Control Number.

Page - In hard copy, one side of a 2-dimensional sheet (e.g. paper, microfilm). As an image, the equivalent to one side of a 2-dimensional sheet.

Document - A collection of information authored for the purpose of transferring and preserving knowledge. It has a subject or purpose, an author, is static, is portable and independent from other documents, and has a defined distribution path. A document is information consigned to a medium.

Folder- A collection of one or more documents that are related (linked/bound) to each other in some way.

Index - Uniform structured criteria for organizing, storing, retrieving, searching and managing information.

Document Index - Information provided upon filing of a document that helps future user search for, locate, and retrieve a document.

Document Index Data Dictionary - A collection of uniquely named field names that may be used to define secondary document filing schema for different document types within the agency.

Document Profile - All informational and index fields that are related to a specific document. Comprised of data fields, document type index, secondary index, primary index, and primary folder key.

Primary Folder Key - Index information that uniquely references a document or group of related documents in a folder.

Agency-wide Index Fields - Index field that are common to all documents regardless of document classification or type. These fields consist of both mandatory and optional fields.

Primary Index - Mandatory index fields that are common to all documents regardless of document classification or type.

Secondary Index - Optional index fields that are common to all documents regardless of document classification or type.

Document Type Index - An index field that is specific to a particular document type. These index fields are typically associate to a document type that is specific to an organizational unit at either a Division or Office level.

Meta-data - Meta-data is information about information and is used to classify, group, track, retrieve and dispose of documents.

Mask - Data entered in a masked field is automatically changed to the format specified in the mask. A field defined with a mask prevents users from entering data in an invalid format, or converts the data entered to the required format (e.g. upper vs. lower case).

Look-up Table - Predefined list of index values that is centrally managed.

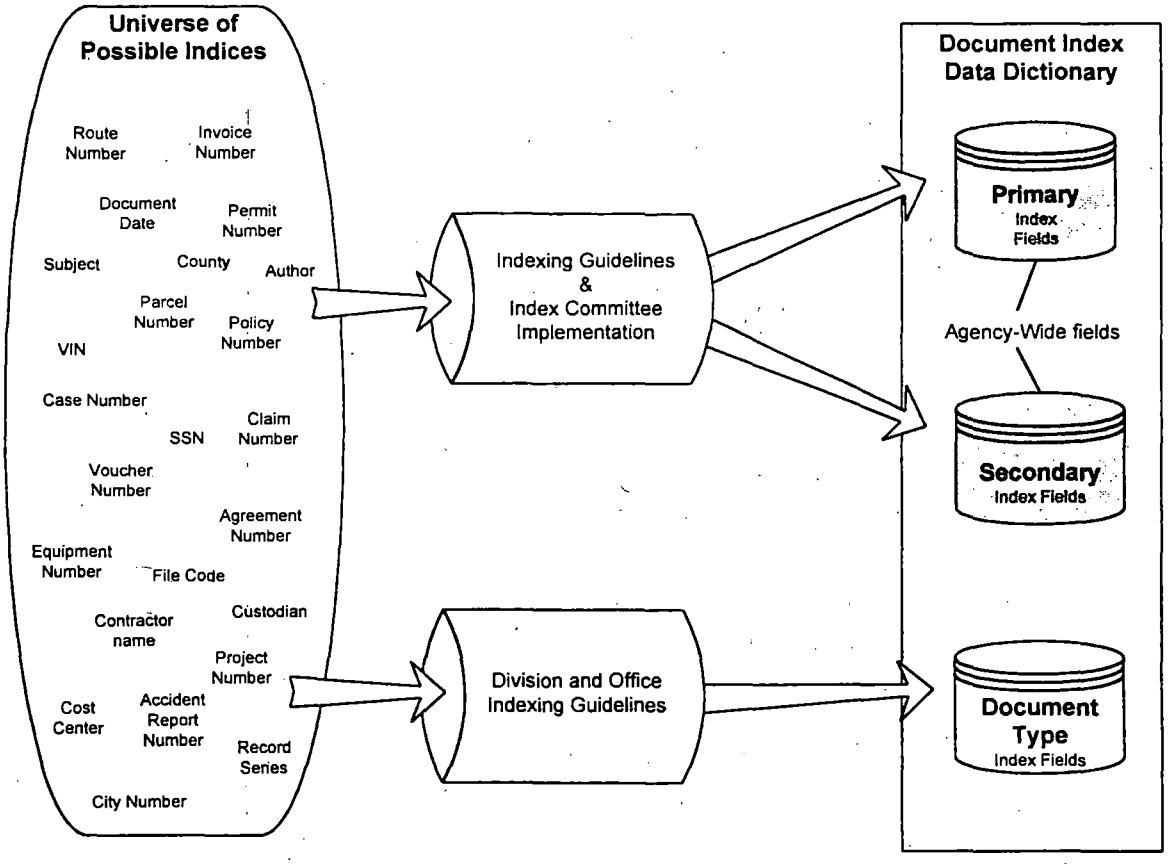
Secondary Key - Document level index information that may help to qualify references to a document or group of related documents in a folder.

Work Group - A group of individuals who share files, data, and possibly applications. Work groups are generally defined around an office, a project, or a group of tasks. The individuals who make up a work group may change as a project progresses or as tasks change.

2. INDEX STANDARD

2.1 Index Relationships

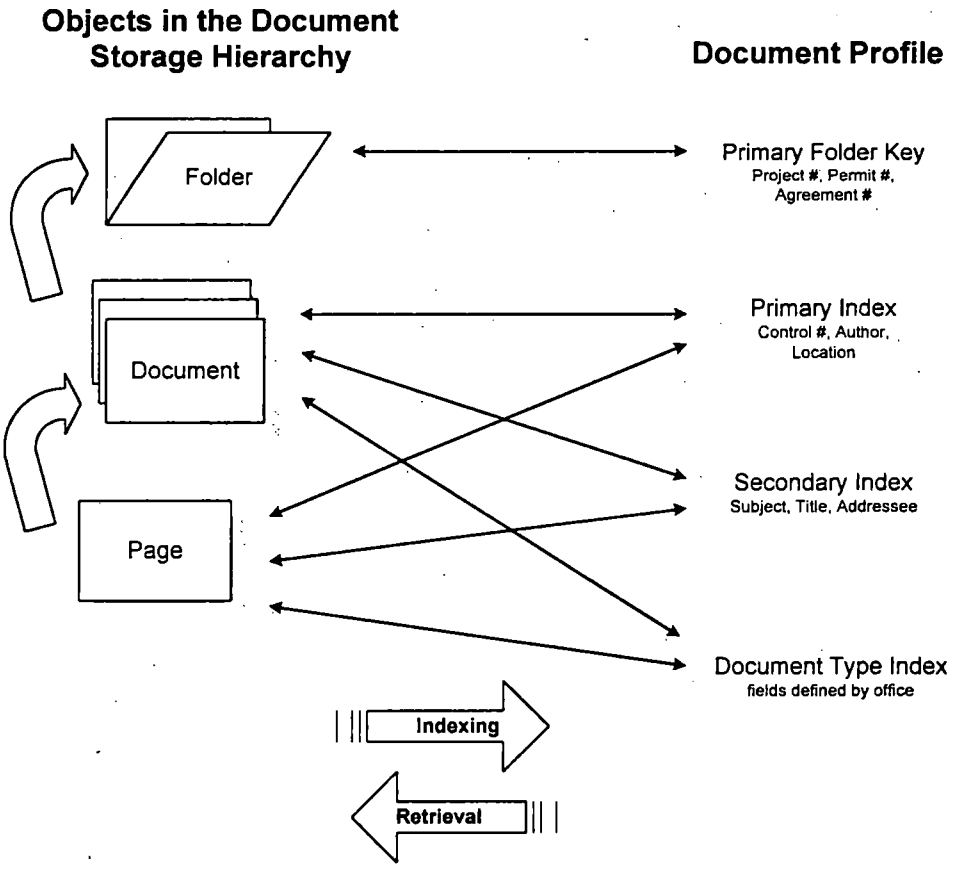
To give perspective to the index attributes described in Section 1.6, a hierarchical view of indexing entities are shown below. The Index Committee has sorted through the "universe" of potential document indexes within the Department and defined a list of common fields that apply to all documents (primary and secondary index fields). The process of selecting and defining index fields can now be passed on to divisions as a framework for defining and classifying other index fields. The Indexing Committee will work closely with the Document Management Team (DMT) to translate these concepts into a policy that will form the basis for an implementation approach. The following diagram illustrates the process.



The following diagram is a graphical representation of the relationship between objects in the system and the indexing values associated with the object. The objects in the left column are the levels of the system hierarchy used to store documents. This hierarchy is

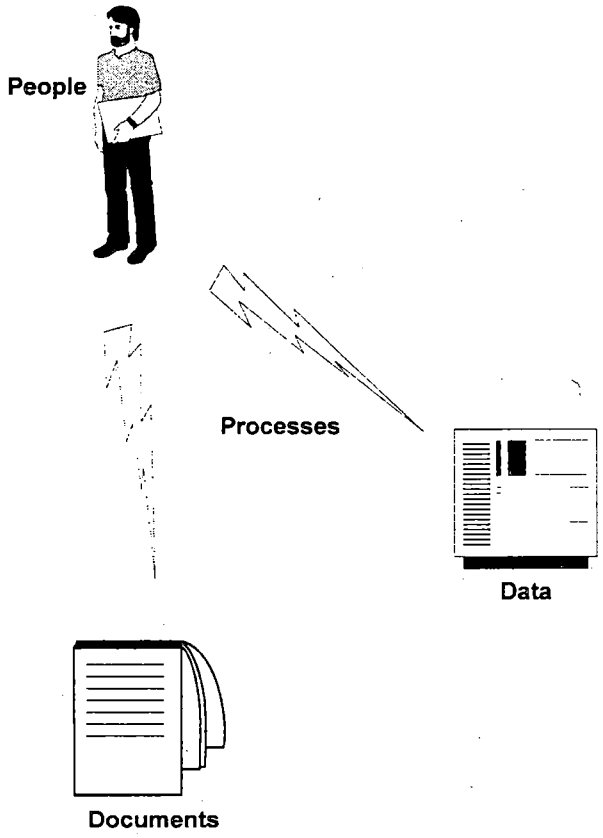
a logical structure. The folders and documents are defined so as to be useful for the system users. The values in the right column are the various indexes used in retrieving objects from the system. A given index is used to identify objects at a certain level in the system. For example, data fields in the Secondary index range may relate to a document or to specific pages within a document. Examples of the data fields that belong to each category of index are listed in the column.

When documents are indexed for addition in the system, information is taken *from* the objects and entered into the appropriate data fields. When a user is retrieving documents, information is entered in the data fields and then matched *to* objects in the system.



Note: This diagram is representative of how these indexes could be arranged. The samples do not reflect the conclusions of the Index Committee.

An RMS is composed of four components: People, Processes, Documents and Data. People work through defined processes and perform actions on documents and data. Documents are fixed objects, whereas data changes with time. The system processes are defined by the operators of the system, i.e., the committee and the project manager.



Retrieval is a process that uses data to allow people to find documents. Indexing standards provide structure to this process and data.

2.1.1 Document Index Attributes

The document index attributes identified below are intended to be a high level blue-print for the agency-wide RMS database schema. The following is a legend for the document index attributes identified for the agency-wide indexes.

Field Name - This is the name of the field as it would be displayed to an end user.
Description - This describes the field and provides other characteristics about the field.
Type - Valid values are Alpha-Numeric, Date, Number, or Text.
Mask - Provides a mask for data entry operations.

These document index attributes may be used as a reference for defining the data elements within a relational database schema for implementation within a RMS.

A majority of these attributes would remain transparent to an end user of the system. Providing the ability to specify default user preferences for document indexing may assist in automating the indexing and retrieval operations even further. The business rules associated to the record series, document types, folders and other indexing constructs can be programmatically enforced by the RMS software. The implementation choices for these business rules should be left to the capabilities of the selected RMS vendor.

2.1.2 Primary Index Fields

Primary index fields are mandatory index fields that are common to all documents regardless of document classification or type. The following is a list of all mandatory common document indexes currently identified:

Field Name	Description	Type	Mask
Document Control Number alias: DCN, Document ID	A unique number (which may or may not be a system generated field) that identifies a specific document within the system. This field will most likely be meaningless to an end-user, but may be useful in tracking the document in an agency-wide system.	Number	N/A
Date of Creation aliases: Date of Event	The date that the author/originator created the document. Date is determined from the author/ originator's point of view or the custodian in the case of external documents.	Date	mm/dd/yyyy
Author alias: Originator	The person or the office/position responsible for the creation of the document. The author is usually indicted by the letterhead and/or signature. For ownership purposes the author/originator must be a personal name or official title, not a code or alias.	Text	Free form + lookup table
Custodian aliases: Originating Office, Cost Center	Official name or code that reflects the agency, division, office, section, or position having physical and legal control over the existence, authenticity, location and accessibility of document. If the document is created by an external entity, the office of receipt is the custodian.	Text	Free form + lookup table

Field Name	Description	Type	Mask
Record Series alias: Document Classification	A group of related records arranged by subject or function.	Text	Lookup table
Reference Number(s)	A method of numbering and arranging documents by subject matter, e.g,, project number, permit number, agreement number, file code number.	Alpha-Numeric	Free form
Document Type	A sub classification of Record Series or file code referring to similar documents that can be indexed with the same document index fields.	Text	Lookup table
Document Location	Refers to the physical storage location for a document within the organization. It may be the RMS or a location where the hard copy is maintained such as the Library, or the Records Center.	Text	Lookup table
Physical Medium aliases: Document Format, Media Type	The physical form or characteristics of documents in a record series. E.g., paper, microform, photographs, slides, negatives, video, electronic files.	Text	Lookup table
Access Classification	A classification which designates a document as Confidential, Confidential Limited, Non Confidential, or Non Confidential Limited in accordance with Iowa DOT Policy No. 030.05 (Limited documents have an associated fee.)	Text	Check-box or lookup table
Status alias: Life Cycle States	A classification which designates the status of a document in terms of life cycle states of Draft, Final or Superseded. This status will indicate the access level outside the work group, which is determined by the owner/custodian of the document.	Text	Lookup table

2.1.3 Secondary Index Fields

Secondary index fields are optional index fields that are common to all documents regardless of document classification or type. The following is a list of all optional common document indexes currently identified:

Field Name	Description	Type	Mask
Subject	The subject matter that the document relates to.	Text	Free form + Lookup table
Title	The name of the document as specified by the author.	Text	Free form
Date of Receipt	The date of receipt by the agency, not the date of delivery to the addressee.	Date	mm/dd/yyyy
Addressee	The name of the agency, division, office, section, position, or individual to whom a document is addressed.	Text	Free form + lookup table
Keywords	Keywords that may be used to describe the subject matter of the document only from a list of predefined keywords.	Text	Lookup table

2.1.4 Primary Folder Key Index

The primary folder key index is the data element which associates a group of documents. The indexes shown in the following table should be associated with the responsible division, office or section within DOT. The responsible office should then be requested to provide a definition of the index similar to those already defined for primary and secondary fields. The following is a list of the potential primary folder key indexes identified that may be used within the agency-wide RMS.

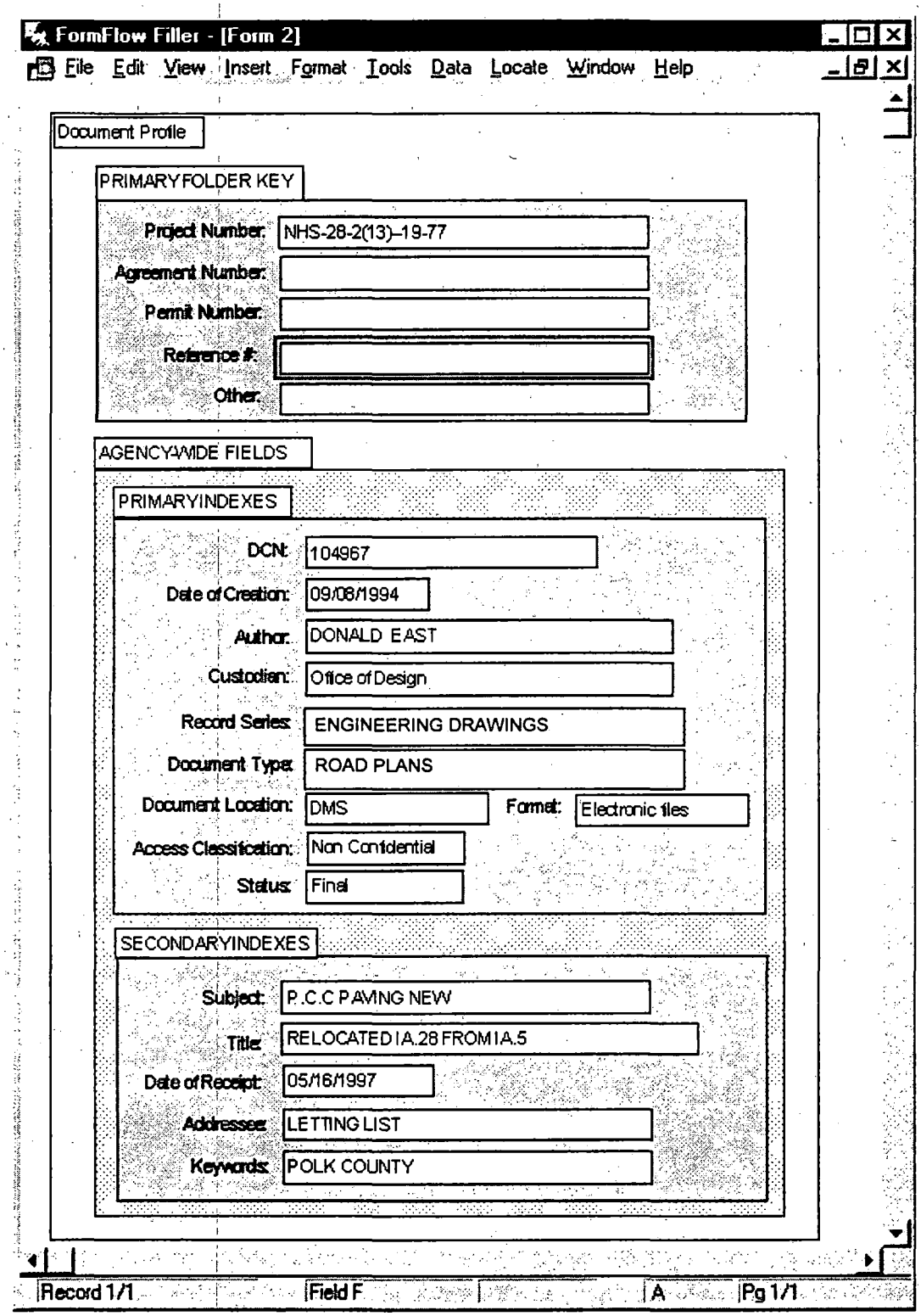
Field Name	Division	Office (Section)
Project Number		
Permit Number		
Agreement Number		
File Code Number		
Policy Number		
Drivers License Number		
Vehicle Identification Number		
Vehicle Title Number		
Accident Report Number		
Accident Location Number		
License Plate Number		
Dealer Number		
Carrier Account Number		
Law Enforcement Case Number		

Field Name	Division	Office (Section)
Social Security Number		
Person's name		
Employee ID		
County		
Route Number		
Road Number		
City Name		
City Number		
Urban Area Number		
Parcel Number		
US DOT Number		
Bridge Number		
Reference Code Number		
Accounting Identification Number		
Source Name		
Rail Road Crossing Number		
Airport Number		
Aircraft Number		
MPO Number		
RPA Number		
Public Institution Number		
Agency		
Voucher Number		
Purchase Order Number		
Invoice Number		
Contractor Number		
Contractor Name		
Cost Center		
Tort Claim Number		
Tort Claim Refund		
Design Number		
Project Identification Number		
Equipment Number		
Sign Number		
Billboard Number		
Condemnation Appeal Number		
Publication Number		

Field Name	Division	Office (Section)
Computer Program Number		
Service Request Number		

2.2 Prototype Screens

The following is a prototype screen for how the proposed database indexes may appear in the agency-wide RMS data entry and retrieval screens.



While the above fields demonstrate how the agency-wide index fields may be presented, users should have the flexibility of requesting the addition of other index fields that are specific to document types within their work group (work group systems administrators

will perform this function). Agency-wide index fields will provide the ability to search for documents in a consistent manner across the agency. Document level indexes will give the offices and sections the ability to customize the index and retrieval screens for documents owned by an individual work group.

3. INDEXING GUIDELINES

The following functional requirements for indexing components of an agency-wide RMS have been developed and approved by the Indexing Committee. These guidelines have been submitted to the Technology Committee for consideration and incorporation into the Technology Standard.

1. All indexed fields will be stored by the RMS in upper case to permit searching consistency. Users will be able to enter information in either upper or lower case, but the system will automatically save the information in upper case.
2. Date fields will be presented to the user in the format of MM/DD/YYYY during input and retrieval operations, storing the data as a date field in the database. Four digit year compliance is required.
3. A "fuzzy search" capability is desired to support related searches. (e.g. DOT = Depart. of Trans. = Department of Transportation).

While these may seem to be simple requests for a Document Management solution provider, standardization of these rules will ensure commonality in the indexing structure for the agency-wide system.

3.1 Indexing Issues for Consideration

The following is a list of issues related to development of an agency-wide indexing standard that should be addressed by the RMS vendor during pilot implementation.

1. Records Management practices and policies and definitions
    - Custodianship
    - Document Classification
    - Retention Scheduling
    - Disposition
    - Archiving
2. GIS and RMS integration
3. Changes to the Iowa DOT Project number system.

4. Document Cross-Referencing is complex and requires significant analysis. Following is a list of questions/issues that should be address with potential solution providers.

- Project Numbers
  - * Should construction projects with multiple project numbers be filed under the same contract number?
  - * What can be done with project names that change over time?
    - ◆ Can project aliases be used?
    - ◆ Projects contain a "corridor" number that is in all derivatives of the original project.
    - ◆ How can we handle projects that are split into several smaller projects?
    - ◆ What information systems are currently being used to perform cross-referencing of document indexes?
      - ◊ Design number, bridge number, county road, city street, railroad crossing, - **Base Record**
      - ◊ Project number - **Project Scheduler**
      - ◊ Drivers license, VIN, plate - **CICS**
      - ◊ City name & number - **flat data file**
      - ◊ Proj Id Num - **Proj Mgt**
      - ◊ Dealer Num, voucher-purchase-invoice, equipment, parcel tracking - **IDMS**
      - ◊ Aircraft "N" number - **FAA**
      - ◊ USDOT - **MICIS**?
      - ◊ Other numbers may be further investigated to see if there is a validation link to be used
- What cross-referencing should exist between RMS and GIS?
  - * Start in GIS, then access information in the RMS, MPs and township-range-section is needed to identify RMS documents for retrieval in the GIS.
  - * GPS may be added for accident location.
- Who needs access to both RMS and GIS?
  - * GIS may include information for archaeological sites, this would require another link.

4. APPENDIX A

4.1 Indexing Standards Committee

NAME	PHONE	OFFICE	PROFS ID
Sam Koehler (Chair)	1533	Records Management Supervisor	SKOEHLE
Julie Taylor	1971		JTAYLOR
Tom Parham	1148		TPARHAM
Dennis Peperkorn	1188		DPEPERK
Hank Zaletel	1200	Library	HZALETE
Mark Kerper	1591	Project Planning	MKERPER
Bill Lutz	1009	Transportation Data	BLUTZ
Jim Olson	1551	ROW	JOLSON
Nancy Strait	515/955-3766	Ft Dodge Maintenance Office	NSTRAIT
Troy Strum	1318	Finance, Budget	TSTRUM
Michael Kennerly	1446	Contracts	MKENNER
Kermit Wilson	1168	Purchasing	KWILSON
Glen Miller	Speed #240	Southwest TC, Atlantic	GMILLER

4.2 Indexing Standards Resource Personnel

NAME	PHONE	OFFICE	PROFS ID
Desi Asklof	1492	Records Management	DASKLOF
Sharon Bowers	1539	ROW	SBOWERS
Dan Ohman	1430	Design, Road	DOHMAN
Bev Abels	1475	Employee Services	BABELS
Arnita Colbert	1655	Payroll	ACOLBER
Phyllis Padgett	515/237-3015	Motor Vehicle/Driver Svcs	PPADGET
Kirsten Bandow	515/237-3109	Motor Vehicle/Vehicle Svcs	KBANDOW
Tom Jacobson	1453	Construction	TJACOBS
Annette Jeffers	1079	Bridge	AJEFFER
Kevin Jones	1232	Materials	KBJONES

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TABLE OF CONTENTS

LIST OF EXHIBITS

1. INTRODUCTION

This report provides an overview of the Records Management System (RMS) Document Standards proposed for the Iowa Department of Transportation (Iowa DOT) by Universal Systems Inc. (USI).

1.1 PURPOSE OF DOCUMENT

The purpose of the Document Standards is to begin the process of developing standards that will best support Iowa DOT's effort to build an agency-wide Records Management System (RMS). This document will provide a starting point for identifying document procedures and policies for inclusion of Iowa DOT documents in the RMS. This information will provide valuable input to the RMS vendors who will work with the department to refine the implementation as the RMS initiative moves from pilot to production. In addition, this document will identify issues for further investigation and consideration in developing document standards for the agency-wide RMS.

1.2 BACKGROUND

The process to develop this report began with a Joint Application Development session (JAD) with the Iowa DOT Document Standards Committee. Iterative work by both the Document Standards Committee and USI has led to the recommended policies and standards detailed in this report. It will be necessary for the Document Standards Committee, working in concert with the Document Management Team (DMT), to continue to review and refine internal Iowa DOT business processes and standards. The accurate description of these processes and standards will be a vital part of the implementation of a RMS for the Iowa DOT. This, and other work products, will provide important information for potential vendors to evaluate how their product offerings will be best able to support an affective RMS that will reflect the mission critical business standards of the Iowa DOT.

The adoption of computer technology introduces fundamental change in the way an organization thinks about data. Prior information technology allowed data to be collected and related to activities and projects individually. Organized stores of data were the exception rather than common practice. This led to duplicate data collection and storage (as in different departments) and to the possibility of erroneous data existing in one or more locations. One of the goals of computer systems and database development is to eliminate redundant data collection and storage. The principle is that data should be collected only once and then accessed by all who need it. This not only reduces redundancy but it also allows for more accurate data and a greater understanding of how the same data is used by multiple divisions. The necessary condition for successful computer system and database development is for different divisions and offices to cooperate in the development of the system. A database becomes an organization-wide resource and is created and managed according to a set of defined standards.

The two different types of electronic management systems are: Document Management Systems (DMS) and Records Management Systems (RMS). Both are more that just imaging systems. Essentially the difference between a DMS and a RMS is the scope of the documents that are contained in each system. The DMS deals with documents that are viewed in the system, including scanned images, and imported electronic files such as spreadsheets and word processing files. A RMS incorporates all of the documents in an enterprise, even those that do not exist as images or documents in the system itself. For example, the RMS would contain index information about microfilm or historical documents that are stored only in hard copy. Users could find information about these documents in the system and would be referred to a location to find the physical documents. Electronic documents and scanned images, stored voice and video and any other components of a DMS could be considered a subsystem of a larger RMS.

The overall system of recording information and the use of records at the Iowa DOT is a records management system. The current records management system at the department is a mixture of manual processes and automated processes from various applications running on mainframes and networked personal computers. A records management system is extensive by definition and contains every document (electronic or hardcopy), form, drawing, videotape, photograph, microform, data tape, database, etc., in the department.

Regardless of whether or not this records management system is fully automated as an electronic RMS, a Document Management System will have to function as a part of this overall system. In order to mesh with the existing records management system, already in place, if a DMS is selected it must be implemented according to a set of business rules that take into account the records management system rules. *The DMS is, itself, a component of the records management system and should reflect the same overall system in its internal procedures.* Exhibit 1-1 shows some of the elements of planning and policy that are included in an affective records management system, whether manual or automated.

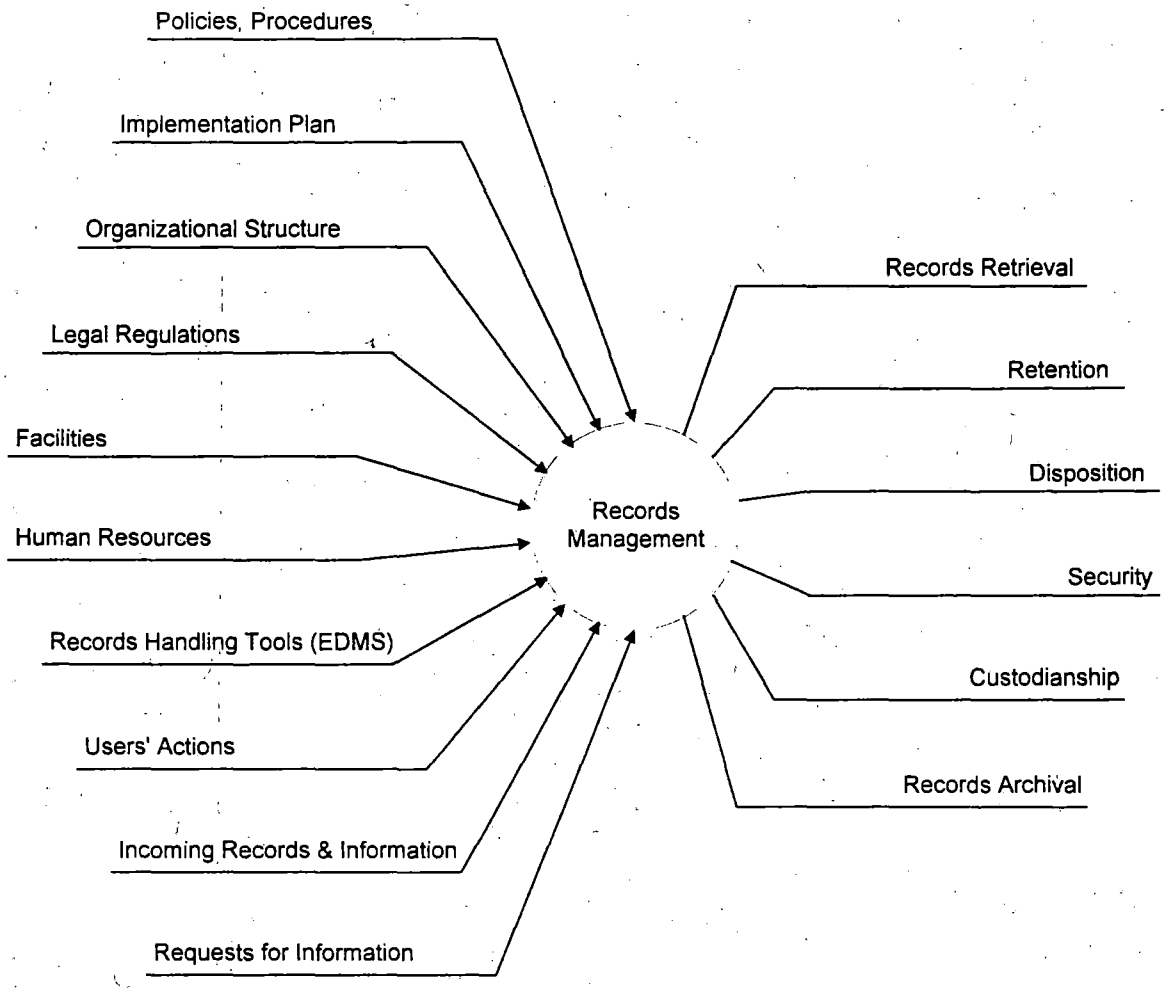

Exhibit 1-1 Records Management System

Qualities of the records management system that should be developed as business rules of the DMS are:

- *Policies of the Iowa DOT* - Department policies and procedures for documentation should be reflected in the system design. These policies affect areas such as revision control, generation of copies, access to documents under development, technical and historical needs for archived documents, and the schedule of document importation into the system. The policies of the Records Management Manual will be reflected in the RMS for all Record Series contained in the RMS.
- *Implementation Plan* - The plan for implementing the RMS, including pilot programs, will directly affect the RMS rules. The RMS rules may be established along with the pilot program and may only cover those operations performed by the pilot. As other pilot systems are developed, RMS procedures will also be expanded.
- *Organization of the Iowa DOT* - The organization of the department will be reflected in the organization of the electronic documents within the RMS. It will be important to establish rules to govern the interaction of multiple offices of the department with one electronic document.

- *Legal requirements* - RMS rules must comply with all legal requirements regarding retention of documents, access to documents, and document integrity.
- *Custodianship* - Each electronic document in the RMS must have a single owner in order to control revisions and maintain integrity. Business rules must reconcile this requirement with the existing role of the Record Series custodian.
- *Retention/Disposition* - A policy of retention, archival, and disposal must be in the RMS rules.
- *Security* - The RMS must have clearly defined access rules for all electronic document types in the system, including draft, personnel, historical, confidential, and public documents.

The Electronic Document Management System differs from an Electronic Records Management System in that the DMS is a *management system* for *electronic documents*, whereas the RMS is an *electronic system* for *records management*. The scope of the former is narrower than the latter. An electronic RMS is a very complex undertaking. The logistical demands to make a truly enterprise-wide electronic RMS work are heavy. Each employee throughout the institution must be diligent in recording each movement of a record in order to maintain the integrity of the system. The practical use of records by a large and de-centralized organization makes this level of effort difficult to achieve.

For the purposes of communication with potential solution providers, USI recommends that the DOT refer to this system as a Document Management System with some Records Management functionality.

1.3 ROLE OF THE DOCUMENT COMMITTEE

The Document Committee consists of a representative cross section of the Department and includes personnel from most Divisions. Maintaining this wide departmental representation will be essential for continued success in developing the agency-wide document standards. Extraordinary efforts must be undertaken to ensure that any proposed document standard will not exclude any organizational element within the Department. The primary goal of the Document Committee is:

> *"To review and recommend changes to existing business standards (rules) that will be used to facilitate development of agency-wide policies and procedures for a RMS".*

The activities involved in obtaining this goal include:

1. Development of a DOT policy for treatment of e-mail
2. Review of Record Series (and document) retention periods
3. Development of a strategy for purging documents

Developing a Document Standard is an important aspect in implementing the agency-wide RMS. However, it is not critical that this standard be completed before issuance of an RFP. RMS vendors can build upon the foundation of work completed by the Document Committee for the development of pilot systems which will be evaluated by the Iowa DOT Document

Management Team. The Document Committee should work in conjunction with the Index Committee in supplying information that can be added to the Record Management Manual (RMM). The Department can then incrementally update the RMM as the individual business processes and the documents associated to these business processes are incorporated in the agency-wide RMS. This standard can then be validated or adjusted as necessary based on the evaluation of RMS pilot systems.

The definition of business standards, or rules, is a difficult process. In any business process or workflow, rules and procedures may be employed by personnel that do not exist in a written code of policies and procedures. Conversely, written procedures may be easily circumvented by personnel who may choose to follow a different approach to accomplishing their work on a day-to-day basis. One of the qualities of a Records Management System (RMS) is that the system should be empowered to enforce a defined set of business rules. This results in a more efficient system and greater integrity of documents and data, *provided that the business rules are based on the actual workflow of the system.* To this end, the Document Standards Committee has the important task to review existing standards as set forth in such documents as the Records Management Manual, to consider other sources of rules such as external standards and internal unwritten standards, and to synthesize these standards into a useful set of rules for the RMS.

1.4 DEFINITIONS

The following definitions are used throughout this document. The Document Committee will revise these definitions as clarifications are required through out the life-cycle of the agency-wide RMS acquisition.

Custodian - The head of the organizational unit that is responsible for a particular record, as identified in the Records Management Manual. The rights and duties of a custodian are also extended to the custodian's designees and to those persons above the custodian in the chain of command. All documents classified as "records" belong to a record series and all record series have a custodian. Custodians are authorized to grant access to open records and in certain circumstances to confidential records.

The custodian of each record series must be aware of legal requirements when determining the retention period, or requests for extension of a retention period, for documents in the record series. Sources to be consulted for these legal requirements include:

- Iowa Code
- Iowa Administrative Code
- Code of Federal Regulations
- FHWA
- US Code
- Federal legislative acts
- State Management Act of 1975
- Requirements of other state agencies

Document Owner - The Document owner is the point of control for the data in a document. Ownership is transferred as the document moves from office to office, while the custodian remains the same. The owner of a document may be considered to be the gatekeeper of change in the document resulting in the current revision of the document.

Document - A document is defined as a collection of information authored for the purpose of transferring and preserving knowledge. It has a subject or purpose, an author, is static, is portable and independent from other documents, and has a defined distribution path. A document is information consigned to a medium.

Record - Information stored or preserved regardless of physical form. This includes any information in the physical possession of the Department. A record that is not confidential is termed an *open* record.

E-mail - An electronic mail message that is a document created or received on an electronic mail system including brief notes, formal or substantive narrative documents, and any attachments, such as word processing and other electronic documents, which may be transmitted with the message.

Identification Code - A code assigned to all correspondence, internal and external. In many cases this code will be a project number, permit number, agreement number or file code. File codes should only be used when no project number or permit or agreement number is applicable. These file codes identify subject matter and are not intended to be unique to any division or office.

Records Management - Records management describes the management of all records used by an organization, regardless of their physical medium. A DMS may be used for records management and if so may actually track documents that do not exist within the DMS itself. For example, the DMS may capture indexing information about microfilm so that users may locate the microfilm as a source of information, but the film itself is located outside the DMS.

In a Records Management System, procedures must be defined for maintenance of the official copy of a document. The documents may be in either electronic or hard copy, particularly at the beginning of the project, so some notation of the physical location of the hard copy could be made.

Document Management - Document management is the storage, retrieval, and modification of documents in a controlled system.

Enterprise Document Management - Enterprise document management is the coordinated management of documents in an organization across divisional boundaries.

2. DOCUMENT STANDARDS

USI recommends that the committee implement standards for the RMS on the basis of the pilot systems as they are rolled-out as production systems. This approach allows the committee to focus on a smaller set of documents, yet allows the committee to build the enterprise-wide document standards as the pilot systems are added to build the RMS.

One of the most important elements in establishing an affective and efficient RMS will be to ensure that the Records Management Manual (RMM) reflects the current practices of the department.

USI recommends that the Document Standards Committee closely review the RMM as the pilot projects evolve. As each pilot process is developed, the committee should review the record series used by the project offices or divisions in the pilot system. By conducting this review with each pilot project, individual elements of information documented in the RMM can be revalidated under close scrutiny. The committee should manage the overall review of the RMM as each pilot system is brought on-line.

The following sections address the subjects that are to be defined for documents in the RMS.

2.1 DOCUMENT CLASSIFICATION

Certainly one of the most basic questions which must be addressed by the committee is "What are we going to put into this system?" In order to answer this question, the committee needs to examine:

- What kinds of documents do we have in the department?
- Who uses the documents and how are they used?
- What documents should be stored in an electronic RMS?

The document types in use at the Department and who uses them are defined in the RMM. The documents to be stored in a RMS remain to be defined. USI recommends this decision be made as each of the Pilot Projects are developed.

2.1.1 Overall Classification Considerations

Factors to be considered when determining the best storage medium and system generally involve the value of the information and the value of the record. Value can be determined according to the following issues:

Operational Value - Does the document have transaction value? In other words, is the document critical to delivering the service or product? The importance of the record in assisting the organization in performing its primary function.

Vital Record - A record necessary to continuing the operation of the business or organization in the case of disaster or emergency.

Fiscal or Tax Value - Does the document have fiscal value? Are there accounting/audit and taxation issues relating to the documents? The usefulness of the records in case of audit.

Legal Value - Does the document have legal value? Are there laws regarding retention and deposition of the information on the documents? Do the records comply with legal requirements for maintaining information or to provide protection in the case of litigation?

Historical Value - Does the document have historical value? Is it a historical archive application? Does the record document past events of the business or organization?

2.1.2 Active Documents

USI recommends that the committee oversee the addition of documents to the RMS through a three-step process. The program manager for the pilot project will coordinate the preparation of a list of document types needed in the business process, then the committee will approve the list. The custodians of the records series will then authorize new documents to be created in the RMS as needed.

The first step will be for pilot project manager to thoroughly document the business process and workflow of the selected business area. One product from this effort will be a listing of all document types as needed. This list will be submitted to the Document Committee for review.

The second step will be for the committee to review the business process and each document type and form needed. These document types should then be prioritized by the order of their need in the sequence of the process flow. As document types are entered into the RMS during the pilot project, this fact should be recorded in the RMM to avoid duplication during a subsequent pilot project and to maintain a list of documents entered in the RMS.

The third step will be for the Record Series Custodian to authorize access to these document types. This can be accomplished by establishing work group access. Individual members of the work group are identified and submitted to the System Administrator. The System Administrator then creates this work group on the RMS with the appropriate access privileges. When this process is complete, the pilot project team can create the document types and begin to test the system.

At the end of this process, all document types needed for a specific pilot project will be in the RMS. Access to these document types for other pilot projects and work groups can then be authorized by the Record Series Custodian and implemented by the Systems Administrator. System users who have been granted access and authority to use these document types will become the initial owners of the documents and will be responsible for the future revisions of data in the documents

2.1.3 Drafts

USI recommends the adoption of standards for addressing the inclusion of draft documents in the RMS. Draft documents may appear in hardcopy, electronic document or e-mail form. They may be a valuable part of the business process in the department and at the discretion of the draft document owner, may be maintained in the RMS. Standards should be established in two areas: Access and Retention.

2.1.3.1 Access

USI recommends that system level security be used to control access to the drafts that are managed by the RMS. Security can be usedto limit access to predefined work groups until the draft is released as a final document. Group security allows for the creation of a "work group" that has access to their draft documents which are maintained in the system. Individual users may be added to the work group to give them access to the work group specific draft documents. Group-based security offers less administrative bookkeeping than individually assigning access to users.

2.1.3.2 Retention

USI recommends that a document classification of "draft" be included while indexing draft documents. This classification can be associated with a special retention period that may be specified by the draft document owner, or default to a predetermined time period specified by the Document Committee. Regardless of the method chosen, USI recommends the retention of draft documents in the RMS only until the final document is published. Copies of draft versions should then be deleted or archived to a physical medium and retained by the document owner for a period of time deemed appropriate by the document owner. The process for notifying system users of pending purging actions as described in Section 2.2 may also be applied to draft documents.

2.1.4 Revision Control

One of the benefits of a RMS is the ability to control revisions to a document and to maintain copies of old revisions for future reference. USI recommends that Iowa DOT adopt revision control as necessary function for the RMS. Revision control will permit the maintenance of one and only one (the current) revision of a document. The current document will be the product of the document owner creating the most recent revision. USI further recommends that the revision control adopted by the department be limited to users authorized by the original document owner to create new revisions of documents. Other users should have access to view documents but not to revise documents. Revised documents are transient and subject to frequent change, principally during development of a draft.

Revision control should also include a method for archiving past revisions. USI recommends that old revisions be maintained on-line and be accessible to users as reference materials (note that this differs from the recommended policy on draft documents).

In addition to revision control, the system should include tools for markup of documents for editing. Markups should be associated with documents until such time as a revision is made to the document, whereupon the markups should be removed.

2.1.5 Version Control

Version control is applied to the final version of documents that are revised periodically and distributed to contacts on a distribution list. The superceded document then becomes a historical record, and may be available only to the custodian. Potential RMS solutions being evaluated may present functionality that includes automatic assignment of version numbers which may have manual overrides to meet special circumstances.

2.1.6 E-mail

E-mail has a major role in the efficiency of communications; widespread and easy use of e-mail has made it an important tool for the conduct of business. Iowa DOT is encouraged to ensure that e-mail messages that document their policies, programs, plans and functions are appropriately preserved. E-mail records are no more and no less important than other records. Department personnel should apply the same decision- making process to e-mail that they apply to other documentary materials regardless of the media used to create them. Careful implementation of e-mail policies will result in thorough documentation of agency activities.

The preservation of drafts, including those circulated on e-mail systems, could be necessary for the Department to meet its record keeping requirements. Draft documents or working papers that propose or evaluate policies or decisions and provide unique information that contributes to the understanding of major decisions of the Department should be preserved. Iowa DOT should apply the same criteria to drafts that are circulated on e-mail as they apply to drafts circulated by other means. The final policy determination issued should stress that drafts and other working papers that are circulated on e-mail systems may be records.

USI recommends that Iowa DOT consider selected e-mail messages as documents to be included in the RMS.

E-mail to be included in the RMS should:

- Relate to a record series or coded correspondence in the RMS;
- Have technical or historical value, or propose or evaluate policies or decisions and provide unique information that contributes to the understanding of decisions; and
- Preserve some transmission data (i.e., names of sender and addressee(s) and date the message was sent) for each electronic mail message in order for the context of the message to be understood.

USI recommends a standard format be used for entry of e-mail into the RMS. A template from a word processor could be used for this function or alternatively a third party E-Forms product could be used to standardize the format and content of e-mail correspondence to be archived. Some vendor offerings may include the capability to capture, electronically, an entire e-mail message with all of the necessary information to fully identify the sender, addressees and body of the message. A sample form for archiving e-mail messages is at Exhibit 2-1.

E-Mail Archival Form	
Date of E-Mail	Date of Archival
Name of Sender	E-Mail Address of Sender
Name of Addressee	E-Mail Address of Addressee
Attachments	
Subject of E-Mail	
Body of E-Mail	

Exhibit 2-1 Sample E-Mail Archival Form

2.1.7 E-Forms

On-line electronic forms can be used to speed forms processing. As the DOT continues to refine this and other Standards, close coordination with other initatives to implement electronic forms processing should be pursued. The agency-wide goal should be to acquire systems that are interoperable. When evaluating candidate business processes for piloting, a candidate that involves use of many forms may be a good test for proposed RMS solutions to interface with existing DOT electronic forms applications (i.e., Out of State Travel, Staff Action, Request for Purchase Orders).

2.1.8 Document Access

The three main categories of document access are:

- Open documents, available for public review .
- Confidential documents, available for review by certain DOT employees and are otherwise restricted.

- Documents where access is controlled by the department for reasons other than confidentiality.

USI recommends that a business process be implemented that requires the custodian of a document to define the initial access category for the document being entered into the RMS. It will be the responsibility of the custodian to maintain the accuracy of the access category throughout the life cycle of the document.

2.1.9 Tracking & Coordinating

One of the important issues to consider during the actual implementation of a RMS is the process of integrating the existing paper-based system with its automated components with the expanding new RMS. USI recommends that the committee draft a policy to efficiently manage the transition of documents and record series from the current system to the RMS. Since there are often many users of a given document, the schedule for entry of new documents into the system should be well established so as to prevent duplication of effort by users searching both the paper and electronic system for the same documents. Furthermore, a clear procedure for the transition to the new RMS will reduce logistical conflicts, for example, will the mail room staff become responsible for scanning all incoming correspondence received from citizens or will that become the responsibility of the office responding to the inquiry? The Document Committee will be reviewing the recommendation of each pilot program manager as to the priority of documents for entry into the RMS. The committee should publicize this order once approved to system users.

2.2 RETENTION

Document retention periods are important from an end user efficiency perspective as well as a management perspective. If all documents were retained indefinitely, users would find it increasingly difficult to locate useful information. From a management point of view, document retention periods must balance usefulness with sound procedures for disposal by the document custodians.

The Records Management Manual clearly defines retention periods for each Record Series and File Code category. These retention periods are sufficiently detailed to allow their continued use in an automated RMS. Retention periods detailed in the Records Management Manual should be carefully reviewed to ensure documents which have a historical value are preserved. As a minimum, the document owner and the custodian should be involved in making the decision to extend the retention period of a document thought to be of historical value.

USI recommends that the primary responsibility for purging documents at the end of the designated retention period remain with the custodian of the document throughout the life cycle of the document. If a user of a document has a requirement to keep a selected document in the RMS beyond the designated retention period, it will be incumbent on the user to notify the owner of this need and request an extension of the retention period.

In a similar process, any user who believes a document may have significant historical value should be permitted to submit a recommendation for further retention to the document owner. The document owner then coordinates a review of the request with the document custodian.

The function of actually purging documents from the RMS should be the responsibility of a Systems Administrator. USI recommends the institution of a business process similar to the following.

In a separate Systems Administration module of the RMS, each Record Series and File Code will be predefined. Associated with these entries will be other information such as the Custodian, Owner, and Retention Period. When a document is entered (indexed) into the RMS, the field(s) Record Series or File Code must be assigned to the document. Based on this entry the other associated fields (i.e., Custodian, Owner and Retention Period) will be automatically populated. Near the end of the predetermined retention period (i.e., 90 days prior to purging), a new message will be presented to anyone retrieving the document from the RMS. This message should identify the scheduled purge date, identify the document owner and advise the user that if the document is needed beyond the retention date a request for an extension of the date should be forwarded to the document owner for consideration. The custodian will make the decision to grant or deny the request and will advise the System Administrator of the action to be taken.

2.3 BACKFILE CONVERSION

As part of the management of the transition to a RMS, the record series custodians and the project manager must assess the value of converting existing documents. The cost of backfile conversion is relatively high, and it may not be prudent to convert all existing hard copy documents to electronic format for use in the new system. USI recommends Iowa DOT adopt a policy of 'conversion on demand' to add older documents to the system as they are needed.

As part of the implementation of a pilot system, the project manager will have approved a list of document types to be added to the RMS. Many existing records of that type will be accessed after the pilot system is in use. As frequently used documents are retrieved, they should be entered into the RMS. Each addition will have to be indexed and an image must be transferred or scanned. This function should be performed by the same business unit of the department that will be indexing new documents created after the pilot system is brought on line, since the indexing structure and input process will be familiar to members of this unit.

The backfile conversion process has a potential for breaks in system integrity. It is important to maintain strict logs of the movement of hardcopy documents from their storage location to the scanning facility, or log the movement of electronic files. The Business Process Pilot Project Manager should engage in a periodic audit of the backfile conversion logs to ensure that all documents are accounted for.

The Business Process Pilot Project Manager should make every effort to keep system users up to date on the pace of backfile conversion so as to lessen the number of searches needed to

find a given document. If hardcopy documents are removed from a storage location, their existence in the RMS should be noted in the previous storage location.

The project manager should also implement a policy of a priority project override of the roster of documents to be input into the RMS. This will allow project documents to be entered into the RMS and become retrievable in a timely fashion for an urgent project.

3. AGENCY-WIDE IMPLEMENTATION

The Document Standards Committee should strive to coordinate the efforts of each pilot project in the RMS deployment process in order to produce an enterprise-wide set of document standards. In order to accomplish this the committee should review the proposed standards for each pilot system with an eye toward future systems needs and in view of all existing RMS document standards.

In pursuing the goal of incremental development of enterprise-wide document standards, it is recommended that the Document Committee seek to:

- Coordinate the efforts of each pilot project development team in regard to Document Standard compliance. If the committee will brief each development team on the evolution and current status of the Document Standard, duplication of effort between pilot system teams can be avoided. An updated copy of the Document Standard should be provided to each team as they begin their pilot project.
- Closely review the list of documents to be added to the RMS by each pilot project development team. The Document Standards Committee should assume the responsibility of maintaining the RMM with regard to the documents that have been introduced to the RMS.
- Standardize retention requirements that may differ between pilot project teams for the same document types.
- Apprise all users of the RMS of new and revised document standards that may result from the implementation of each pilot system.

3.1 INTERFACE WITH OTHER INFORMATION SYSTEMS

The Technology and Indexing Standards Committees are identifying other sources of automated information that should be available to the RMS. The Document Standards Committee should work closely with these committees to ensure continued compatibility of enterprise-wide standards development.

3.1.1 Geographic Information System

The Iowa DOT Geographic Information System (GIS) Committee is in the process of identifying GIS applications for use in the Department. Unlike many other computer applications, a GIS is not a "plug and play" type system. The several components of a GIS must be acquired according to well documented specifications. The database must be created in a careful and organized manner. Once all the individual components have been acquired, they must be integrated and tested. Parts of the GIS which may appear to work fine individually may not work properly when put together or integrated with other information systems.

There is substantial benefit to implementing an interface between a RMS and GIS, however, close coordination between the two committees will be necessary to produce a useful integrated solution for the department.

3.2 FOR FURTHER CONSIDERATION

The following is a list of issues related to development of an agency-wide document standard that should be addressed during pilot implementation.

1. GIS and RMS integration
2. Implementation of the proposed changes to the DOT Project number.
3. Review retention policy for documents.
4. Determine retention policy for revisions.
5. Determine access to historical documents.
6. Review legal requirements for retention.
7. Continuous revision of the Records Management Manual.
8. Establishment of business standards for coordinating other electronic information systems at the department.

4. APPENDIX A

4.1 DOCUMENT STANDARDS COMMITTEE

NAME	*PHONE*	*OFFICE*	*OV ID*
John Haas	239-1040	Environmental Unit	JHAAS
Jerry Dickenson	239-1667	Directors Staff	JDICKIN
Dave Ellis	515 472-4171	Local Systems/SEITC	DELLIS
Bruce Schuck	237-3041	Drivers Services	JSCHUCK
Julie Fitzgerald	239-1362	Director Staff	JFITZGE
Steve Belzung	239-1672	Contracts	SBELZUN
Desiree Asklof	239-1492	Records Management	DASKLOF
Dick Peterson	423-7584	NEITC	DPETERS
Annette Jeffers	239-1079	Bridges & Structures	AJEFFER

4.2 DOCUMENT STANDARD RESOURCE PERSONNEL

NAME	*PHONE*	*OFFICE*	*OV ID*
Dave Ferree	239-1509	General Counsel	DFERREE
Gordon Peterson	239-1584	Transportation Data	GPETERS
Fred Cirksena	239-1316	ROW - Fiscal	FCIRKSE
Kermit Wilson	239-1168	Procurement	KWILSON

Iowa Department of Transportation

Records Management System

Technology Standard

July 17, 1997

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TABLE OF CONTENTS

1. INTRODUCTION

This report provides an overview of the Records Management System (RMS) technology standards proposed for the Iowa Department of Transportation (Iowa DOT) by Universal Systems Inc. (USI).

1.1 Purpose of Document

Although the term Records Management System is used to describe the overall technology role for the proposed agency-wide system, the frame of reference for most standards discussed in this document is a Document Management System (DMS). Therefore, the purpose of the RMS Standards document is to determine which technology standards will best support Iowa DOT's effort to build an agency-wide DMS infrastructure as a component of an RMS. Many RMS technology standards exist, but they are often in transition to keep up with a dynamic industry. USI recommends that the Iowa DOT focus on standards that allow document management systems to operate within the existing technology framework and technology direction of the DOT.

This document contains background information on the prevailing standards in the document management industry and identifies important issues that need resolution. This document includes information on existing imaging, data format, inter-connectivity standards, and an overview of various industry committees that supply market direction to DMS standards development. The report provides more detail on DMS specific technologies and less on general technologies with which Iowa DOT is more familiar.

1.2 Role of the RMS Standards Committee

It will be the role of the Iowa DOT RMS Technology Committee to recommend standards for technology to the Document Management Team. The Document Management Team must in turn recommend agency-wide policies which uphold a strict technical standards process. As the Department examines how to apply and enforce these standards to build the agency-wide RMS, the first priority should be to focus on the agency-wide accessibility of documents where multiple offices are involved with specific business processes. Those offices who believe they have extenuating circumstances for not following the agency-wide standard should be required to prepare and submit a written request for exception to the Iowa DOT standard. The RMS Technology Committee should recommend approval or disapproval of these requests to the IP Steering Committee. These decisions should be made based on the potential value to the agency-wide records repository of documents generated or managed by these offices.

1.3 Criteria

USI has identified four criteria to be used to prioritize the standards recommended for the Department's agency-wide RMS. These criteria are:

- Existing Technology Infrastructure,
- Technology Direction,
- Industry Best Practices, and
- Market Leaders.

These criteria are described in detail below from most important (Existing Technology Infrastructure) to least important (Market Leaders).

1.3.1 Existing Technology Infrastructure

The Iowa DOT already has a significant investment in the computer technologies that comprise the Department's technology infrastructure. Any technology standards proposed for the agency-wide RMS must be compatible with some of the basic computer infrastructure components such as the network, servers, operating systems, and electronic file formats being generated in the current environment. This includes the Departments' inventory of PC workstations running a variety of software applications that include:

- Microsoft Windows and OS/2 operating systems,
- Ethernet and Token Ring networks,
- Computer Aided Drafting and Design (CADD),
- Office Automation Software (Microsoft Office, Corel and Lotus Suite),
- Driver Services Imaging System,
- Mainframe based e-mail (Office Vision)
- Mainframe based databases (DB2 and IDMS).

All of these components provide an infrastructure on which the agency-wide RMS will need to operate.

1.3.2 Technology Direction

Several major system and software acquisitions are either ongoing or are on the horizon for the Iowa DOT's computing environment. These acquisitions include:

- Trns-port SiteManager (formerly known as CMS),
- A Geographical Information System (GIS), and
- Internet access software.

Technology standards for these systems have not been finalized in some cases, however, there are definitive recommendations from the suppliers of these systems as to the required operating environments.

The Iowa DOT has formed the MONITOR group which is composed of Iowa DOT's technical support staff who represent the various Divisions within the Department. The group has recommended technology standards to the IP Steering Committee for adoption across the agency. USI has reviewed the MONITOR recommendations and endorses

them as compatible with the proposed RMS Technology Standards presented in this document. A summary of the pertinent recommendations are listed in Section 2.4.1, "*Operating System Recommendation.*"

1.3.3 Industry Best Practices

USI has drawn upon a number of sources to identify what standards can be labeled "Industry Best Practices." Some standards have evolved from federal government initiatives to become industry standards in both the government and commercial environments. In other cases, certain products have such a large market share that they have become *de facto* standards. USI has also examined technology standards chosen by several other State Departments of Transportation including Florida, Indiana, and Kansas.

There are numerous standards already defined for DMS that have become industry best practices. Standards are not static and technology continues to improve. As the market demands change the industry will continue to develop new standards. A majority of the existing document management standards that are available today apply to systems that are deployed using a single document management vendor product. The standards discussed in this document are "building blocks" that records or document management vendors should be required to adhere to in building the framework for the Iowa DOT agency-wide RMS. Adopting this approach will result in the creation of an information management system that is interoperable with other, existing Iowa DOT information systems.

1.3.4 Market Leaders

Where there is a need for a product, often the product that is first to the market may become the leader in a short period of time. When this happens, it is difficult for standards to evolve from a field of competing products to displace the market leader. Microsoft is the clear leader in the field for providing client/server based developer standards. Many developers wait to see what Microsoft will do before committing to development standards that compete with Microsoft's products. Other vendors, such as Oracle, have captured a large segment of the market on the basis of a quality product with good marketing.

Technology standards from market leaders have one thing in common: longevity. Some of these may suit Iowa DOT's needs very closely. In other cases, the current skill sets and investments in Iowa DOT technology standards will have priority over the offering of market leaders. Within the document management industry, no one vendor dominates the field. Because few vendors can manufacture all the components in a document management system, it is to Iowa DOT's advantage to look for the vendors who adhere to standards that are compatible with the Department's technology infrastructure.

It is the recommendation of USI that the Iowa DOT stay with today's industry leaders as identified in the following sections. Most of the products or vendors mentioned in the following section have a proven track record of stability and presence in the industry. By adopting certain *de facto* standards for vendors to follow in providing solutions for the

RMS, the Department will help to ensure the longevity of the technology building blocks chosen for an agency-wide infrastructure. USI recommends that the Iowa DOT select DMS/RMS vendors which use or support these building blocks.

2. TECHNOLOGY STANDARDS

Technology associated with document management is one of the most rapidly evolving segments of client/server computing environments. As a result, the need for standards has become an important issue for any organization considering the acquisition of DMS or RMS technology. USI's mission is to identify the standards that will keep the Iowa DOT strategically positioned to successfully achieve an agency-wide records management infrastructure in a potentially multi-system environment.

2.1 Committees and Organizations

As a starting point for Iowa DOT's RMS Technology Standards development, USI examined some of the industry's leading authorities on DMS standards. The technology industry as a whole has a number of domestic and international standards organizations that contribute directly or indirectly to DMS standards. These are:

- American National Standards Institute (ANSI)
- Federal Information Processing Standard (FIPS)
- International Organization for Standardization (ISO)
- National Institute for Standards and Technology (NIST)
- Telecommunications Standards Sector (TSS) (*Note: Formerly known as Consultative Committee on International Telephony and Telegraphy - CCITT*)

While these organizations contribute to technology standards that encompass DMS, the three organizations that are recognized as leaders in DMS are:

- Association for Information and Image Management (AIIM)
- Document Management Alliance (DMA)
- Workflow Management Coalition (WfMC)

These standards organizations have leadership roles in evaluating and establishing document management standards. These organizations also have a responsibility to ensure that technology improvements are compatible and interoperable with earlier versions of DMS standards.

There are a variety of competing forces in the standards development world, each with its own agenda. Competing factions often join forces and develop a hybrid standard which can result in a compromise in quality. One of the most important roles of a standards organization is to cut through the political landscape, and give an unbiased assessment of today's best industry practices.

2.1.1 Association for Information and Image Management

AIIM International has 600 corporate trade members and 9,000 professional members in 150 countries. AIIM International is accredited by the American National Standards Institute (ANSI) as a national standards development organization. AIIM receives many

proposals for new standards each year but only approves a few that have the potential of being successful and helping the industry. AIIM is charted with a leadership role in standards for document imaging environments. The AIIM organization is constantly developing and evaluating new standards. Some of the current AIIM Standards activities that should be monitored by Iowa DOT include:

- **Image Network Architecture**: planning considerations for designing and implementing electronic imaging applications on a computer network.
- **Electronic Folder Interchange**: a project covering image index information, headers for image objects, and delimiters for DMS applications. The objective of this project is to design techniques permitting the interchange of electronic folders.

Today most standards promoted by AIIM are for systems that are deployed using a single document management vendor product. The standards activities mentioned above may contribute to the development of enterprise DMS standards. As a corporate member of AIIM, USI subscribes to many of the document management standards recommended by the AIIM organization. It is with this background that USI has prioritized the recommended DMS standards to be adopted by the Iowa DOT.

2.1.2 Document Management Alliance (DMA)

The Document Management Alliance was created in April 1995 with the merger of two leading document management initiatives:

- Document Enabled Networking (DEN), sponsored by Novell Inc. and Xerox Corp., and
- Shamrock sponsored by IBM Corp. and Saros Corp.

DMA is a task force of AIIM comprised of product vendors, service providers, and end users. The goal of the organization is to provide a specification that will define a vendor-neutral, enterprise-wide document management specification for library services and a middleware layer to allow access and search for documents between different document management systems, flat file repositories, file servers and other document management services. Services and applications operating across DMA will provide users with transparent reliable and uniform access to information in electronic documents, regardless of storage media or format. Users will be able to find and use documents created in most common office applications simply by searching for document attributes, such as author and date, or via content searches.

The DMA specification will accommodate different applications ranging from ad-hoc office systems to high-end mission-critical document management solutions. It will enable work groups and offices to select from a variety of existing and emerging software components that not only address their specific needs, but also fit into an overall enterprise architecture. The DMA specification will also allow system integrators and end-users to easily customize specific DMA-based solutions to meet specific requirements.

The development of the DMA specification involves multiple vendors, products and platforms. In order for vendors to deliver integrated solutions to customers, there must be consensus on a common document management model. Just as the database market gained momentum with the advent of SQL, the document management market will experience rapid growth by vendors adhering to a common framework that will still allow for product differentiation. DMA provides such a vendor-independent interface to multiple document management services and repositories.

2.1.3 Workflow Management Coalition

The Workflow Management Coalition (WfMC), founded in August 1993, is a non-profit, international organization of workflow vendors, users and analysts. The Coalition's mission is to promote the use of workflow through the establishment of standards for software terminology, interoperability and connectivity between workflow products. Consisting of over 100 members, the Coalition has quickly become established as the primary standards body for this rapidly expanding software market.

The stated mission of the Coalition is to:

- Increase the value of customers investment with workflow technology
- Decrease the risk of using workflow products
- Expand the workflow market through increasing awareness for workflow

The Coalition is divided into two major committees, the Technical Committee and the Steering Committee. Small working groups exist within each committee for the purpose of defining workflow terminology, interoperability and connectivity standards, and for assisting in the communication of this information to the workflow user community. Coalition membership is open to all interested parties involved in the creation, analysis or deployment of workflow software systems.

2.1.4 DMA and WfMC Recommendation

USI believes the efforts of the DMA and WfMC are in the right direction and worth following as a long term strategy for the Iowa DOT. There are concerns that these organizations have too many disjointed special interest groups that could slow the progress of standards development. There is also a concern that these groups will promote standards with many exceptions that would not exclude their products. If a product vendor is designing their products to meet the DMA and/or WfMC specifications it *may* be to the advantage of the Iowa DOT, but to exclude a vendor because they are not DMA or WfMC compliant is not recommended.

Those vendors which are DMA and/or WfMC compliant may allow an agency-wide RMS to be built using different DMS products if the Iowa DOT chooses a multi-vendor solution. The alternative is to select a single DMS vendor that will fit the general requirements of an agency-wide RMS that may not offer the best fit for all business processes within the Department. USI recommends that these selection criteria be considered during the vendor selection process.

2.2 System Architecture

There are two major architectural choices for any large information system: *Distributed* or *Centralized.* Both have distinct advantages and disadvantages in the cost to implement and the resources required to maintain each architecture. *Centralized* is synonymous with mainframe based environments whereas *distributed* environments are most frequently associated with the domains of other platforms. UNIX and Windows NT, which provide the server operating systems in many client/server environments, are the most popular choices for large scale distributed processing environments. The term client/server is perhaps unfairly used to differentiate between mainframe and other server based solutions. The mainframe certainly may be used as the server component in many PC based applications that interface with applications executing on a server platform.

Whether a *distributed* or *centralized* system architecture is chosen for the agency-wide RMS, the system will involve the interaction of both server and PC based clients. The major architectural decision related to the server will involve two key components of the agency-wide RMS: Database and Optical Storage. Either of these subsystems can become a single point of failure if the architecture is not designed to anticipate catastrophic disasters, whether they are environmental or system failure related.

The agency-wide RMS must be capable of both functional and technical expansion. As the Iowa DOT moves forward in its system implementation changes will occur in both business practices and technology. The Iowa DOT should be in a position to efficiently take advantage of these changes as they occur and become necessary. The primary means by which such expansion can be accomplished is based on an adherence to an open systems approach to the architecture implemented.

2.2.1 System Architecture Recommendation

The Department has made significant investments in the current technology infrastructure which should not be discarded simply because a newer technological concept is being considered for introduction into the organization. Rather, these investments should be reused to the fullest extent possible given current utilization of that technology and the human skills within the Department. Either architecture may be employed by using the Department's existing IBM mainframe or a distributed processing environment on Windows NT platforms. The Department has a significant investment in IBM mainframe technology running various mission critical applications. The Department has also adopted Windows NT as a standard server platform for engineering related activities such as CADD, GIS, and general file server capabilities.

USI recommends that the selection of a system architecture to support the agency-wide RMS should be based on the following principles:

- The system must be capable of expansion within the boundaries of recognized standards,

- The system must incorporate existing infrastructure investments within information technology where appropriate, and
- The system must support both centralized and distributed computing components and provide centralized administration as much as possible.

Ultimately, the standard chosen for the system architecture may depend on the role of the agency-wide RMS envisioned by the Iowa DOT. USI has provided a general discussion of these issues in Section 3.4, *"Availability,"* for the Standards Committee's consideration in making an appropriate selection.

2.3 Network

The development of network standards has done much to promote the growth of client/server based PC networks. Because DMS technology is largely based on client/server architectures, network standards play an important role for DMS. A document management system which supports an open systems architecture should be independent of the underlying network in both the physical topology and network protocols. Transmission Control Protocol/Internet Protocol (TCP/IP) and Microsoft's NetBEUI (NetBIOS Extended User Interface) have become the most popular network protocols in the industry.

2.3.1 Transmission Control Protocol/Internet Protocol

Transmission Control Protocol/Internet Protocol (TCP/IP) is a set of communication protocols available on numerous computer systems, providing the most efficient way to connect disparate computer systems within an enterprise-wide system. TCP/IP was developed by the Defense Advanced Research Projects Agency (DARPA) between 1978 and 1980, when it was deployed on DARPA's Arpanet. Today, TCP/IP is used in most large corporate networks to give users access to a wide variety of platforms on different networks. Windows NT and Windows 95 ship with a TCP/IP stack and OS/2 WARP Connect as part of the operating system. TCP/IP is also the protocol of the Internet. The Intranet/Internet is a compelling reason for adopting TCP/IP as the preferred networking standard for the Department's agency-wide RMS initiative. The evolution of the Internet is the fastest growing segment of DMS technology today and is paving the way towards entrenching TCP/IP even deeper into tomorrow's networking standards.

2.3.2 Microsoft's NetBEUI

Although TCP/IP has become the networking protocol of choice for most organizations using DMS, Microsoft's networking protocol known as NetBEUI (NetBIOS Extended User Interface) is also a popular network protocol. Both TCP/IP and NetBEUI can coexist on Ethernet and Token Ring networks and this is a standard configuration in many organizations using DMS. Windows for WorkGroup, Windows 95, and Windows NT all support multiple protocol stacks running concurrently from client PC

workstations. This allows PC users to access both OS/2 and Windows NT mounted network file systems from the same workstation.

2.3.3 Network Protocol Recommendation

USI recommends that the Department continue to support both these network environments, but prioritize TCP/IP over NetBEUI for enterprise network connectivity. TCP/IP is the most popular network protocol supported by vendors. The Department is intending to phase out support of NetBEUI in favor of TCP/IP over time. This will allow the Department to move towards a homogeneous network protocol standard of TCP/IP for the interconnecting of diverse platforms within the Department.

2.4 Operating System - Microsoft Windows

Microsoft offers a scaleable range of graphical user interface (GUI) based OS products to support stand-alone systems to fully networked PC workstations on a large scale LAN. At the low end of the scale, Microsoft offers Windows 95 which replaces the previous windowing standards of Windows 3.1 and Windows for WorkGroups (WFWG) 3.11. With an upgrade path to Windows 95, the industry is cautiously migrating Microsoft's next generation products. However, there are many computer users within the DOT that are moving directly to Windows NT clients. Window 3.1 and WFWG 3.11 still have a useful life for some time.

On the high end of the scale, Microsoft offers Windows NT for more network and computing intensive environments. Windows NT continues to gain momentum in industry as a replacement for systems which were once dominated by UNIX platforms. Window NT is a multi-tasking operating system unlike other Windows OS products which makes the system ideal for computing intensive environments as can be found in a number of the Department's engineering environments. In these environments, Windows NT will be needed in both a server and client capacity.

2.4.1 Operating System Recommendation

USI recommends the Iowa DOT adopt the operating system recommendations as stated by the MONITOR group. These recommendations will provide the Iowa DOT a suitable infrastructure for a majority of the DMS products that are currently available in the market. Recommendations from the MONITOR group include:

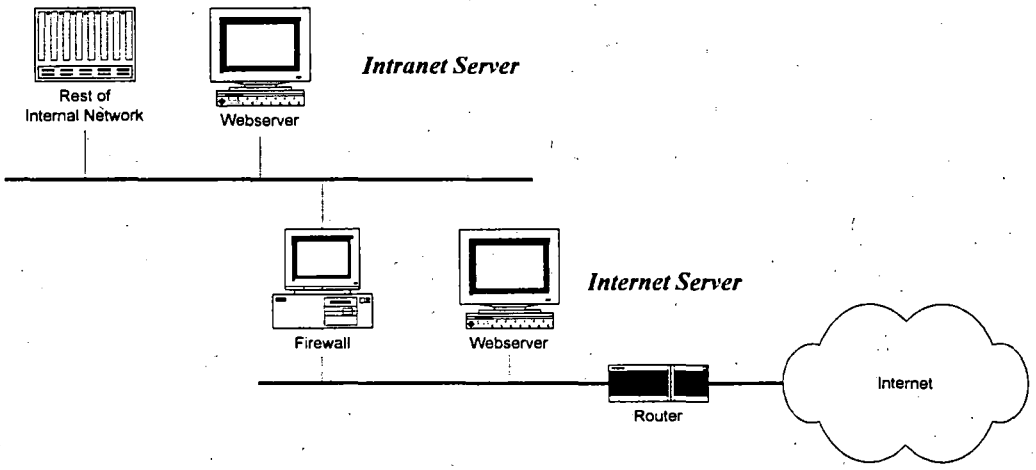
- Implementation of Window-based Operating Systems for new and replacement PC clients.
- Implementation of Windows NT on existing OS/2 servers and all new and replacement servers.
- Adoption of TCP/IP as the standard network protocol.

With the exception of the Motor Vehicle Division, a majority of the Department's microcomputers are running Microsoft Windows as their PC based operating system. The Motor Vehicle Division has a large inventory of PCs running OS/2 as their operating

system to enable access to the Driver Services Imaging System. Regardless of the Department's eventual use of Windows NT, it is clear that Microsoft's Windows OS has a majority of the Department's current client based PCs. Therefore, the Department should require all vendors to operate with all MS Windows environments.

2.5 Intranet/Internet

The Iowa DOT currently does not have a standard operating environment for Intranet/Internet components. To date, the Department's use of Internet technology components has been primarily used to gain access to information on the World Wide Web (WWW). From a software perspective, virtually everything that works for the Internet will also work for the Intranet, since the only difference is which side of the firewall the clients and servers reside.



There are, however, significant differences between the security constraints between Internet and Intranet applications. Although these technologies are evolving to the point where security is becoming very robust, the Iowa DOT will need to assess the risk of unauthorized access to any documents stored on an Intranet repository. This will be an issue that should be resolved before the Department begins to use and maintain their own Intranet servers for internal use.

The Department currently has a number of users who have a need for Web Browser software to access information external to the Iowa DOT. As the Department moves forward with RMS technology acquisition, it will become increasingly important to standardize on specific Intranet/Internet technology components. Therefore, USI recommends technology standards for the following areas:

- Web Servers
- Web Browsers

Web technologies and DMS are rapidly converging and much of the new development from document management vendors is integrated support for Intranet/Internet. The Iowa DOT should evaluate two key points when considering how these technologies will be deployed within the agency-wide RMS:

- Uncontrolled growth may lead to the dissemination of unreliable information.
- Too many controls may result in too little useful information.

The goal of defining Intranet/Internet standards is to ensure the Iowa DOT's Intranet/Internet strategy is balanced with the goals that are important to the deployment of an agency-wide RMS. The following sections provide further detail on these components.

2.5.1 Web Server

Web Servers are offered by a number of vendors, however, the clear market leaders are Microsoft's Internet Information Server (IIS) and Netscape's Enterprise Server. Both of these products offer comparable capabilities and both are widely supported by DMS vendors who offer Intranet/Internet add-on products. Because every copy of Windows NT 4.0 Server ships with free copy of Microsoft's Internet Information Server (IIS), it is advantageous, from a cost perspective, to consider adopting IIS as the Web Server standard for the Iowa DOT.

2.5.2 Web Browser

As with Web Servers, Web Browser are offered by a number of vendors, however, the clear market leaders are Microsoft's Internet Explorer and Netscape's Navigator. Both of these products offer comparable capabilities and both are widely supported by DMS vendors who offer Intranet/Internet add-on products. The distinct advantage of Microsoft Internet Explorer is that its free.

2.5.3 Intranet/Internet Recommendation

Any components procured for Internet access must ultimately build a computing infrastructure that will be suitable for RMS integration. This is especially true with Web Browsers that can be used as a graphical front-end to many vendor products. Using a Web Browser as a graphical front-end can have a significant cost impact, reducing the number of per seat licenses required for an agency-wide RMS. Most DMS vendors support an interface to Web Browsers and Web Servers. As with any software or hardware component, the more homogeneous the computing environment is, the less complexities the DMS vendor will have to deal with in supporting the environment.

It is USI's observation that the Iowa DOT has not made a significant investment in Intranet and Internet components. USI recommends that the Department continue to test and evaluate product offerings from both of the market leaders in web viewing technology (Microsoft and Netscape). IBM and Computer Associates both offer Intranet/Internet add-on products that are advertised to "Web-Enable" mainframe based

applications. These products should be evaluated for possible implementation and should not be discounted as applicable to the agency-wide RMS.

2.6 Application Programming Interfaces

An application programming interface (API) is software that an application program uses to request basic services to be performed by the computer's operating system. APIs provide a standard development environment for an operating system. APIs allow applications to run under particular operating systems and may take the form of system calls, program library functions, object calls, or Dynamic Link Libraries (DLLs). For Windows, the API also helps software programs manage windows, menus, icons, and other graphical user interface elements. The API concept has been adopted by DMS vendors to help manage the ever-increasing number of software layers required for today's networked and Graphical User Interface (GUI) based DMS environment. The APIs that USI recommends for adoption by the Iowa DOT are presented in the following section.

2.6.1 ODMA

The Open Document Management API (ODMA), has emerged as the one of the most critical development standards for organizations considering an enterprise document management system. ODMA, developed by a consortium of vendors including Lotus Development Corp., Novell Inc., and Watermark Inc., is an API of 12 simple calls that lets compliant applications integrate with one another and access a DMS running on a server. This standard lets DMS vendors replace an application's native File Open screen with one of their own. If the Iowa DOT chooses a single DMS vendor for an agency-wide RMS, this standard will not be critical. However, if the Iowa DOT envisions the use of multiple DMS vendor products, ODMA compliance is the best choice for tying together disparate DMS repositories.

2.6.2 ODBC

Open Database Connectivity (ODBC) is a specification developed by Microsoft designed to give Microsoft Windows users access to data stored on corporate mainframes and LAN-based database servers running different file formats. ODBC provides for a database independent API. Both relational and non-relational database management systems which comply with the ODBC specifications and protocols ensure the portability of data and applications across multiple platforms. Oracle, DB2, and IDMS each provide ODBC drivers which can be used to access either mainframe based or NT based databases from PC clients running Windows or OS/2 operating systems. By supporting ODBC, the RMS document indexing subsystem will have a means to interface with information that is stored in Oracle, IDMS, or DB2 databases regardless of which database is eventually chosen for the RMS standard.

2.6.2.1 ODBC Compliance Levels

ODBC drivers are rated by their ODBC 'Compliance level'; either Level 1, 2 or 3. Each level is a subset of the entire ODBC API. A driver's compliance depends upon how much of the ODBC specification is implemented in the specific driver; the higher the compliance level the more functionality the driver will support. The SQL conformance indicates the ability of the driver to convert data types between the RDBMS and the PC application as well as how much of the SQL syntax the driver is capable of implementing. The following is a list of the possible ODBC API compliance levels:

- Core API
- Level 1 API
- Level 2 API
- Level 3 API <new>

Each one implements successively greater amounts of the full ODBC specification. The following paragraphs discuss the ODBC features of the various databases which may be used for the Department's agency-wide RMS database standard.

2.6.2.2 Oracle ODBC Connectivity

The Oracle7 ODBC Driver enables a wide variety of ODBC-compliant applications to work together with an Oracle7 database server. In simple terms, the Oracle7 ODBC Driver acts as a translator between the ODBC interface used by popular front-end applications and the native interface to an Oracle7 database. The current ODBC drivers provided by Oracle are **Level 2 compliant** with CORE SQL Conformance. Oracle previously distributed a Level 1 compliant driver. The major version number of the driver indicates its compliance level so a driver version 1.x is a Level 1 compliant and the version 2.x drivers are Level 2 compliant.

Oracle's ODBC drivers communicate with Oracle's SQL*Net product to connect to a local or remote Oracle RDBMS. Since SQL*Net is specific to the network protocol, SQL*Net for TCP/IP is the specific product which would be used for TCP/IP environments. On Windows platforms, 16-bit applications require installation of the 16-bit versions of ODBC and SQL*Net drivers; 32-bit applications require installation of 32-bit versions of the ODBC and SQL*Net drivers.

2.6.2.3 IDMS ODBC Connectivity

The Department has already procured an add-on product from Computer Associates, the vendor of IDMS, that provides ODBC connectivity. The product which is called CA-IDMS® Server is a communications component that provides SQL access to CA-IDMS/DB mainframe data from Windows client applications running on LAN based PCs. ODBC connectivity to IDMS has already been tested successfully within the Office of Data Services, however, CA-Server is not adequate for large scale interactive use.

2.6.2.4 DB2 ODBC Connectivity

The Department currently employs IBM's DDCS (Distributed Database Connection Services) on a database gateway which provides client connectivity to the DB2 database. On the workstations, IBM's DRDA (Distributed Relational Database Architecture) is implemented in the DDCS product as the native connectivity layer. The proposed ODBC standard would require the use of a DB2 ODBC driver, which is included with the DDCS product, to interface to the IBM DDCS client software.

The DB2 Client Application Enabler (CAE) for Windows provides a driver that **conforms to Microsoft ODBC Level 1 and 2 specifications**. It allows any application that conforms to the same level of ODBC to access any database supported by this CAE. DB2's Call-Level-Interface (CLI), an SQL interface based on the X/Open CLI specification, is compatible with the 16- and 32-bit Microsoft ODBC specification. DB2 CLI allows Windows-based DB2 applications to be ported to other platforms. Although ODBC connectivity to DB2 has not been tested by the Iowa DOT, it is being used by Iowa State University.

2.6.3 Messaging APIs

Simple Mail Transfer Protocol (SMTP) focuses specifically on how an underlying mail delivery system passes messages across a link from one machine to another. The objective of SMTP is to transfer mail reliably and efficiently. Most operating system vendors include SMTP as part of the operating system. For this reason, SMTP is widely available from most major vendors and many small software houses. Basic Internet messaging has been implemented and deployed more widely than any other messaging technology, standardized or proprietary. As a mail protocol, SMTP is the undisputed *de facto* standard in the industry.

Popular proprietary E-mail systems are typically integrated with a document management system on an additional layer. For these environments, LAN based E-mail messaging APIs are commonly used to integrate document management system software with LAN based E-mail packages. LAN based E-mail messaging API standards have emerged from the two industry leaders of LAN based client/server mail packages:

- cc:Mail and Notes from Lotus, and
- Mail and Exchange from Microsoft.

Lotus developed the Vendor Independent Messaging (VIM) API, with help from Apple, Novell, and Borland. Microsoft developers writing to the VIM interface would be able to plug any E-mail or groupware application into a VIM-enabled operating system without having to write format translation software. Likewise, Microsoft developed the Messaging Application Programming Interface (MAPI) for use with the Windows environments including Windows 3.x, Windows for WorkGroups, Windows 95 and Windows NT. For those offices within DOT which may use these environments as their E-mail system, MAPI and VIM may be used to integrate with the agency-wide RMS.

To provide a bridge between PROFS/OfficeVision/VM™ and the agency-wide RMS, the Iowa DOT should consider evaluating a product from Attachmate called EXTRA!®

Client Connection for PROFS®/OV. This product gives the PROFS/OfficeVision user a familiar user-friendly interface and integrates messaging into the Microsoft Windows desktop environment. Windows files can be sent to other users by selecting the "Send" command from Word, Excel, PowerPoint, or any application supporting Microsoft Messaging API.

2.6.4 Scanning APIs

Document scanning and capture is a part of every document (image enabled) management system. As a result, two scanning APIs have emerged as *de facto* standards in the industry. These are: Technology Without An Important Name (TWAIN) and Image and Scanner Interface Specification (ISIS). The intent of these standards has been to provide a common specification for programming applications that interface to document scanning devices. The goal of these standards is to provide a common methodology to allow interoperability of various scanning devices from multiple vendors. The following sections discuss the specific areas of each of these complimentary standards.

2.6.4.1 TWAIN

Technology Without An Important Name (TWAIN) is an industry standard for input within the desktop imaging market. Most small scanners and desktop applications support this widely used scanner communication protocol. It allows for many scanners with different features to communicate to the application without the application having to know the exact name, type, or features provided by the scanner. Most high-speed scanners do not support this protocol for both proprietary and performance reasons.

2.6.4.2 ISIS

Image and Scanner Interface Specification (ISIS) is a standard developed by Pixel Translations and is in many ways the imaging counterpart of the TIFF specification. Like TIFF, ISIS allows for the definition of "private" tags to describe an application developers interface to a specific scanner. What makes ISIS so significant is that all the information about the objects and processes of image handling (i.e., setting scan parameters, scaling, rotating, painting.) is housed and managed outside the view of the application programming. Scan solutions which are ISIS compliant are generally more open systems oriented. Unlike TWAIN, ISIS is more suited for high speed scanners.

2.6.5 API Recommendations

USI recommends the following APIs for adoption as the Department's RMS standards. These APIs are:

- Open Document Management API (ODMA)
- Open Database Connectivity (ODBC)
- LAN Based E-mail messaging APIs (VIM & MAPI)
- Scanning APIs (TWAIN & ISIS)

While most of these APIs are important only to systems deployed with a single document management vendor product, ODMA is important for enterprise development where multiple document management vendor products exists. ODMA is also the least mature API standard in the industry.

Additionally, USI recommends the Iowa DOT consider evaluating a product from Attachmate called EXTRA!® Client Connection for PROFS®/OV as a LAN based E-mail standard for potential connectivity between the Department's mainframe based E-mail system and the agency-wide RMS.

2.7 Database

Document Management Systems are closely tied to an underlying Relational Database Management System (RDBMS) to provide the mechanism to index documents into the DMS. The Department has several options, all of which offer some level of SQL compliance. The Department must choose the most suitable database standard that meets the needs and resources of the Iowa DOT, not simply the industry leader. The following sections discuss database standards that are recommended for consideration and adoption by the Iowa DOT.

2.7.1 Structured Query Language

The current standard for SQL (Structured Query Language) is referred to as "ANSI X3.135-1992, American National Standard for Information Systems - database Language SQL," or as "ISO/IEC 9075:1992, Information Technology - database Languages - SQL." This standard specifies data definition statements as well as data manipulation statements, system catalog requirements, integrity constraints, cursors, and so forth. SQL includes the data manipulation language (DML) for retrieving and updating data values in relational databases, as well as the data definition language (DDL) to create and manage the database schema. SQL is such a popular standard that today, every major client/server application supports it; no competing architecture has come close.

2.7.1.1 DB2 SQL

Because of IBM's influence in the computer industry, DB2's SQL has become the *de facto* standard--the ANSI Level 2 SQL standard is predominantly based on the DB2 implementation of SQL. The latest release of the DB2 product (Version 5.0) from IBM called DB2 Universal Database **conforms to ANSI/ISO SQL92 entry-level specifications**. DB2 Universal Database now also provides an SQL optimizer which claims to improve performance of SQL processing which is a key capability for any large scale database such as the one envisioned for the agency-wide RMS.

DB2 Universal Database also includes Extenders that handle text, image, fingerprint objects, audio, and video data. IBM is working with third-party vendors to create Extenders for additional data types. These features may provide a means for the agency-wide RMS to manage various document file formats within a DB2 database.

2.7.1.2 IDMS SQL

With the CA-IDMS DBMS, SQL is a primary programming language. All major SQL dialects are supported, including ANSI, FIPS, SAA (DB2) and CA Extended SQL. IDMS provides an add-on product called SQL Option that provides SQL connectivity. The CA-IDMS® SQL Option implements relational processing by fully integrating ANSI-standard SQL native to the CA-IDMS/DB database engine. The CA-IDMS SQL Option user can fully define, manipulate and secure databases using SQL and can take advantage of CA SQL extensions, such as SQL DML access to existing databases that were not defined with SQL.

2.7.1.3 Oracle SQL

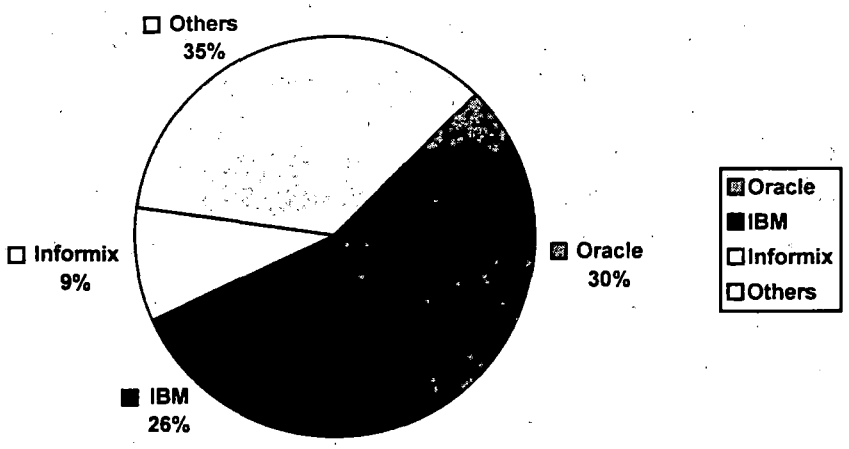
Although SQL was developed by IBM, it was brought to minicomputers in the late 1970s by Oracle Corporation, which eventually ported SQL down to microcomputer LANs and stand-alone PCs. Oracle's SQL became one of the first truly scaleable application development platforms. Oracle7 is **ANSI/ISO SQL92 entry-level compliant**. In addition, Oracle7 offers a number of robust SQL extensions that allow complex operations to be expressed in SQL, improving developer productivity by reducing the need for procedural code. Application performance and scalability are enhanced by performing complex data manipulation operations within the Oracle7 SQL engine. Like DB2, Oracle 7 also includes advanced query processing techniques using a cost-based optimizer that improves the speed of processing complex SQL requests.

2.7.2 Database Market Surveys

The relational database market has grown rapidly in the industry due to the standardization of SQL and the growth of client/server computing. USI has provided database market survey data from two perspectives: General Market Share and DMS Vendor Support Share. This information is provided for consideration in the RMS database standard selection process by the Iowa DOT.

2.7.2.1 General Market Share

Of the market leaders, IBM and Oracle Corporation own approximately 56 percent of the database market. The following table shows the market share of the RDBMS market for 1996. (Source: Dataquest, URL - `http:// www.gartner.com/ aboutgg/ pressrel/ dqdbpr.html`).



The market share chart provided shows that Oracle and IBM have the largest percentage of the RDBMS market.

2.7.2.2 DMS Vendor Support Share

In a market survey conducted by Datapro published in March of 1996, Datapro surveyed more than 100 document and imaging system vendors regarding their document imaging management software products. Datapro received response data on 88 document and image management software/systems from 67 vendors. The results of the survey show that the most popular databases for use document indexing are Oracle (52%), Sybase (47%), Informix (35%), Gupta SQL Base (23%), DB2 (22%), Ingres (16%), and Btrieve (12%). Although IDMS was not mentioned in the survey, some vendors responded that their systems would support any SQL compliant database.

2.7.3 Database Recommendation

The predominant databases currently in use within the Department are IDMS and DB2. If the Department chooses to implement a *centralized* mainframe based solution for the agency-wide RMS, USI recommends DB2 as the database standard. DB2 is recommended for following reasons:

- DB2 has a proven track record as the database standard for the Driver Services Imaging System. 9.5 million documents are now stored in DB2.
- DB2 is currently the standard for the Trns-port SiteManager system which will have many potential interfaces to the agency-wide RMS.
- 22% of document and image management software/systems support DB2 as an index database.
- IBM has ported DB2 to Windows NT and a variety of UNIX operating systems and is aggressively pursuing the Window NT market.

If the Department chooses to implement a *distributed* processing architecture on a Windows NT platform for the agency-wide RMS, USI recommends Oracle as the database standard. Oracle is recommended for the following reasons:

- Oracle is more mature than DB2 in the Windows NT market and has a large install base of production databases on Windows NT.
- According to the most recent market surveys available, Oracle provides the most marketable RDBMS building block for DMS vendors. 52% of document and image management software/systems support Oracle as an index database.
- Oracle has been procured for GIS pilot development within the Iowa DOT. Because GIS and RMS integration is critical to many offices within the Iowa DOT, the database standard chosen for GIS may influence the standard for the agency-wide RMS.

In conclusion, USI recommends that the Department defer selection of a RMS database standard until a system architecture standard is selected. The decision can be made at the same time the agency-wide RMS vendor selection is made. DMS and RMS vendors should be made aware of the Department's significant investment in DB2 licensing and personnel resources, and the Department should solicit responses in the context of this information. The Department should also solicit DMS and RMS solution providers to detail the costs associated with training. Regardless of whether a centralized or distributed database architecture is selected for the Department, the agency-wide system should be required to provide access to information stored in either IDMS or DB2 based information systems. The determination of a database for the enterprise system should not constrain access to information on current systems.

2.8 File Formats and Compression Standards

In a Document Management System, the information assets of the system are in two forms; a document index and electronic files. The document index is typically managed by a third party relational database management system (RDBMS). As a result, document index information is relatively secure from technology changes if the RDBMS vendor used is a market leader following *de facto* standards such as SQL. The electronic files that are stored in a RMS are however more critical to the long term security against changes in technology.

There are many other potential file formats that may be generated by office automation software such as word processing, spread sheet files, and even audio and video. Any selected Document Management System should be able to store these files in their "native" file format. Therefore, USI is focusing on those file formats which are envisioned to be the most common "document" file formats for the Iowa DOT's agency-wide RMS. By selecting key file formats and compression standards that are predominant in the market and file formats which are important to the Iowa DOT, the information assets of the agency-wide RMS can be secured. It is with this background that USI offers the following recommendations for file formats to be managed by the agency-wide RMS envisioned for the Iowa DOT.

2.8.1 Raster Image File Formats

Tagged Image File Format (TIFF) is a *de facto* standard but is sometimes a controversial one in practice. It is widely used to specify the header portion of the stored image data. The header is the text portion of the file containing information about the graphics contained within the record, such as the size of the image, the number of bits per pixel, and the resolution. TIFF headers can be used with Telecommunications Standards Sector (TSS) Group 3 or 4 compressed images, and other compression standards, as well as uncompressed images.

The latest version of the TIFF specification (6.0) defines two types of files that can be stored. Type I supports untiled images and is the default. Type II addresses tiled images. Type I raster files are created from a digitized image compressed into a single file. Type II raster files are created when the resulting bit map from digitization is divided into squares, each of which is individually compressed. The compressed squares can then be transmitted, decompressed, and displayed. Type II files offer a performance benefit for larger engineering sized drawings which are stored as raster files. Similar information is provided under the Continuous Acquisition and Life-Cycle Support (CALS) file format, used by the U.S. Government. Although CALS is not as widely used as TIFF, it is more standardized and is better able to handle larger engineering-sized images.

TIFF is one of the most versatile and misused formats on the market today. The TIFF 6.0 specification supports many different imaging technologies. This versatility, though, also creates a considerable amount of frustration for the end user. Given all the possible image technology variations and combinations that can be defined within a TIFF file, coding conflicts can occur. One vendor might provide support for only a subset of the TIFF specification. Another vendor's program might not provide the same type of functions. With this inconsistency compatibility issues tend to arise.

It would be impractical to require that an DMS provider follow one of the 350 possible permutations of TIFF tags. The best approach to ensure that the image files can be read by other systems is to require vendors to provide the TIFF header structure used by their application. Typically it is the supplier of the scanning software that provides the software component responsible for compressing the scanned image files into a specific format.

2.8.2 Vector Graphics

Vector graphics are a method of representing graphical objects as sets of endpoints for lines, curves, and other geometric shapes with data about width, color, and spaces bounded by lines and curves. The entire image commonly is stored in the computer as a list of vectors called a display list. Vector graphics are used when the user needs geometric knowledge about the object created. Geometric shapes keep their integrity: a line always can be picked, extended, or erased. Today, most screens are raster graphics displays (composed of dots), and the vectors are put into the required dot patterns (raster) by hardware or software.

2.8.2.1 Computer Graphics Metafile

Computer Graphics Metafile (CGM) is a graphics data interchange standard which defines a neutral computer-interpretable representation of 2D graphical (pictorial) information in a manner that is independent from any particular application or system. CGM is also used in the commercial desktop publishing arena, however, it is a more appropriate image standard for the Iowa DOT's CADD environment. A CGM can contain:

- vector graphics (e.g., polylines, ellipses);
- raster graphics (e.g., tile array); and
- text.

The purpose of the standard is to facilitate the storage and retrieval of graphical information between applications, software systems, and/or devices. MIL-D-28003A (CGM) Digital Representation for Communication of Illustration Data provides the specifications for CGM. MIL-D-28003A is a subset of ANSI/ISO 8632:1992. 8632 is also adopted by the Federal Information Processing Standard (FIPS) 128-1.

CGM has limited capabilities for handling 3-D geometry, providing fine control over line drawing details, and using font resource references to enable reasonably accurate fonts, and describing color. Several additions to the CGM standard are being developed. These modifications would add a global symbol capability, 3-dimensional geometry extensions, and improved engineering drawing capabilities (such as better control over fine details of line drawings). These CGM changes are intended to be upwardly compatible with existing versions of the specification.

2.8.2.2 Programmer's Hierarchical Interactive Graphics System

Programmer's Hierarchical Interactive Graphics System (PHIGS) is a relatively well-known 3D system. Based on GKS (Graphics Kernel System), PHIGS is an ANSI (American National Standards Institute) standard. PHIGS (and its descendant, PHIGS+) provides a means to manipulate and draw 3D objects by encapsulating object descriptions and attributes into a display list that is then referenced when the object is displayed or manipulated. One advantage of the display list is that a complex object need be described only once even if it is to be displayed many times. This is especially important if the object to be displayed must be transmitted across a network. One disadvantage of a display list is that it can require considerable effort to re-specify the object if it is being continually modified as a result of user interaction. Another difficulty with PHIGS and PHIGS+ (and with GKS) is that they lack support for advanced rendering features such as texture mapping.

2.8.2.3 OpenGL

OpenGL is a flexible procedural interface that allows a programmer to describe a variety of 3D rendering tasks. It does not enforce a particular method of describing 3D objects, but instead provides the basic means by which those objects, no matter how described, may be rendered. This view of rendering provides for efficient use of graphics hardware,

whether that hardware is a simple frame buffer or a graphics subsystem capable of directly manipulating 3D data. OpenGL is rendering-only, so it is independent of the methods by which user input and other window system functions are achieved, making the rendering portions of a graphical program that uses OpenGL platform-independent.

Because OpenGL imposes minimum structure on 3D rendering, it is an excellent base on which to build libraries for handling structured geometric objects, no matter what the particular structures may be. Examples of such libraries include object-oriented graphics toolkits that provide methods to display and manipulate complex objects with a variety of attributes. A library that uses OpenGL for its rendering inherits OpenGL's platform independence, making such a library available to a wide programming audience.

2.8.3 Gray-scale and Color Image Compression

The standard produced by Joint Photographic Experts Group (JPEG) is the first international digital image compression standard for multilevel continuous-tone still images (both gray-scale and color). Some applications to which JPEG addresses itself include photovideotex, color facsimile, quality newspaper wirephoto transmission, desktop publishing, graphic arts, and medical imaging. The Joint Photographic Experts Group started working on a still-image color compression standard in 1986. The JPEG standard has been developed jointly by both ISO (International Standards Organization) and ITU-T (a subcommittee of the International Telecommunication Union), hence the nomenclature "joint", for compression of still images. It can compress typical images from one-tenth to one-fiftieth of their uncompressed bit size without visibly affecting image quality.

JPEG is also part of the PostScript Level 2 standard, to enable faster printing of documents that include complex images. JPEG will be an important image technology compression standard for the foreseeable future since it works relatively well and is already available in the marketplace, as evident by vendor support. The Driver Services Imaging System which is based on the IBM ImagePLUS product utilizes the JPEG standard for color photograph images and signatures.

2.8.4 Publishing File Formats

The Internet technology industry is rapidly propagating the use of and standardization of portable electronic documents. A portable electronic document is a "published" electronic file, or more generically, printer output that can be viewed independent of the application that was used to author it. The advantage of this concept is the creation of paper is not necessary to distribute a document. Documents can be printed to a file and distributed. The technologies and the companies that promote this concept are:

- Acrobat (Adobe),
- Envoy (Novell),
- Common Ground (Common Ground Software), and
- Replica (Farallon Computing).

Of these technologies Adobe Acrobat is quickly becoming the *de facto* standard. This has happened partly because of Adobe's name recognition with electronic publishing, savvy marketing, and an open standard. The Acrobat Reader is freeware and can be downloaded from the Internet at Adobe's web site (http://www.adobe.com/). The file format for the Acrobat technology is called Portable Document Format (PDF).

A primary benefit of a portable document is that it maintains the intelligence of the document. This allows document management systems to access the information for features such as full text searches. The information in the document can also be cut and pasted. Additional extensions of portable document formats are features such as: thumbnails, annotation, and links to the World Wide Web (WWW). USI recommends that Iowa DOT adopt PDF as a standard for electronic publishing of business sized documents as well as supporting HyperText Markup Language (HTML) for all other documents published on the WWW. HTML was developed as a subset of SGML (Standard Generalized Mark-up Language) which is a higher-level mark-up language. Like HTML, SGML describes formatting and hypertext links, and defines different components of a document. HTML is the simpler of the two, however few web browsers support both. HTML was conceived for transmission over the Internet (via web pages). HTML is a public standard.

2.8.5 File Format Recommendations

In conclusion, USI recommends Iowa DOT adopt the following standards for any RMS/DMS component that will generate electronic files to be managed by the agency-wide RMS:

- TIFF TSS G4 Type I as the standard format for scanned business sized documents (e.g., up to 11"x 17").
- TIFF TSS G3 or TSS G4 Type I as the standard format for faxed documents.
- TIFF TSS G4 Type II as the standard format for scanned engineering sized documents (e.g., over 11"x17").
- CALS as an optional file format for engineering sized documents (e.g. over 11"x17").
- JPEG for color and gray scale images.
- CGM for graphics files for CAD files.
- PDF and HTML for an electronic document publishing format.

While these formats are prevailing standards for most DMS environments, the Iowa DOT's agency-wide RMS should require view support for the image file format produced by the Driver Services Imaging System. The Driver Services Imaging System is based on the IBM ImagePLUS product. Raster image files produced by this system are stored as Image Object Content Architecture (IOCA) files stored in a MO:DCA (Mixed Object Document Content Architecture) wrapper. Although MO:DCA and IOCA are proprietary to raster image files created by the ImagePLUS system, there are several third party image viewers that support this file format. The Iowa DOT has a large repository of documents already stored in this format and therefore should require view support for this file format, however, it is not an industry standard file format for raster image files.

USI recommends that the DOT not adopt a standard for 3D at this time. Several standards have been proposed for 3D graphics, but none has (yet) gained wide acceptance. The Technology Committee is encouraged to continue to monitor developments in 3D graphic standards. As this technology matures, a specified or *de facto* standard will emerge that will serve the requirements of the Department. When preparing the RMS RFP, vendors should be required to present a discussion of their position and/or recommendation for use of 3D graphical software and associated compliance with any industry standard.

3. OPERATIONAL STANDARDS

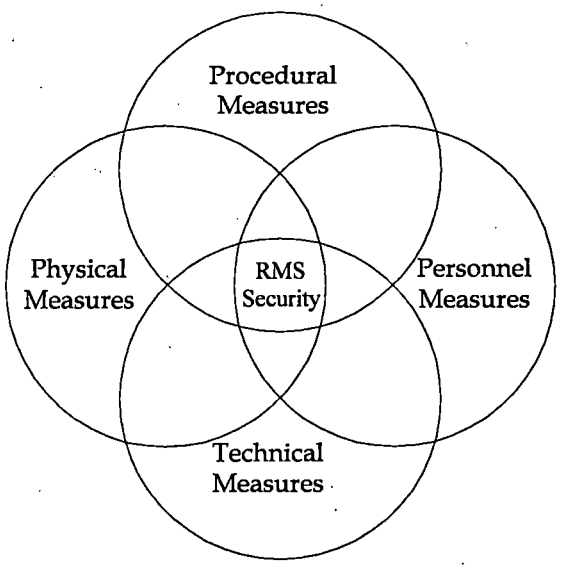
This section provides an overview of operational standards that may be applied to the administration of the agency-wide RMS. This overview of operation standards addresses topics in the following areas:

- *Security*
- *Performance*
- *Backup and Recovery*
- *Availability*

This high level, functional overview provides guidelines from which the Department can derive standards for the agency-wide RMS. The Driver Services Imaging System can provide the RMS Standards Committee a baseline for the operational guidelines discussed in this section and should be used as a point of reference for establishing operational standards for the agency-wide RMS.

3.1 Security

Several types of security may be employed to address the overall security requirements of records or documents to be stored in the agency-wide RMS. These include physical, procedural, personnel, and technical measures. Some threats can only be addressed through physical measures. For example, protection against the theft of disk media can be controlled with physical security, e.g., by keeping the disks in locked rooms. Other threats can be addressed with different security measures. For example, protection against uncontrolled dissemination of printed information can be controlled by implementing a process for handling classified documents, or protection against unauthorized access to a facility can be controlled by requiring personnel to wear badges. An example of how technical security may be implemented in the RMS is the use of a multilevel secure system, which protects documents from unauthorized access. These different factors are not mutually exclusive and come together to form a proposed basis for RMS security, as shown in the accompanying exhibit.



Rarely can comprehensive data security requirements be met without implementing a

security policy that combines all four types of security. Physical measures are always necessary to ensure some elements of confidentiality and availability. Procedural measures control information entering and leaving secure systems (for example, manually downgrading or labeling information). Personnel measures like providing functional access level to user ids based on whether the user is an internal DOT employee, consultant, or public user can also be used to control access.

Within the current paper based environment, the Iowa DOT relies upon physical measures guided by records management policies and practices to control access to documents. As the Department moves forward with an automated approach using the technologies provided by DMS and RMS software, security will be a feature of the system. Iowa DOT will no longer be able to rely solely on physical security measures to control access to documents. The increasing capabilities of available technical security measures can help reduce the need to enforce security through physical, personnel, and procedural measures. The following issues relate to some of the technical security measures that are recommended for consideration by the RMS Technology Committee in developing operational and functional standards for the agency-wide RMS.

3.1.1 Database Level Security

While securing a database may be only one of many types of security implemented, database security is perhaps the most vital of these technical security measures. As the repository for critical and sensitive information, the database server is a key technical component in addressing the DOT's overall security requirements. Operating systems, network services, and encryption devices also provide important measures; however, the database server is chiefly responsible for handling the processing of the most valuable and vital portion the records management system - *information.*

3.1.2 Application Level Security

For the purpose of evaluating operational standards for the security of the agency-wide RMS, application level security requirements are separated into two broad areas of concern:

- Requirements for specific security functionality normally addressed in terms of *confidentiality*, *integrity* and *availability* of data, and
- The requirement for *assurance* that this functionality performs correctly.

While *confidentiality*, *integrity* and *availability* of data are all areas that can be addressed through the technical features of the software, assurance can only be attained through proper documentation of the system's use.

Policy number 030.05 from the Iowa DOT Records Management Manual describes the general security issues as they may be applied to the agency-wide RMS. As the DOT moves forward with system acquisition plans, the eventual system will need to programatically enforce the business rules identified in this policy statement. In addition, the system should incorporate any other provisions that apply from a state-wide perspective in accordance with Iowa Code chapter 22 and rules 761 IAC chapter 4.

Confidentiality means documents are accessible only to those individuals who have a need-to-know and who are authorized to access that document. Systems enforce confidentiality through identification and authentication, mandatory and discretionary access controls, auditing and accountability mechanisms, and object reuse (ensuring that deleted documents can not be retrieved improperly).

Integrity means documents can only be modified so that they are consistent and not contradictory. In a RMS, overall integrity is a combination of system integrity mechanisms to ensure document integrity, and integrity mechanisms to ensure that documents are not altered without proper functional privileges.

Availability means documents are easily obtained in a timely manner, while ensuring the RMS is tolerant of system failures, resistant to denial of service attempts by malicious users, and recoverable in the event of system failure.

Assurance provides an underlying level of confidence in the correctness and effectiveness of a system's confidentiality, integrity, and availability mechanisms. Assurance is achieved by use of sound security engineering techniques, internal and third-party testing activities, and by external evaluations.

3.1.3 Security Policy

A security policy is the set of laws, rules, and practices regulating how an organization manages, protects, and distributes sensitive information. The relative importance of the system's confidentiality, integrity, and availability components in providing proper security varies in different organizations and applications. For example, military environments that require strict protection of classified information might weigh confidentiality more highly than integrity or availability; in a financial industry system, continuity of service (availability) and data integrity may be more important than confidentiality. In the pharmaceutical industry, confidentiality and integrity, more than availability, are vital to clinical trial data. For the Iowa DOT, public and inter-agency accessibility of information generated by the Department is a goal of the Department.

Each organization has slightly different requirements and priorities for these technical security measures, as well as site and organization-specific requirements for physical security, personnel security, and procedural security measures. The composition of all of these requirements can be thought of as a system's *security policy*. The DMT should evolve an overall security policy for the agency-wide RMS that will take into consideration the state and DOT imposed security guidelines as well as the DOT's goals for the system.

An RMS or DMS product that properly implements these and other requirements provides a framework within which the DOT can manage and secure its information while simultaneously meeting its business process objectives. Tradeoffs between these requirements may be necessary to achieve a security policy that correctly meets the DOT's objectives. Consequently, the selected RMS or DMS components must provide the flexibility to allow system administrators to enforce their unique security policy,

rather than being forced to compromise their security requirements to accommodate the limitations of the technology.

3.2 Performance

There are specific operational guidelines that provide the basis for evaluating the performance of a Records Management System. The question to ask is whether the system meets the quality and requirements it was intended to deliver. System acceptance is based upon guaranteeing accuracy, proper utilization, technical features, and timeliness.

3.2.1 Accuracy

Data integrity is a major area of concern for the proper implementation of the system. It is crucial that the document retrieved is the actual document requested. The accuracy of the indexing information attached to each document must be ensured. However, the Department should also recognize that any operation that includes human intervention, such as indexing a document, will not be 100 percent accurate. Deliverable documents must clearly define the programmatic methods and database definitions to ensure the design is sound. Typically, the detailed database design will identify all unique keys and indexes which enforce data integrity at the database level. A detailed database design, and structure should be provided by the RMS/DMS vendor.

3.2.2 Utilization

Proper utilization encompasses all tasks and functions of the RMS. Attention should be focused on the main sub-functions (indexing, quality control, upload to optical) and system components (optical storage, servers, database) involved in the automation of records and document management. The appropriate allocation and utilization of system resources should be addressed in order to optimize system performance as a whole. The following discusses the pertinent issues related to system utilization.

- The initial tasks of scanning, indexing, quality control must all function evenly and without any backlog. For example, a backlog of scanned documents can occur when the procedure of indexing is not expedient.
- If optical storage technology is used, optical disk utilization and capacity should be consistently analyzed during the initial periods of implementation to ensure proper sizing and operation of the jukebox(es) deployed.
- The configuration and activity of each server should be closely monitored.
- Network traffic must be analyzed. The volume of files, file types, and peak operating periods must be examined.

3.2.3 Technical Features

Technical features of hardware and software may include resolutions and compression methods. Technical feature standards provide a baseline for establishing acceptable

performance parameters. It is important that the technical features inherent in any proposed vendor solution adhere to the standards derived for the Department. The following is a lists of recommended standard features:

- Image resolution (200-300 dots per inch);
- Display resolution for high-end monitors (120 dots per inch or higher);
- Image compression ratio (TSS Group 4 averages 10:1).

3.2.4 Timeliness

All aspects of system response time must be examined. Initial application execution should be tested. The time it takes for a document to be scanned, indexed, and uploaded to optical must be examined. How long it takes to retrieve a document is equally important.

- Document scanning speeds (*de facto* standard is 15-100 pages per minute and will vary by Division or office and need);
- Document print speed (*de facto* standard is 8, A-size pages per minute with image coprocessor);
- Average document search speed (ranges vary based on size of database and the complexity of the query, typically 3-7 seconds is acceptable for local databases);
- Average active document retrieval speed from on-line magnetic storage (*de facto* standard is 3-5 seconds to display the first page (image) of the retrieved document from magnetic cache);
- Average historical document retrieval speeds from near-line storage (*de facto* standard is 15-20 seconds to display the first page from an unmounted platter in an optical jukebox and 5-10 seconds to display the first page from a mounted optical platter);
- Average archived document retrieval speed from off-line storage (*de facto* standard is 20-60 seconds to display the first page from an unmounted tape cartridge in a tape jukebox).

3.3 Backup & Recovery

A primary responsibility of a system administrator is planning and implementing a disaster recovery plan for any system which contains organizational information assets. It is also the administrator's responsibility to see that backup procedures are performed in a timely manner and that backup tapes (and other media) are labeled correctly, and stored safely and securely. Backup and recovery will be an important functional component for the Iowa DOT's agency-wide RMS. Backup and recovery may be performed using operating system utilities or third party backup and recovery products. The backup and recovery of optical storage is often performed using utilities provided by the optical storage software vendor. The complexity of the backup and recovery procedures depends on the underlying system administration utilities provided by the vendor. The two most common approaches used in the backup and recovery of optical storage subsystems are mirroring and journaling.

3.3.1 Mirroring and Journaling

In a mirroring technique, optical jukeboxes have a primary platter and a backup platter. The backup platter mirrors the primary platter. In the event of loss of a primary platter, the backup platter may be used to replace the primary platter. With a journaling approach, a designated "active" backup media is used to store all updates to multiple platters which are updated over the course of a normal backup period. The primary difference between a mirroring and journaling approach is the amount of time required to perform a recovery in the event of a loss of any primary optical media. With mirroring, the operation is straight forward requiring only the replacement of the primary media with the mirrored backup media. With a journaling approach, recovery of a primary platter requires the use of multiple primary platters to rebuild a primary platter since the updates are most likely spread across multiple platters.

3.3.2 Policies and Procedures

The Iowa DOT policies and procedures are a key component of its backup and recovery solution. In fact, it is the one component over which there is the greatest control. These policies should be well-documented, tested, reviewed and updated as appropriate.

Unfortunately, there is no magic key or single technology that can eliminate anxiety over backup and recovery. The success of any backup solution lies within the relationship between software solutions, hardware configurations and policies and procedures that are well-grounded with the Iowa DOT's data availability requirements. Like an insurance policy that there is seldom an occasion to use, in the event it is necessary, you're glad it's there.

Iowa DOT should require RMS and DMS vendors to provide backup and recovery procedures that are specifically geared towards their products, and any third party components, and operating system features of any system provided by the solution provider. Backup and recovery procedures can then be evaluated by the Department as part of RMS solution evaluation. The Driver Services Imaging system may provide a baseline for the Department as a model for other RMS acquisitions. The backup and recovery procedures developed for the Driver Services Imaging system should be examined by the RMS Technology Committee as a possible guideline for other systems. The Department can then derive a disaster recovery plan that is in compliance with the Department's operational standards. For further reference, the U.S. DOT has prepared a detailed Disaster Recovery Plan that may be used as a guideline for the Department in developing a plan for the Department's agency-wide RMS.

3.4 Availability

The availability of the system for users, that is, how much time during the day will the system be "up", is a key question to be addressed by the RMS Technology Committee. In order to evaluate the issue, the committee should assess the costs and benefits of choosing different availability for the system. The Driver Services System Imaging System has set the standard for the Department as a 24 by 7 system which provides

continuous access to documents. The question the committee needs to address is should the agency-wide RMS provide the same level of availability? The answer to this question will have a significant impact on the technical architecture, specifically the server components of the system. The Iowa DOT should solicit solutions from DMS and RMS vendors that will provide the level of system availability that Iowa requires for the agency-wide RMS.

3.4.1 Usefulness

In order to determine the costs and benefits of different levels of availability of the system, the committee should evaluate the usefulness of the system at different levels of availability. These levels may be expressed as business hours, evenings, weekends, and 24-hour availability.

Business processes do not always take place during normal business hours. There may be some degree of efficiency in allowing work to be accomplished at the convenience of DOT employees and consultants. Providing the flexibility for employees to work outside of normal business hours to accomplish extra work under deadline may also be an unrealized benefit. External access by the true customers of the DOT, the public, may occur at any time as Iowa DOT documents become accessible on the Internet.

This is an area where the RMS Technology Committee should work closely with the Document Committee. One of the roles of the Document Committee is to derive criteria by which the value of Iowa DOT records can be determined. Value can be determined by evaluating the following values:

- Operational Value,
- Is the record a Vital Record,
- Fiscal or Tax Value,
- Legal Value and
- Historical Value.

Example of documents which have high operational value requiring the highest level of availability within the DOT are As Built Plans and Material Safety Data Sheets. There are situations where these types of documents would be required during non business hours in which a 24 by 7 accessibility may prove justifiable in the long run.

3.4.2 Implementation

The terms high availability and fault tolerance have evolved over many years, and have taken on somewhat different meanings in the personal computer and local area network environment than in the realm of minicomputers and mainframes. It is important to understand the differences in these terms.

The original definition of the term "fault tolerance" was that system operation would never be interrupted by the failure of a component or subsystem. Typically this architecture was implemented by the use of redundant components and "fail-over" mechanisms, so that any failing component or subsystem was immediately and

automatically replaced by a working one, and in such a way that higher-level system operations were not affected. Such systems were often described as having "no single points of failure," meaning that every component and subsystem was protected.

While achieving very high levels of system availability, this approach required large amounts of redundant hardware, as well as mechanisms which watch for failures and perform the "fail-over" operation when failures occur — and is therefore very expensive. It is also generally true that these systems are based on proprietary operating systems, or proprietary versions of industry operating systems, and have therefore become less desirable as computing has moved towards environments based on industry standards.

The term "high availability" implies an architecture designed to prevent or recover from most faults, but available at much lower prices than fault-tolerant systems. High-availability systems may have one or more of the following characteristics:

- The process of recovering from a failure may take several seconds or more, instead of being immediate.
- Some components which hardly ever fail may not be protected.
- Operation after a failure may take place in a "degraded mode," meaning at a reduced rate or with lower capacity than normal (for example, with fewer processors or less memory).
- In some cases, normal operations may be restored by restarting the entire system.

The basic concept of high availability is providing a high level of system uptime at a reasonable price.

The term "fault tolerance" is increasingly used by personal computer server vendors to describe systems which (by the original definitions) are not fault-tolerant and may, in fact, have very limited high-availability features.

At the high end of the availability spectrum are real-time applications which cannot tolerate even momentary interruptions. These are sometimes called "mission-critical" applications, and tend even now to be implemented on proprietary, large fault-tolerant host machines. Examples include air-traffic control and stock-floor trading systems. These applications, while important, are small in number. For this reason, the use of fault-tolerant systems is growing less rapidly than the rest of the computer industry.

The large "middle ground" is occupied by high-availability servers. These systems are used for a range of applications from (low end) file services and E-mail through (high end) client/server applications like database management and transaction processing. These applications are often referred to as "business-critical."

At the low end of the availability spectrum are applications which, although important, are not critical. Examples of these applications are workgroup backup or print servers. In many cases, servers purchased for these applications have limited availability features.

Another aspect of availability is whether it is increased by preventing problems from impacting users and operations, or by quickly recovering from them when they *do* occur. A server with a disk array is an example of prevention, because it keeps a disk failure

from affecting server users and operations. Automatically restarting a server in the event of a "hang" is an example of recovery, because users and operations are momentarily interrupted. Decisions between these two paths are based on an analysis of cost and need.

Questions to be answered when evaluating the degree of availability and fault tolerance needed for the agency-wide RMS include:

- How much availability is needed? Are the documents to be managed by the RMS "nice to have?" or "business-critical" or "mission-critical"? What is the impact on the Iowa DOT of a server failure? Can it be measured in lost time? Human safety? Customer service dissatisfaction?
- What failures are most likely to encountered? Do the features of the servers under consideration address problems likely to be encountered?
- What kind of availability is needed? Do needed applications require prevention-based availability, or is recovery-based availability adequate?

The answers to these questions may help to establish the most suitable system architecture for the Iowa DOT's agency-wide RMS.

Redundancy may be accomplished by a variety of methods. Redundancy is, by its very nature, inefficient. The higher level of availability that is required of a system, the greater the inefficiency of the system. However there are better ways to accomplish this redundancy in the overall context of the system.

24 by 7 operations requiring redundant capabilities has traditionally been the domain of mainframe environments which have a proven track record of operational status in mission critical environments. Mainframe technology has redundancy features inherent at both the operating system and hardware levels. However, for distributed computing environments which use server platforms such as Windows NT running on Intel based PC devices, the system hardware and software requires high-end components. These high-end components are usually in addition to the base features of hardware and OS components that are considered entry level platforms which are more typical for systems which operate on an 8 by 5 availability schedule. Therefore, the context of the following guidelines apply to operational standard considerations for distributed processing architectures which use non-mainframe components.

3.4.2.1 Hot Backup

Hot backup features are incorporated into many servers to ensure data integrity and high system up time. These systems come with a hot-swap disk subsystem and frequently with a dual-SCSI backplane for easy internal-disk duplexing and continued access to the server during replacement of failed drives. Some hot-swap subsystems also are equipped with an intelligent bus for managing the subsystem and its hard drives. Error checking and correcting (ECC) memory with error-management capability is available with some models as is a built-in automatic server restart feature that activates the server in the event that the network operating system (NOS) ceases operation.

Some manufacturers include dual-channel array controllers which support various RAID levels (0, 1, 5 or 6). These systems usually provide higher performance through the PCI

bus and better processor utilization, as PCI array controllers are equipped with automatic hot-spare drive architecture. In the event of a drive failure, this drive architecture reconstructs data on a spare drive automatically and without user intervention.

3.4.2.2 Cold Backup

Cold backup and recovery solutions are determined by the level of data availability required. This level of data availability depends on the cost of downtime to Iowa DOT. It also determines the type and implementation of backup and recovery solutions. Backup is required in any recovery environment. Although recovery from a backup tape in a high availability environment may never occur, the protection and safeguarding of critical business data is still essential.

Tape Rotation- A good tape rotation method is vital to ensure tape data will allow for backup if an important file is lost, or perhaps if an entire hard drive is found to be defective. Tape rotation should use anywhere from three to ten tapes.

The selected rotation method needs to include a total backup at least once a week, if not everyday. Total backups should be on separate tapes in case one becomes corrupt. If total backups are not made daily, then procedures should call for a backup to be performed as a modified backup on the other days of the week on a separate tape. Always keep one copy of the latest total backup off-site or in a fireproof safe.

If there is a need to archive specific programs or data using selective backups, use separate tapes but be sure to use the total/modified backup procedure outlined above.

Tape Retensioning - Every tape needs to be retensioned. Before performing a backup, restore, or format the tape. Tapes that haven't been used for days or weeks tend to become loose and need to be tightened before use. The newer versions of the tape backup software have a menu selectable Tape Retension option.

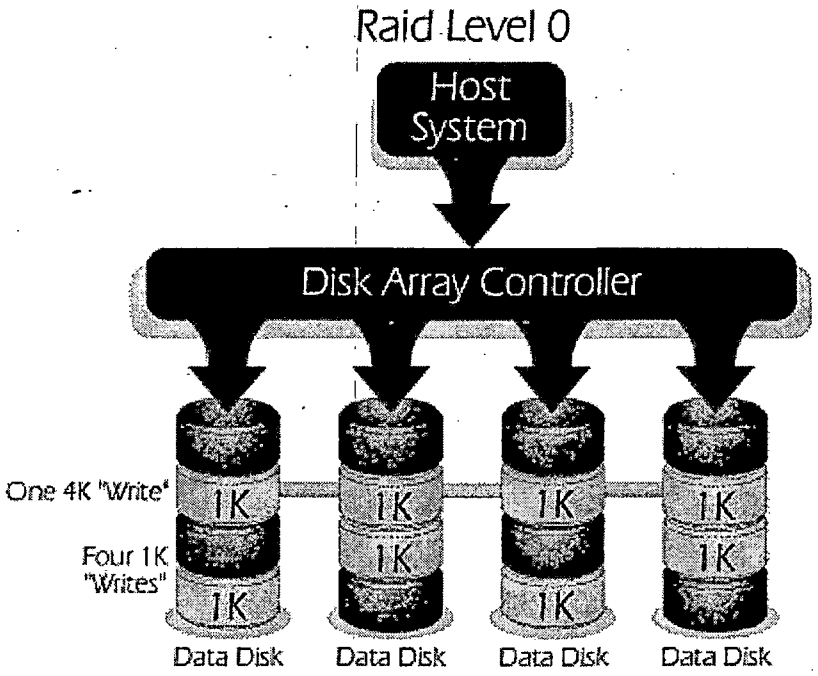
Tape Compare - It is recommended that operating procedures specify either a manual compare of the backup or setting up the backup software to automatically compare every backup. Doing a compare pass on each backup is the only way to guarantee a successful backup. When performing a compare, each file on the tape is tested for readability and matched against each file with the same filename on the hard drive. Automatic comparison is the easiest compare option to use.

3.4.2.3 RAID

A Redundant Array of Inexpensive Drives (RAID) system is an alternative for data and image storage. It offers fast data transfer rates, expandability and is fault tolerant. RAID provides for continuous operation of disk storage systems even if there is a disk failure. Some RAID systems provide fault tolerance for controllers, power supplies, and fans. For management systems, the rationale is, that by writing data to more than one disk, RAID offers a level of security and permanence that can rival WORM or rewritable media.

RAID uses multiple drives and writes data across all the disks in a predefined routine. Typically, RAID uses four or five drives, but more are not uncommon. The RAID array is always seen as a single drive by the user. The rules for reading and writing depend on which RAID level the system supports. RAID levels are designated by numerical values from 0 through 6, with each value representing a different way of dealing with the data (not increasing power or speed).

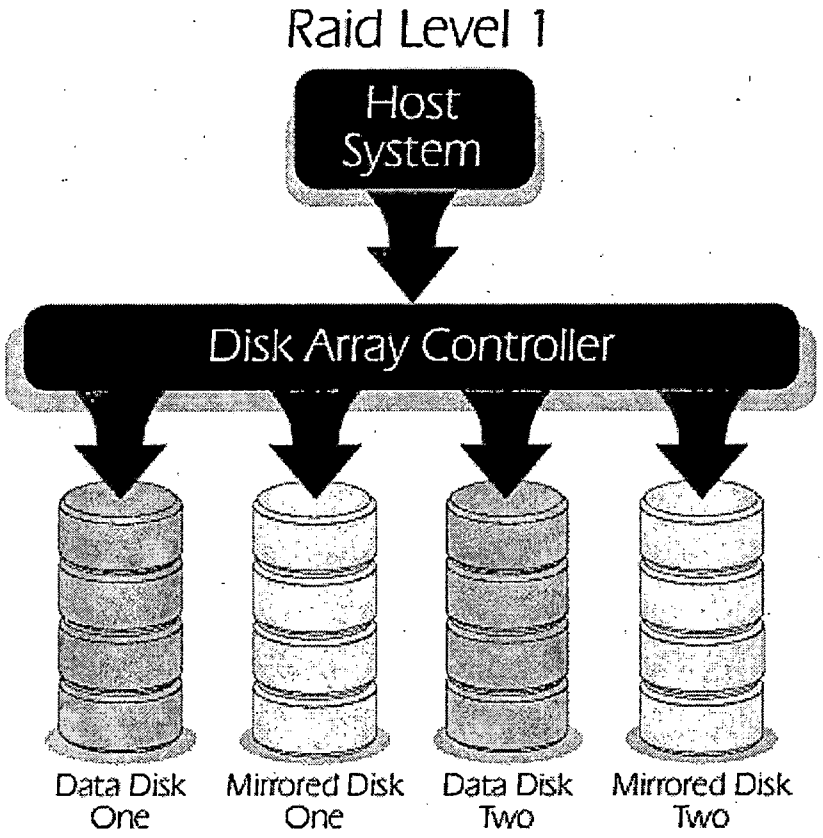
- *Level* 0 - Data striping/disk spanning; block interleaving. In data striping, data is written block by block across each drive, with one block to each drive. An alternative to data striping is disk spanning, in which data blocks are written to the next available disk. If a disk is full or busy, it may be skipped in a particular turn. Level 0 provides no fault tolerance. The loss of a hard disk can mean a complete loss of data. Level 0 provides the highest performance optimizing the buffering characteristics of the SCSI controllers on each drive. Level 0 is not true RAID, because it does not provide data redundancy or protection. The following diagram shows how a large four-kilobyte "write" would be spread by the array controller among the disk drives. This large transfer requires that all four be available before it can execute. The drawing also illustrates four separate and independent one-kilobyte "writes" overlapping each other in time, serving to increase the I/O rate.



- *Level 1* - Disk mirroring or duplexing. With disk mirroring, a single channel is used to write the same data to two different hard disks. If one drive is damaged, the data is still accessible from the other drive. But if the channel fails, both drives will be lost. In disk duplexing, the data is written to two

hard disks using two different channels, which protects the data, unless both channels or both drives fail. Disk mirroring provides excellent fault tolerance, but at twice the cost per megabyte and slower performance than a single drive on write operations, but better performance on reads.

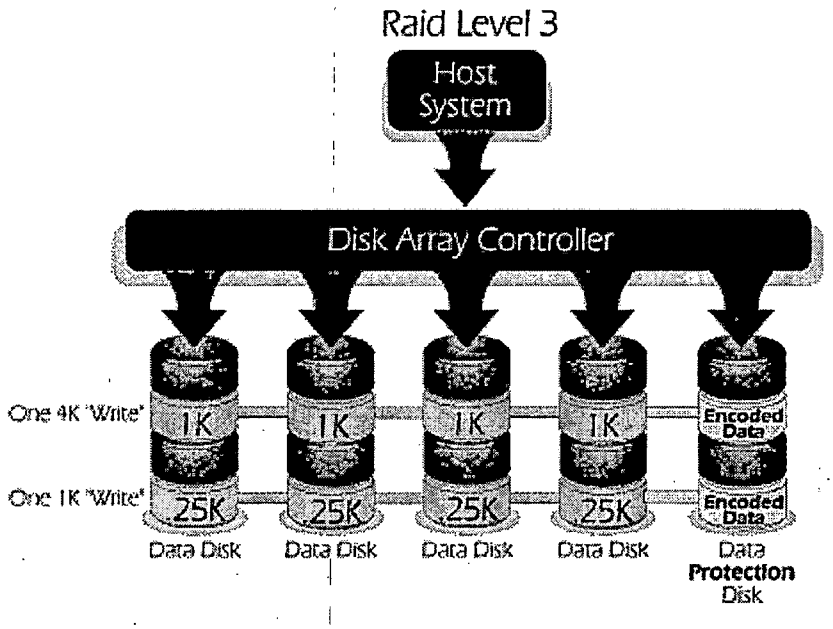
The following diagram shows a typical RAID Level One disk array:



- *Level 2* - RAID 2 provides data striping over an array of as many as 12 hard disks. Several of the drives in an array have copies of data that exist elsewhere, enabling them the catch and fix errors in the outgoing data stream. Level 2 is not widely used, because other levels provide comparable benefits at a lower cost.

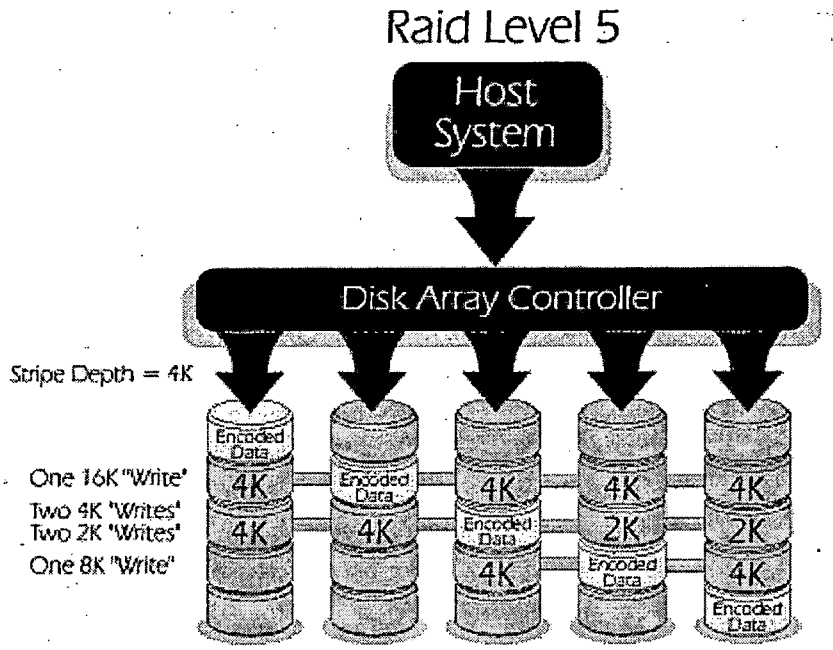
- *Level 3* - Data striping/bit interleaving/parity checking. This is the same as level 2, except that a single parity block is written to a parity drive instead of checksums to checksum drives. It is more reliable than level 2, because there is only one parity drive that can fail. Level 3 is very similar to level 2, in which the hard disks that contain the copies of data that appears elsewhere can detect but not fix errors in the outgoing data stream.

  Here's an example of a typical data protection disk array configuration. The data protection feature in this example provides disk failure immunity for four data disk drives.



- *Level 4* - Data striping/block interleaving/parity checking. This is like level 3, except that an entire block (sector) is written to each hard disk each time. Level 4 distributes copies of sectors across an array of hard disks and uses one drive to check for, but not correct, errors in the outgoing data stream. Level 4's sector-copying technique is a special type of data striping. Level 4 is not widely used, because other levels provide comparable benefits at a lower cost.

- *Level 5* - Data striping/block interleaving/distributed parity. This is like level 4 except that the parity or checksum information is distributed across the regular disk, rather than being written to special disks. Level 5 allows overlapping writes, and a disk is accessed only if necessary. The most commonly used implementation, level 5 uses a sector-based data striping scheme like level 4, but does not require a special data-checking disk since it distributes that function across the entire array. Level 5 is the most popular because it provides the best space utilization.



- *Level 6* - An implementation that allows two hard disks to fail without loss of data and boasts very good data-reading performance, but also has poor data-writing performance. Level 6 is similar to level 5, except that it distributes two copies of the error-checking data across the array.

Exhibit 3-1 graphically shows the relative cost, availability and performance of the most widely used RAID levels.

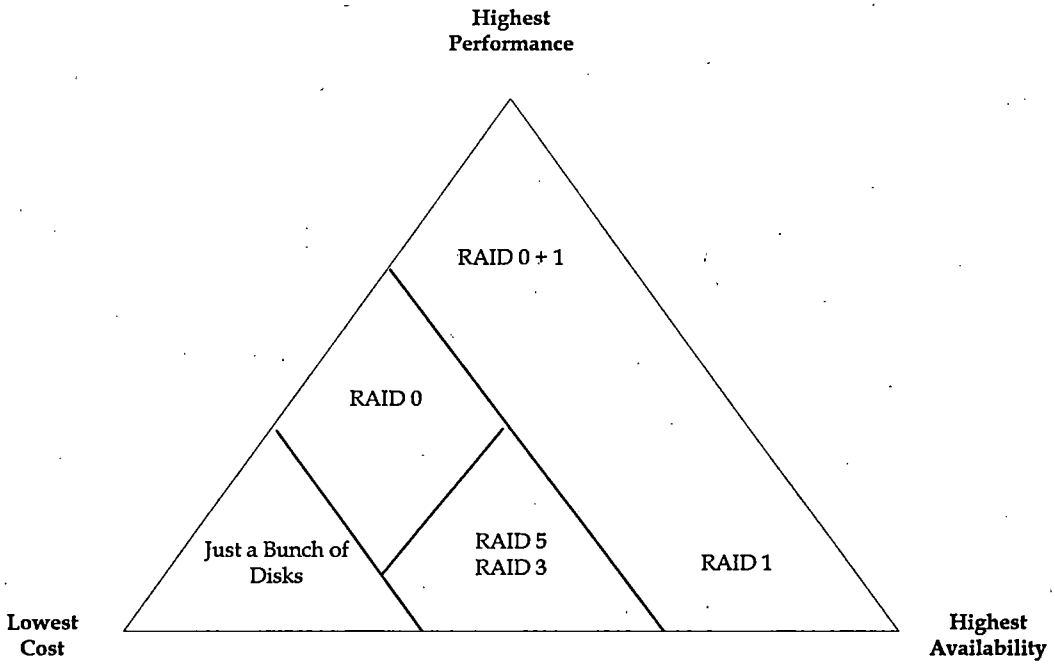


Exhibit 3-1 RAID Cost, Performance, Availability Matrix

4. DMS STANDARDS SUMMARY

This section summarizes the recommendations and requirements for moving forward with the adoption of RMS standards that will promote agency-wide compatibility.

4.1 Overview

The document management industry has many standards and organizations that promote competing standards. Many organizations promote standards guided only by their interpretation of what a record or document is and what the mission of the record or document management system should be. These organizations and committees are comprised of industry leaders and in some cases end users. However, there is not always a consensus on these issues even within the industry. Eventually they will draw conclusions and promote technology standards that will advance their industry. The key for the Iowa DOT is to adopt technology standards that will keep the Iowa DOT strategically positioned to successfully achieve an agency-wide records management infrastructure in a *potentially* multi-system environment.

4.2 Recommendations

USI recommends a building block approach to the adoption of technology standards that will provide a stable technology infrastructure for an agency-wide RMS in the Department. In summary, USI recommends the following RMS technology standards for adoption by the Iowa DOT:

- Oracle or DB2 for the RDBMS.
- Microsoft Windows OS including Windows NT for servers as per the MONITOR Group recommendations.
- Solutions that are compatible with TCP/IP and NetBEUI networking protocols.
- TIFF, CALS, CGM, JPEG, PDF, and HTML file formats.
- Packages which support APIs including ODMA, ODBC, MAPI/VIM, TWAIN & ISIS.
- Microsoft's Internet Explorer and Netscape's Navigator Web Browsers and Microsoft's IIS Web Server for Intranet/Internet components.
- Evaluation of Attachmate EXTRA!® Client Connection for PROFS®/OV.
- Use ODMA, DMA, WfMC compliant vendor solutions if a multi-vendor solution is selected.
- Minimum performance features:
  Scanning image resolution (200-300 dots per inch);
  Display resolution for high-end monitors (120 dots per inch or higher);
  Image file compression ratio (TSS Group 4 averages 10:1).

It is important for the Technology Committee to continually monitor, review, and update these standards as the agency moves toward a full scale RMS acquisition.

5. STANDARDS COMPLIANCE CHECKLIST

Product	Vendor	Category	Standard	✓	Notes
API					
		DMS	ODMA		
		Database Connectivity	ODBC		
		E-mail Messaging	MAPI		
		E-mail Messaging	VIM		
		Scanner	TWAIN		
		Scanner	ISIS		
File Formats					
		Compression	TSS G3		
		Compression	TSS G4		
		Compression	TSS G4 Type II		
		Raster Image	TIFF		
		Raster Image	CALS		
		Raster Image	MO:DCA		
		Raster Image	IOCA		
		Color/Gray Scale Image	JPEG		
		Graphics 2-D	CGM		
		Publishing	PDF		
		Publishing	HTML		

Product	Vendor	Category	Standard	✓	Notes
Networks					
		Protocol	TCP/IP		
Database					
		Query Language	SQL		
		Distributed Platform	Windows NT		
		Centralized Platform	Mainframe		
Operating System					
		Server	MVS		
		Server	Windows NT Server		
		Client	Windows 3.11		
		Client	Windows 95		
		Client	Windows NT Client		
Intranet / Internet					
		Web Server			
		Web Browser			
Year 2000 Compliance					
		Compliant			
		Not Compliant			
Software Architecture					
		16 Bit			
		32 Bit			

6. GLOSSARY OF TERMS AND ACRONYMS

Provided below are various terms and acronyms used throughout this document and the imaging industry.

AIIM
Association for Information and Image Management - AIIM is a national standards organization that publishes standards targeted primarily at imaging and document management disciplines.

ANSI
American National Standards Institute - ANSI is a national standards organization that publishes standards for imaging, data transmission codes, protocols, and many other technical disciplines. ANSI gives final approval of U.S. standards made by AIIM.

API
Application Programming Interface - An API is software that an application program uses to request and carry out basic services performed by the computer's operating system.

CALS
Continuous Acquisition and Life-Cycle Support - CALS is a Department of Defense initiative that promotes the exchange of information in standard electronic formats.

Client
A component of a client/server architecture that requests the services of peripheral servers, generally a user workstation.

Client/Server Architecture
A configuration where peripherals managed by servers are shared by client user workstations connected by a network.

Compression
Compression is the use of an algorithm to reduce the number of bytes required to store an image and move it over a network.

DLL
Dynamic Link Library

DMA
Document Management Alliance - DMA is an organization of professionals that publishes technology standards related to document management. DMA's standards are intended to promote interoperability between diverse document repositories on an enterprise network.

E-mail
E-mail automates the process of sending mail and information to others by transmitting it electronically.

DMS
Document Management System

Iowa DOT
Iowa Department of Transportation

GUI
Graphical User Interface - A GUI (pronounced "gooey") refers to standard software interfaces, such as Microsoft Windows, that use icons, windows, and a mouse to control computer functions.

ISO

International Organization for Standardization - ISO is an international organization that publishes technology standards. ISO gives final approval of international standards made by AIIM.

ISIS

Image and Scanner Interface Specification - A standard developed by Pixel Translations for high speed scanners.

LAN

Local Area Network - A system that links computers together to form a network, usually with a wiring-based cabling scheme.

MAPI

Messaging Application Programming Interface - Microsoft's E-mail messaging standard.

Network Protocol

The network protocol refers to the procedures used to place data on the network and retrieve data from the network.

NetBEUI

NetBIOS Extended User Interface. Pronounced "net-booey," it is an enhanced version of the NetBIOS protocol.

NFS

Network File System

NIST

National Institute for Standards and Technology - NIST is an U.S. organization that publishes various standards and promote technology.

ODBC

Open Database Connectivity - A specification developed by Microsoft designed to give Microsoft Windows users access to data stored on corporate mainframes and LAN-based database servers running different file formats.

ODMA

Open Document Management API - A simple API for interfacing desktop applications to document management systems and other groupware systems.

OS

Operating System - The operating system is the underlying program that runs on a hardware platform and schedules the use of system resources.

PDF

Portable Document Format - A document file format which is a "published" electronic file, or more generically, printer output that can be viewed independent of the application that was used to author it.

Raster

Images defined as a set of pixels or dots in a column-and-row format. Used when scanning images or displaying images on the monitor.

RDBMS

Relational Database Management System - A logically coherent collection of information stored in tables. Columns between tables are related in order to provide a broadened level of information.

RMS

Records Management System

Scanning
Scanning is the process of using an electronic scanning device to transform a hard copy document into a bit stream that can be stored in an electronic image file.

Server
A computer which is dedicated to the task of serving documents and files, fax requests, print requests, or database requests. It is usually connected to a LAN.

SQL
Structured Query Language - An ANSI standard high level language used for database manipulation. Developed by IBM, it has become the *de facto* standard for relational databases.

System Architecture
A system architecture is often used to refer to any combination of hardware, software, or network architecture, depending on the context.

TSS
Telecommunications Standards Sector (Formerly known as Consultative Committee on International Telephony and Telegraphy- CCITT) - TSS is an international consultative and advisory committee established by the United Nations to recommend worldwide communications standards. TSS Group 3 and Group 4 standards for the compression and transmission of digital images are widely used in facsimile and imaging systems.

TIFF
Tagged Image File Format - A standard file header format used for storing raster images.

Topology
Topology refers to the physical layout of a network.

TWAIN
Technology Without An Important Name - An industry standard for scan input within the desktop imaging market.

UNIX
A high end operating system which supports multiple simultaneous users.

USI
Universal Systems Inc.

VIM
Vendor Independent Messaging - Lotus's E-mail messaging standard.

Windows
An operating system that features multiple screens and a consistent graphical user interface (GUI).

Iowa Department of Transportation

Records Management System

Laboratory Configuration Recommendations

June 30, 1997

Universal Systems Inc.
3675 Concorde Parkway, Suite 800A
Chantilly, VA 22021
(703) 803-7550/2280 FAX

TABLE OF CONTENTS

List of Exhibits

1. INTRODUCTION

As the Iowa Department of Transportation (DOT) moves closer to releasing a Request for Proposals (RFP) for the acquisition of an agency-wide Records Management System (RMS) it is important to study the manner in which vendor proposed solutions and pilot projects will be evaluated. Establishment of an in-house development laboratory will permit the Iowa DOT to control and closely observe system installation and application development of proposed RMS solutions to minimize project risk. This document provides background information, an overview of the existing Iowa DOT training laboratory configuration, and proposed enhancements.

1.1 BACKGROUND

Electronic records and document management is a relatively new technology, therefore many agencies use a phased approach during implementation. In step one they initially evaluate the technology. Their next step is to establish either a prototype or a pilot project. Finally, if cost-justified, they expand the pilot to a fully functional system.

1.1.1 Prototypes

The first phase of a typical RMS implementation includes a serious evaluation of the technology. Site visits and perusal of image processing literature can go a long way towards orientation and general education. If a decision is made after the initial evaluation to develop a prototype or a pilot system then a requirements analysis and preliminary design can be pursued.

Prototypes are tools that can be used by system developers in the initial stages of a project to demonstrate potential capabilities of a system. They are generally standalone or small (less than a half dozen workstations) networked systems setup to emulate an operational network. Tools such as code generators and Graphical User Interface (GUI) toolkits can be used to develop prototypes. Prototypes can model the functions of a single business process or a portion of a process, but are rarely fully functional systems.

Potential uses of electronic Records Management System prototypes include:

- **Training-** The prototype is useful in familiarizing users and managers who have no previous exposure to electronic document management with the potential capabilities of a system. It helps them to think in the constructs of the technology and can greatly assist in project definition and requirements gathering.
- **Proof-of-Concept-** A prototype can be used in a proof-of-concept experiment to demonstrate electronic document management capabilities. The results of prototyping can have a big impact on the "go - no go" decision.
- **Benchmarking-** Small prototypes can be used to benchmark system performance on specific document types.
- **Requirements Definition-** Prototyping can be used as a tool to help define user requirements. A single prototype can undergo iterative revisions as requirements definitions are refined.

Prototypes themselves are usually discarded rather than expanded upon, but the lessons learned by prototyping are used in subsequent phases of a project. Because of concerns about expending resources on what is essentially a throw-away system, prototyping is not always used. However, in the right circumstances, it is a valuable development tool.

1.1.2 Pilots

Pilot systems are fully functional systems that may be used in a production environment. They are generally limited to one or two functional areas but can address a full range of processing within those areas. Frequently, pilots are run in parallel with the existing manual systems. There may be various phases within the pilot's development as additional capabilities are identified and added to the system design. Exhibit 1-1 illustrates an example of a pilot system development plan.

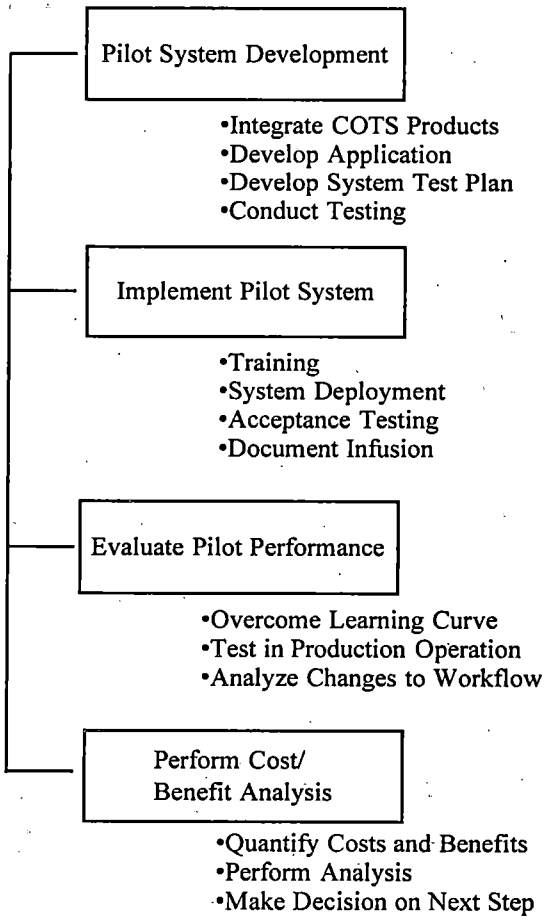


Exhibit 1-1 Pilot System Task Plan

The benefits of a pilot implementation include:

- **Minimize Risk**- Pilots are appropriate for new technology because they minimize losses in case of project failures.
- **Learning Experience**- A pilot is an excellent opportunity to learn through hands on experience with the proposed technology.
- **Expectation Management** - The pilot experience builds realistic expectations for the full scale system.
- **Vendor Familiarity** - A pilot project allows you to get to know a vendor before making a major commitment.
- **Limit Costs** - The cost of a pilot can be significantly lower than the cost of a full implementation.
- **Strategic Planning** - A pilot will let you test how the technology fits into your master plan.
- **Cost Justification** - A pilot project is an opportunity to measure before and after statistics for use in a cost/benefit analysis.

Pilot programs offer a fully functional system that may be used as a production system after roll out. They are not as flexible during testing and development as a prototype system, since they are already functioning systems. However, pilot systems are an excellent option for organizations that do not have the resources to develop prototype systems.

1.1.3 Iowa DOT Approach

Iowa DOT has evaluated the benefits of both prototype and pilot projects to begin the process of acquiring a RMS. Prototyping is mainly an effort undertaken by in-house system developers who have the necessary resources (time, people, and funding) to develop a software system from the ground up. Pilot projects usually are "brought in" by vendors who have already developed a workable solution. Pilot projects also lend themselves to implementation as one phase out of many in an agency-wide implementation. Iowa DOT has elected to pursue a course that omits the prototyping effort and capitalizes on the benefits of piloting selected business processes. As each business process is successfully passed through the pilot phase, that automated process will be "rolled out" to production and another process will start the pilot process. This plan provides an implementation vehicle that is very controllable and minimizes risk.

To accommodate vendor assisted piloting of these business processes, it is appropriate to have a fully equipped development laboratory in-house. The testing atmosphere for a pilot in a laboratory must be representative of the type of hardware, software, and networking environment expected to be used in production. Iowa DOT is already addressing this need and has tentatively selected the existing Computer Training Lab as the location for the RMS development laboratory.

2. CURRENT STATE

The Iowa DOT has established and equipped a room in the headquarters building to facilitate the education and training of staff members on various technology components. Training takes place on a regularly scheduled basis (for periods of up to eight weeks at a time), but the room is not in use continuously. Computers in the Computer Training Lab are connected to the Department's Ethernet LAN to enable students to access programs and data files that will be used in their daily work. Peripheral devices (printers and plotters) are located in various spaces throughout the headquarters building. Current plans are to make the Computer Training Lab a multipurpose space which will be available for both training and RMS Pilot Development.

Under the multipurpose concept, it is envisioned that when a training session is completed, the space will then be occupied by other staff members or vendors working on the RMS Pilot Development effort. Personal computers will be reconfigured, new software and databases will be loaded and system development and/or demonstrations will then take place. When the RMS development task is completed the Data Services staff will backup any necessary development environments and restore the personal computers to the desired training configuration and again conduct training on the installed personal computers.

Use of the Computer Training Lab will be controlled through a scheduling process. A long range training plan has previously been developed, therefore RMS development and/or demonstrations must be scheduled to occur between training sessions. During the RMS proposal evaluation phase this space will also be the location for Live Test Demonstrations (LTD).

2.1 COMPUTER TRAINING LAB

The Computer Training Lab is equipped with eight Intergraph TD-30 personal computers. These computers are configured as follows:

Hardware

- Pentium 133MHz
- 32MB RAM
- Matrox video card w/2MB RAM
- 1.2GB hard drives
- AMD PCNET PCI Ethernet NIC
- Adaptec 2940 PCI SCSI controller
- 17" Color Monitor, model DT1EX47

Software

- Windows NT Workstation 4.0
- Windows NT Workstation 3.51
- DOS/Windows 3.1
- MS NT TCP/IP protocol
- DLC Protocol
- NetBEUI Protocol
- EXTRA! Personal Client (32-bit)

In addition to the equipment physically located in the Computer Training Lab, there are several peripheral devices that are available for use during the training and/or RMS development phases. These peripherals are physically located elsewhere in the headquarters building, connected to the network:

- Anatech large format scanner
- Xerox 8845 36" Black and White LED plotter
- Versatec 8936 color electrostatic plotter
- Versatec 3424 color electrostatic plotter
- Exabyte tape backup library (8mm)
- Pioneer CD-ROM Tower

Exhibit 2-1 is a nominal representation of the overall configuration of the Computer Training Lab as it exists today.

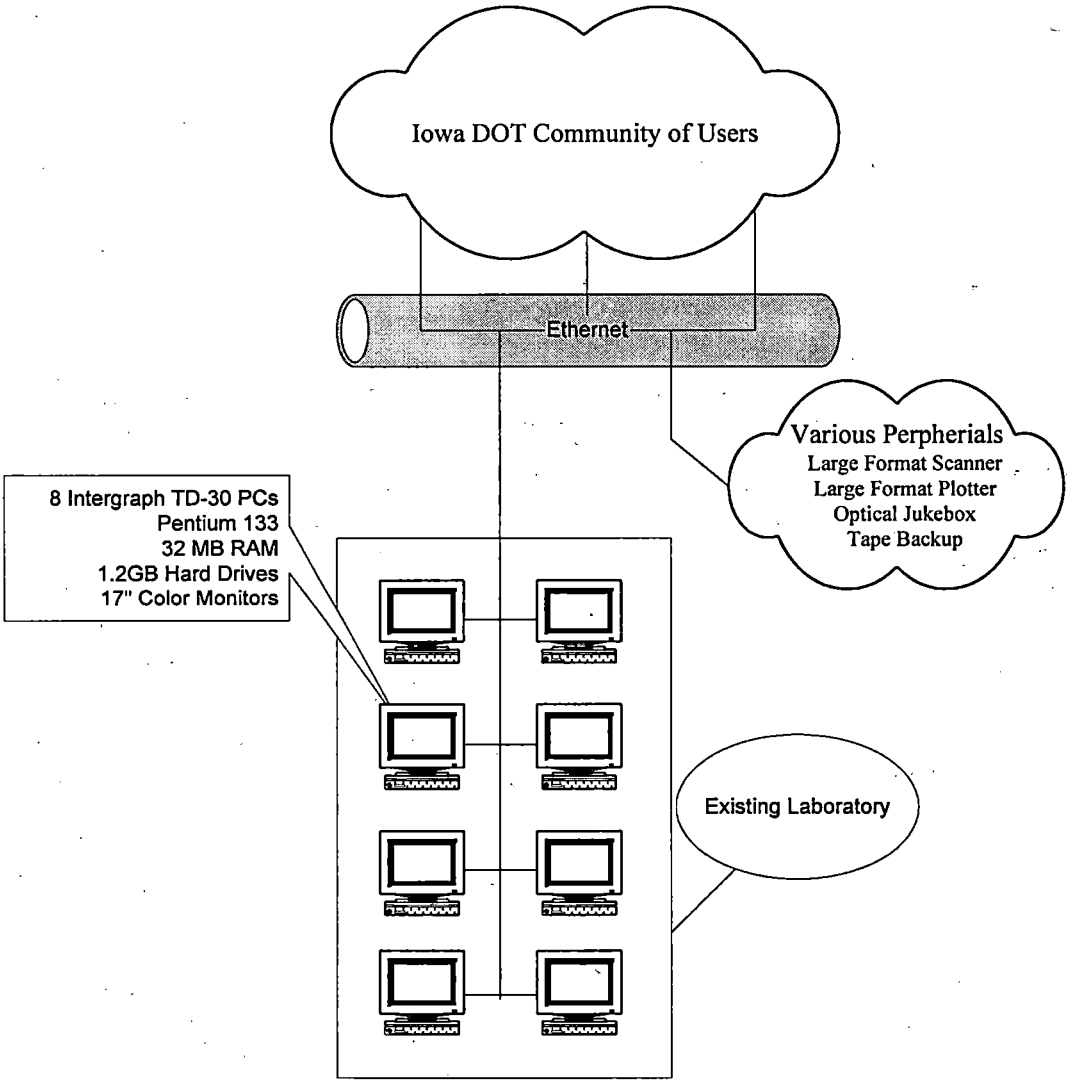


Exhibit 2-1 Iowa DOT Computer Training Lab

2.2 NETWORK

The DOT network consists of multiple 4/16Mbps Token Ring segments connected by Token Ring bridges, T-1 WAN router Frame Relay connections to selected field locations, and an Ethernet 10Mbps 10BASE5 (thicknet) segment. The Token Ring segments are utilized at between 10 and 50 percent of capacity, while the Ethernet segment consistently has usage in the 80 percent range.

Current plans are to segment the Ethernet into smaller domains to cut down on collisions and traffic. To accomplish this, DOT has run fiber optic cable to all wiring closets from the machine room and will use a Bay Networks 10/100Mbps switch and VLAN technology. The thicknet will be replaced by fiber optic cable and CAT 5 Utp wiring. The hubs in the major wiring closets are being upgraded to accommodate 100Mbps Ethernet cards where needed, as well as ATM technology for possible future 155 Mbps full-duplex ATM backbone support. If 100Mbps Ethernet is required in the smaller wiring closets DOT will use a smaller stack hub solution. Token Ring bridges will be replaced by a Bay Networks Centillion Token Ring Switch with an ATM backplane. This segmented, collapsed backbone should provide enough capacity and scalability to meet future bandwidth demands.

3. DISCUSSION

3.1 COMPUTER TRAINING LAB

The Computer Training Lab is approximately 13 feet by 16 feet in size. The physical layout of the room is that of a typical classroom, two rows of four desks each and each desk is equipped with personal computer (see Exhibit 3-1). Because this configuration uses most of the available space in the room, peripheral devices elsewhere in the headquarters building are used to support training classes. Using networked peripherals also eliminates the cost of having duplicate input and output devices physically located in the Computer Training Lab.

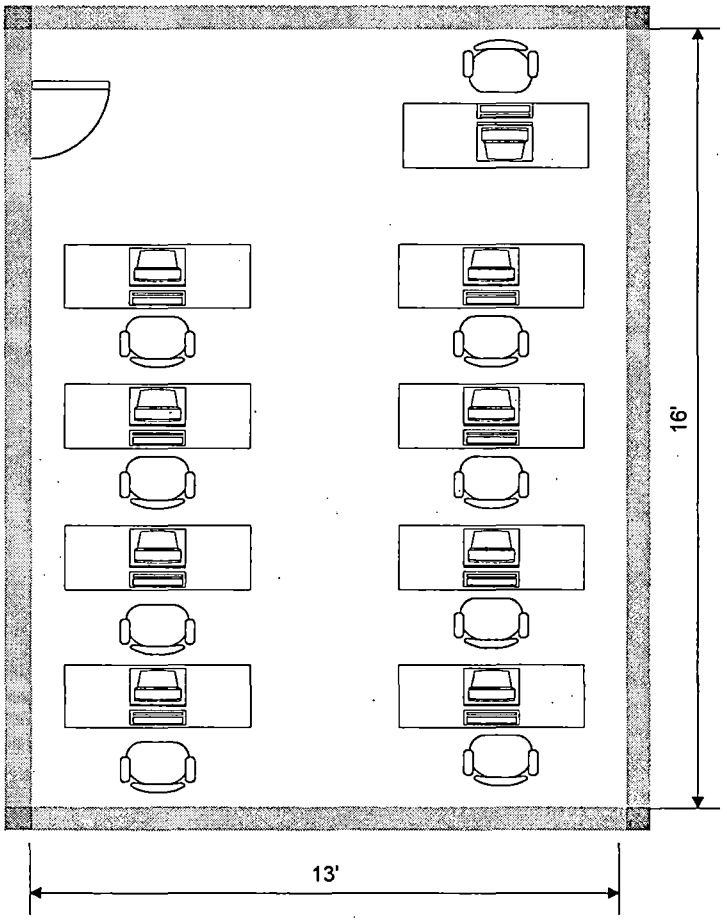


Exhibit 3-1 Computer Training Lab Configuration

3.2 NETWORK

During both vendor demonstrations and RMS pilot development it will be appropriate to test proposed solutions under conditions similar to the anticipated full production load. It is reasonable to expect the following scenario to be played out.

Image Scanning with a low or mid-volume document scanner (i.e., Fujitsu 3097G+)

Rated speed - 39 pages per minute
Average throughput - 40% (est)
Effective operating speed - 16 pages per minute (est)
Test period - 4 hours
Total page throughput - 3,744

Image Indexing

Image is passed through the network from the NT Server to the indexing station and is presented to the Indexing operator who enters indexing information.

Image & Index Quality Control

Image is passed through the network from the NT Server to the QC station and is presented to the Image & Index QC operator for verification of image quality and indexing accuracy. Image may be accepted and committed to the database or returned to the Scan Operator for re-scanning.

Storage On-line

Image is passed through the network from the NT Server to the magnetic storage device and becomes available for retrieval by authorized users.

Storage Near-line

Image is passed through the network from magnetic (on-line) storage on the NT Server to the to a near-line (optical, or tape) storage device.

In this sample scenario 3,744 images could be passed through the network four times. If we consider that this volume can be completed in a 4 hour test, we are able to estimate the additional network load to be six percent.

Time period - 4 hours
Compressed images - 3,744
Compressed image size - 75K
Passes through the network - 4
Bits Per Second to be moved - 624,000
Percent of 10MB (10BaseT) LAN Capacity - 6%

The existing LAN is frequently measured at 80 percent of capacity during the normal business day. If the testing of a RMS were to occur during a time when the network traffic had reached its peak, it is very possible that an overload condition would be created and LAN services may be adversely affected. With implementation of the current LAN upgrade initiative, this overload situation should be avoided.

4. RECOMMENDATIONS

The conclusions drawn and recommendations made in this document are based on the experiences of USI employees gained while developing or using various development laboratories. In our corporate headquarters, we have dedicated over 16,000 square feet of space to our development laboratory which is known as the Applied Technology Center (ATC). The ATC is particularly suited to providing studies and pilots of new technology in support of system development and integration efforts. It is designed to help reduce risk and optimize return on investment by allowing us to test new technologies and try new system concepts before "real-life" implementation.

The most important characteristic of an in-house development laboratory is that it permits technology and work processes to be combined and tuned in a controlled environment that can be modeled after the target environment. As a result, answers to both the technology decisions and the work process refinements that most often accompany major automation initiatives can be closely observed and evaluated. This empowers the owner of the laboratory to exert positive control over the decision processes as the solutions are defined, rather than reacting to unexpected impacts of technological change.

Regardless of how or when the Iowa DOT RMS solution is pursued, upgrading the existing 10MB Ethernet in the headquarters building should remain a priority. As a room in the headquarters building is readied for use in the acquisition of a RMS, it is recommended that a dedicated network segment be established for the RMS Laboratory. USI recommends Iowa DOT continue the ongoing upgrade of the existing network to a 100MB Ethernet (100BaseT Ethernet Cat 5 Cable) system or its equivalent.

Recommendations in this section have been made without consideration for document volumes. Information on expected volumes will become clearer as Iowa DOT continues to document internal processes and procedures. As document volumes are identified, the adequacy of existing computers and storage devices should be reevaluated.

4.1 PILOT DEVELOPMENT LABORATORY

Because of the significant and competing purposes of training, demonstrations and pilot development, USI strongly recommends the establishment of a separate laboratory environment dedicated to supporting the RMS acquisition process.

A sample configuration for the recommended RMS Pilot Laboratory is at Exhibit 4-1.

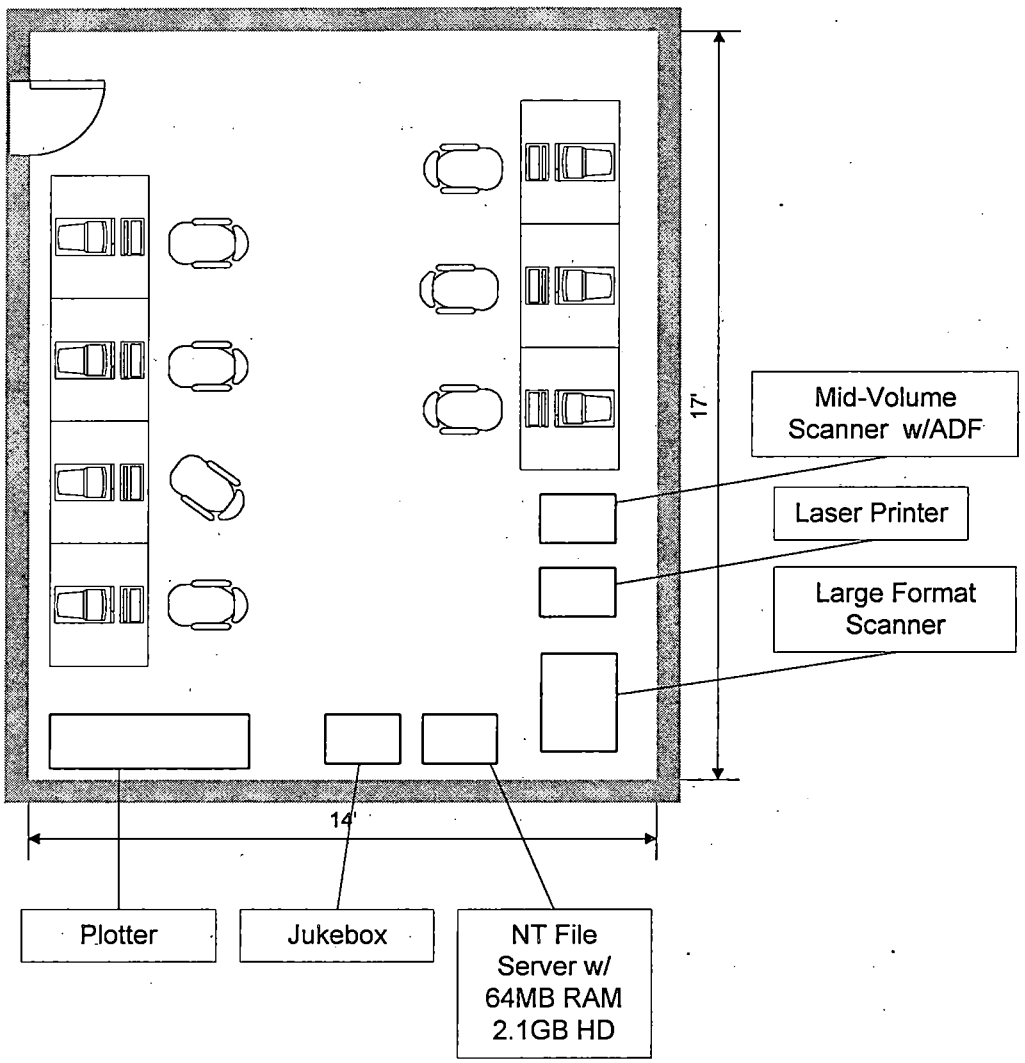


Exhibit 4-1 Recommended Pilot Development Laboratory

4.2 NETWORK

USI recommends that Iowa DOT isolate the RMS Pilot Laboratory from the remainder of the network that supports day-to-day operations. This can be achieved through the purchase and installation of a network mini-hub. When prospective vendors are conducting LTD's, this protected segment will tolerate experimentation and high volume loads without the risk of overloading the entire network.

When it becomes apparent that a solution provider is ready to exercise their system with access to the main Iowa DOT network, that capability still exists. Iowa DOT evaluators will be able to observe and evaluate vendors as the set up their systems for demonstration. Only when Iowa DOT is confident that a full network access test has been adequately prepared, will the vendor be able to access the mission critical network backbone.

4.3 OPTION 1

Implement a separate RMS Development Laboratory. A minimum configuration of hardware and software components should be setup in an area dedicated to developing and testing RMS related technologies and applications. Scanners, plotters, printers, etc., should be set up on a localized (segmented) network in the RMS Development Laboratory. This configuration will provide a controlled environment for the testing, operation, and training aspects of a RMS.

Implementation of this option would necessitate:

- Identification of another room suitable for designation as the RMS Development Laboratory.
- Relocation (or acquisition) of furniture (desks, chairs, white boards, etc.).
- Acquisition of six new personal computers for the RMS Development Laboratory.
  - * One Scanning Workstation
  - * One Indexing Workstation
  - * One QC/QA Workstation
  - * Three User Workstations
  - * Database Server (optional)
- Reallocation of one Windows NT server in the Data Center, which has excess capacity, to the RMS Development Laboratory.
- Relocation of any available peripheral devices that will assist in emulating the anticipated operational environment. (i.e., document printer, large format scanner, plotter, tape backup, etc.).
- Acquisition of a low or mid-volume document scanner (see Product Specifications).
- Acquisition of a network router to segment the LAN (see Product Specifications).

The advantages and disadvantages of this option include:

Pros	Cons
1. Segmenting the RMS Development Laboratory will have no effect on the current Ethernet network and will reduce the risk for other network users. Network traffic from LTD and RMS application development will include generation of heavy traffic loads (images) from scanning, storing and printing.	1. Will require acquisition of six new personal computers.

2. Most of the equipment required for an LTD will be centralized in one location. Vendors will remain in one designated area under the supervision of Iowa DOT personnel. There should be few instances when vendor personnel will have to travel to other areas in the headquarters building.

3. No effect on the current Iowa DOT Computer Training Lab schedule.

4. Personal computers in the Computer Training Lab will not have to be reconfigured to run in other Iowa DOT application specific configurations.

5. A phased roll-out approach could be used to incorporate each subsequent pilot application in the agency-wide RMS solution without impact on the training schedule or other users.

2. Iowa DOT may have to purchase some extra equipment (furniture, network mini-hub).

4.4 OPTION 2

Continue to use the existing Computer Training Lab for RMS demonstrations and pilot development. Plan to incorporate vendor provided hardware and software into the existing Iowa DOT network architecture. Vendor software will be setup and tested on personal computers in the Computer Training Lab with full access to the entire network. Peripheral hardware, such as scanners, plotters and image enabled printers located throughout the Iowa DOT headquarters building will be used for testing and demonstration purposes.

Implementation of this option would necessitate:

- Acquisition of a low or mid-volume document scanner.
- Long range scheduling of the Computer Training Lab to ensure availability for LTDs and Pilot Development.

Pros

1. Decreases the amount of equipment Iowa DOT would have to purchase to implement a dedicated RMS Development Laboratory (personal computers, furniture, network hub, etc.).
2. Iowa DOT could continue to use the existing Computer Training Lab for two distinct purposes instead of having to dedicate a second area as the RMS Development Laboratory.

Cons

1. The current Computer Training Lab is scheduled 40 - 50% of the time for training. Iowa DOT's training schedule could be impacted.
2. Personal computers in the Computer Training Lab will have to be reconfigured or restored to their "original" state after each vendor LTD or pilot development phase.
3. When the scheduled time for RMS development expires, the current development task will have to be terminated. Vendors may not be able to return at a later date to complete unfinished work and/or demonstrations.
4. Vendors will be required to travel throughout the headquarters building to use peripheral devices.

5. ROLES AND RESPONSIBILITIES

When vendor replies to the Iowa DOT Request for Proposals are received there will be little time available to develop an organization to evaluate proposals and setup facilities and processes for vendor live test demonstrations. USI recommends that Iowa DOT begin to plan for this activity now. Establishment of an internal organization to manage and oversee vendor demonstrations (and eventually solution development) will ensure consistent administration of this important phase of acquisition. The roles and responsibilities enumerated in this section are considered to be the minimum required to effectively manage this undertaking and assumes that Iowa DOT will implement Option 1 as described on page 11. If another direction is chosen, many of the roles and responsibilities will still be applicable and appropriate for the efficient and effective use of the RMS Pilot Laboratory.

5.1 RMS PILOT LABORATORY

The RMS Pilot Laboratory should be considered to be a centralized location where the hardware and software that is used to develop RMS pilot applications will be installed.

Minimum procedural rules for laboratory:

a. All RMS Pilot Projects will be developed in the laboratory.
b. The laboratory will be used to test all new RMS technology.
c. The laboratory will be used to maintain RMS pilot projects that have been implemented agency-wide.
d. The laboratory may be used in the evaluation of pilot projects to determine if the pilot meets the RMS standards.

5.2 EXECUTIVE SPONSOR

The Executive Sponsor provides executive level support to individuals involved in the day to day RMS development activities. The Sponsor holds the RMS budget in their cost center and can delegate authority to use the budget to the RMS Project Manager. Responsibilities of the Executive Sponsor should include:

a. Reporting senior for the Chairman of the RMS Team.
b. Responsible for the RMS budget including: review of budget requests, supporting the budget request within the Department and to the Governor's office and Legislature.
c. Provides initial approval to the plan for expenditure of current year RMS dollars.
d. Provides Executive level support for the RMS Team and RMS Project Manager.
e. Assists in making presentations relative to the RMS effort when appropriate.
f. Has direct authority over the RMS Project Manager regarding the RMS effort.

5.3 RMS PROJECT MANAGER

The RMS Project Manager should be appointed by the Executive Sponsor to work with the RMS Team to coordinate and manage the RMS effort. Responsibilities of the RMS Project Manager should include:

a. Develops the budget issues related to RMS.
b. Develops the scope of services and task assignments for vendors and consultants.
c. Monitors the vendor deliverables and requests for payment and processes invoices.
d. Manages the contracts for RMS vendors and consultants which includes processing change orders, supplemental agreements, and encumbrances.
e. Provides daily direction to the vendors and consultants involving schedules, deliverables, task completion, new assignments, etc.
f. Coordinates the review of contract deliverables by the RMS Team.
g. Provides a report to the RMS Team at each meeting regarding the progress of the vendors and consultants, budget issues, and yearly budget expenditures.
h. Manages the RMS budget for the Executive Sponsor.
i. Supervises the RMS Pilot Laboratory Manager.
j. Assists in the resolution of issues that could not be resolved by the RMS Pilot Laboratory Manager.
k. Facilities the creation and coordinates the activities of Pilot Implementation Project Team(s).

5.4 RMS LABORATORY MANAGER

The RMS Laboratory Manager is appointed by the Executive Sponsor to run the RMS Laboratory. Responsibilities of the RMS Laboratory Manager should include:

a. Reports directly to the RMS Project Manager.
b. Directs the daily activities of the laboratory, which include but are not limited to: performance of prioritized work activities, scheduling, issue resolution, and overall monitoring activities.
c. Works with the RMS Project Manager to assist the RMS Team in prioritizing the work to be done in the laboratory.
d. Monitors vendor and consultant deliverables and requests for payment, and processes the invoices.
e. Directs the activities of the Pilot Implementation Project Managers.

5.5 PILOT PROJECT MANAGER

The Pilot Project Manager is the employee from the pilot project user office who is assigned to be the liaison between the vendor developing the pilot application and the user office(s). Responsibilities of the Pilot Project Manager should include:

a. Manages the Pilot Implementation Project Team.
b. Coordinates the development of the Pilot Implementation Project Plan.
c. Reports the project status to the RMS Team.
d. Ensures that all offices affected by the implementation project are informed and trained.
e. Provides daily guidance to the vendor developing the pilot application.
f. Identifies the individuals who will assist in the development of the application specifications and system design.
g. Arranges meetings and interviews with the business users.
h. Resolves issues that arise during the development of the pilot application.
i. Develops the business case for expanding the pilot to an agency-wide implementation.
j. Conducts the initial user testing and schedules other personnel from the user office to test the pilot application.
k. Provides a project status report to the RMS Team for each meeting.
l. Reviews and approves all analysis and design specifications for the pilot application.

5.6 IMPLEMENTATION PROJECT TEAM

The Pilot Implementation Project Team is established by the Pilot Project Manager. Responsibilities of the Implementation Project Team should include:

a. Agency-wide implementation of an RMS pilot project.
b. Develops the Implementation Project Plan.
c. Responsible for carrying out the tasks associated with the Implementation Project.
d. Assists in the development of the training materials.
e. Trains and provides assistance to the new users of the system.

6. Checklists

6.1 OPTION 1

6.1.1 RMS Pilot Laboratory Checklist

Acquisitions

	Six personal computers
	One low or mid-volume document scanner
	One network mini-hub (Intelligent Router)
	Network cable and connectors

Reallocations

	Desks, chairs and white board
	Seven (excess) personal computers
	One Windows NT server
	Large format scanner
	Plotter
	Jukebox
	Tape backup system

Other

6.2 OPTION 2

6.2.1 Dual Purpose Training Room Checklist

Acquisitions

	One low or mid-volume document scanner

Reallocations

	None

Other

	Long range scheduling of Training Room for LTD and Pilot Development

7. Product Specifications

7.1 FUJITSU DOCUMENT SCANNER

The following product information was taken from the Fujitsu Internet site. Suggested retail prices for the Fujitsu, Model 3097E+ and model G+ described in this section are:

Part Number	MSRP
M3097E+	$6525
M3097G+	$7044

The Fujitsu M3097E+/G+ High-Performance Document Scanner

The ideal scanner for high-volume, mission-critical applications, the Fujitsu M3097E+/G+ has a long list of standard features, including:

- Fujitsu's Enhancement Technology which ensures the high quality of everything you scan.
- A 39 page-per-minute scan rate so you can be more productive.
- Improved paper handling to accommodate more sizes and types of paper and eliminate paper jams.
- An intelligent control panel with user-friendly commands that make the M3097E+/G+ scanner exceptionally easy to use.

Product Description

If you're looking for a cost-effective way to increase your document imaging system, look to the Fujitsu M3097E+/G+ high-performance scanner. Designed to meet the needs of high-volume, mission-critical applications, the M3097E+/G+ provides unprecedented speed and flexibility, enabling you to get more done in less time.

Advanced Features Make It Easier

Paper handling can be a headache with some scanners, but not with the M3097E+/G+. In fact, its automatic document feeder will handle up to 100 sheets at a time, freeing you to do other things. And the paper locking guides ensure that your documents go in straight, and your OCR read rate goes up. All of which help to eliminate paper jams and increase overall scanner productivity.

What's more, the M3097E+/G+ features an intelligent control panel that communicates in plain English, making it easier to use and you more productive. So if you've got high-volume scanning needs, you can't beat the M3097E+/G+ scanner.

Product Specifications

Resolutions 200, 240, 300, 400

Speed @ 200 dpi letter size 39ppm

Paper Handling Flatbed/ADF

Document Size

Minimum ADF A6 (4.1" x 5.8")
Maximum ADF11.7" x 17"
Maximum FB 11.7" x 17"

Document Capacity

Maximum ADF 100 Sheets

IPC II Yes (Pre-installed)

256 Grayscale E+: No G+: Yes

Halftone/Dither 64-step and error diffusion

Interface E+: Video G+: SCSI-II

Power Supply (110v/220v) Autoswitching

Dimensions (H x W x D) 6.6" x 27.4 " x 19.6 "

Red Lamp Red Lamp

Enhancement Technology Makes It Better

Fujitsu's revolutionary Enhancement Technology delivers unparalleled image quality while maintaining its high throughput. Fujitsu's Enhancement Technology provides the following features:

Automatic Discrimination Accurately scans your black and white text, and grayscale or halftone photos in a single pass, saving you valuable time.

Dynamic Thresholding By automatically adjusting contrast levels, Dynamic Thresholding increases the accuracy of low-contrast documents that contain handwritten or typed characters with varying line thickness.

Noise Removal Removes particles on copied or faxed documents for better optical character recognition (OCR) read rates.

Subwindows Allows you to zero in and scan key areas of document and store only that information, thus saving you valuable storage space.

Smoothing Reduces the extremes of a line art image for a cleaner, more readable image.

Ball Point Pen Mode Compensates for varying reflective light characteristics of ink.

* The statements in this publication are not intended to create any warranty, expressed or implied. Fujitsu Computer Products of America reserves the right to change equipment and performance specifications stated herein at any time without notice.

7.2 MINI-HUB

The following product information was taken from the BOCA Internet site. Suggested retail prices for mini-hubs described in this section are:

Part Number	MSRP
BEN 240	$299
BEN 220	$199
BEN 210	$99

Boca Research manufactures all of its own products in the United States of America, using the latest surface-mount technology. Each product is covered with a five-year limited warranty, and sold through a worldwide network of marketing partners, including contracted distributors, resellers and retailers.

BOCAHUB-24 Plus

Product Code: BEN240, BENBNC (BNC module), BENAUI (AUI module), BENFBR (Fiber-optic module). This new 24-port Ethernet hub is the perfect solution for network expansion. At a very low cost per port, the BOCAHUB-24 Plus can be used to connect users into workgroups or connect workgroups to a LAN backbone. Provides connection for 24 10Base-T ports with RJ-45 connectors, one 10Base2 port with BNC connector, and one 10Base5 port with AUI connector. Provides an additional port for 10Base2, AUI or fiber-optic cabling using an optional module.

Product Specs (23KB .pdf) ¦ Product Image
Technical FAQ ¦ Press Release ¦ Manual (339KB .pdf)

BOCAHUB-16 Plus

Product Code: BEN220. This 16-port 10Base-T hub provides connection for up to 16 nodes using RJ-45 twisted-pair cabling. It provides a highly reliable, very compact and cost-effective workgroup solution. Gives low-priced workstation connectivity by providing 16 10Base-T ports with RJ-45 connectors. Comes with one 10Base2 port with BNC connector and one AUI connector for cascading hubs and/or connecting to existing backbone networks.

Product Specs ¦ Product Image
Technical FAQ ¦ Press Release ¦ Manual (941KB .pdf)

BOCAHUB-8

Product Code: BEN210. An exceptional value per port, this 8-port 10Base-T concentrator provides connection for up to 8 nodes using RJ-45 twisted-pair cabling, and offers easy connectivity between workstation and host computer. 10 LED indicators confirm status and operation at all times.