A PRACTICAL GUIDE TO ENSURING

DATA QUALITY

PROJECT 09-14 | AUGUST 2010

INTRODUCTION

GIS DATA

CIS DATA

CMMS DATA

OMS DATA

COMMON MISTAKES

APPENDICES

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About the Authors

APPENDICES

- Appendix A: GIS Self-Assessment
- Appendix B: Acronyms
- Appendix C: GIS Background Information
- Appendix D: Measuring Data Quality and Random Sampling
- Appendix E: CIS Data Quality Self-Assessment Template
- Appendix F: CMMS Data Quality Self-Assessment Template
- Appendix G: OMS Data Quality Self-Assessment Template

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PROJECT 09-14 | JUNE 2010

A Practical Guide to Ensuring Data Quality

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PROJECT 09-14

A Practical Guide to Ensuring Data Quality

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The National Rural Electric Cooperative Association

The National Rural Electric Cooperative Association (NRECA), founded in 1942, is the national service organization supporting more than 900 electric cooperatives and public power districts in 47 states. Electric cooperatives own and operate more than 42 percent of the distribution lines in the nation and provide power to 40 million people (12 percent of the population).

NRECA's Cooperative Research Network (CRN) harnesses research and development to benefit its electric co-op members in four key ways:

- Improve productivity
- Control costs
- Increase service excellence
- Keep pace with emerging technologies

CRN strives to deliver new products and services best suited to the particular needs of electric co-ops. CRN communicates with its members through its Web site (**www.cooperative.com/crn**), online and printed reports, newsletters, Web conferences, and seminars.

In addition, CRN staff present at several annual events, including NRECA's TechAdvantage Conference & Expo, the NRECA/Touchstone Energy "Connect" marketing conference, and Touchstone Energy's New & Emerging Technologies (NET) Conference. For more information about these events and CRN's participation, visit the Conferences & Training section of **www.cooperative.com**. For questions about CRN, call 703.907.5843.

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contents

Section 1	**Introduction**	1
	Key Systems	1
	Objectives	1
	Document Organization	2
Section 2	**GIS Data**	3
	GIS Data Definition	4
	GIS Data Attributes	6
	Data Relationships	16
	GIS Data Management Processes	18
Section 3	**CIS Data**	25
	CIS Functionality	25
	CIS Data Categories	26
	CIS Data Alignment	26
	CIS Data Attributes	28
	Data Source for Other Systems	43
	Data Maintenance Challenges	44
Section 4	**CMMS Data**	47
	Core CMMS Functionality	47
	The CMMS Solution Model—CMMS Integration with Other Systems	48
	Technology Solution—CMMS Options Available to Cooperatives	50
	CMMS Data—Data Definition and Data Quality	50
	Full-cycle CMMS Data Quality Management	55
Section 5	**OMS Data**	59
	OMS Data Definition	59
	OMS Data Characteristics and Asset Categories	60
	OMS Data Attributes	60
	OMS Data Load	64
	Common OMS Data Challenges	65
Section 6	**Common Mistakes**	67
Appendix A	**GIS Data Self-Assessment**	69
Appendix B	**Acronyms**	73
Appendix C	**GIS Background Information**	75
	GIS Trends—A Review of Current Industry Directions	75
	The GIS Solution Model—GIS Integration with Other Systems	77
	Technology Solution—GIS Options Available to Cooperatives	78
Appendix D	**Measuring Data Quality and Random Sampling**	81

contents

Appendix E	**CIS Data Quality Self-Assessment Template**	83
Appendix F	**CMMS Data Quality Self-Assessment Template**	95
Appendix G	**OMS Data Quality Self-Assessment Template**	97

illustrations

FIGURE		PAGE
2.1	Conceptual GIS Data Definition	5
2.2	Electric Network Conceptual Representation in the GIS	16
2.3	Conductor Conceptual Representation in the GIS	17
2.4	Civil Structure Conceptual Representation in the GIS	18
2.5	GIS Data Lifecycle	19
3.1	Core CIS Functionality	25
3.2	CIS Data Groupings	26
3.3	CIS Selection Factors	44
4.1	Conceptual CMMS Data Definition	50
5.1	Conceptual OMS Data Definition	59
5.2	Typical OMS Data Load Scheme	65
6.1	Project Strategic Plan Elements	67
C.1	Data Layers of a Typical GIS	77
C.2	MultiSpeak System Integration Architecture	78
C.3	GIS Market Segmentation for Utilities with >100k Meters	79

tables

TABLE		PAGE
2.1	Typical Areas of Confusion for Geospatial and Non-geospatial Data	6
2.2	Scope and Attributes of GIS Data in the Cooperative	9
2.3	Sample Data Source Matrix	21
3.1	CIS Data Alignment	26
3.2	Scope and Attributes of CIS Data in the Cooperative	30
4.1	CMMS Functionality and Data Relationships	49
4.2	CMMS Stages and Asset Categories	51
4.3	Scope and Attributes of CMMS Data in the Cooperative	53
5.1	OMS Data Source Matrix	60
5.2	Scope and Attributes of OMS Data in the Cooperative	62
A.1	Self-Assessment: Asset Information	70
C.1	GIS Applications and Spatial Information	76
D.1	Sample Data Acceptance Criteria	81
D.2	Sample Table for Random Sampling	82
E.1	CIS Data Quality Self-Assessment	84
F.1	CMMS Data Quality Self-Assessment	96
G.1	OMS Data Quality Self-Assessment	98

1 Introduction

In This Section:

Key Systems
Objectives
Document Organization

The importance of data and data quality has long been a secondary concern for many utilities. In the cooperative space, the perception often is "as long as the bills get paid, our data are good enough!" Because customers and members/owners alike have become more demanding about customer service and the impacts of the Smart Grid have become clearer, it is increasingly imperative for co-ops to manage their data in a smarter way. Unfortunately, from the perspective of technical resources, the data are never good enough. Managers are faced with the challenge of balancing adequate data quality against the cost of maintaining that quality. This report provides co-ops with a means of assessing the data availability and quality requirements for their key systems.

Key Systems

Regardless of the size of a utility, it has a key nucleus of systems that form the basis of the enterprise's information backbone. The majority of co-ops' other information systems rely on data provided by such systems. These typically include the following:

- CIS – Customer Information System, which manages all customer- and billing-related data
- GIS – Geographic Information System, which assists in providing the utility with the location of all assets and adds the spatial relationship to work;
- OMS – Outage Management System, which provides an as-operated representation of the distribution
- CMMS – Computerized Maintenance Management System, which tracks the full lifecycle and history of the asset

Objectives

Simply stated, this report provides co-ops with the knowledge and know-how necessary to understand the following points as they relate to the key systems identified above:

- An understanding of data requirements
- A definition of what data is important and why
- Review of the data-specific security requirements

It should be noted, however, that the data requirements and quality recommendations for each of these systems are based on an idealized or generic co-op operating environment.

1

An individual co-op's needs may be different. It is imperative that the data requirements and quality recommendations be validated against the co-op's actual operating needs before it develops and implements system deployment or data quality action plans.

Document Organization

This document includes five sections; in addition to this Introduction, each section is related to one of the key systems of the co-op:

- Section 2 – GIS Data
- Section 3 – CIS Data
- Section 4 – CMMS Data
- Section 5 – OMS Data
- Section 6 – Common Mistakes

Sections 2 to 5 are organized in the following manner to ensure consistency:

- Data Definition – Identifies the functional and data scope of the system
- Data Attributes – Identifies the data themselves
- Data Relationships – Identifies dependent systems and data dependencies—data required to support the operations of a system are entered into the respective systems either by the users or by means of data integration or links with other systems, as described in the report
- Data Management Processes – Discusses how the data are best managed over the course of the full system lifecycle, from initial data load through continuous maintenance of data to data retirement

In addition, each section has a corresponding Appendix that includes a self-assessment tool to enable co-ops to perform an objective review of the state of their data. Data either are entered into the system database by users or downloaded from other co-op systems by means of integrated data links to support system functionality on a real-time or non-real-time basis. This assessment tool is intended for use as a data load guide for the initial implementation of the system, as well as for the assessment of data quality in an existing system for continuous data quality improvement. The tool can be used for the assessment of the quality of entered as well as downloaded data. The assessment tool is not, however, intended for use in assessing the technical adequacy or integrity of the data links. It is recommended that detailed acceptance testing of the data links be performed carefully when the links initially are deployed to ensure proper integration of data (see **Section 6—Common Mistakes**). If the downloaded data are found to be materially different than the primary data source or are not available as designed, the co-op should consult the vendor(s) who initially installed the data link for problem resolution.

Section 6, Common Mistakes, reminds co-ops of the mistakes utilities often make in their planning, deployment, and data maintenance for GIS, CIS, OMS, and CMMS, and presents lessons learned, common challenges, and recommendations.

2 GIS Data

In This Section:

- GIS Data Definition
- GIS Data Attributes
- Data Relationships
- GIS Data Management Process

GIS (Geographic Information System) means many different things to different people. From the perspective of the electric co-op, a GIS is important because it contains an as-built representation of the distribution facilities, including phasing from customer through protective devices to substation. The GIS model references all of the co-op's assets against a map background. The co-op consequently gains an understanding of where everything is located. The GIS data quickly become complicated and more challenging to maintain when the co-op adds an unbalanced 3-phase and single-phase representation for both equipment and conductor size and type.

In many cases, the GIS becomes a convenient system on which to build other applications that rely on spatial data. For example, many co-ops have built maintenance management functionality onto their GIS to allow them to track and manage maintenance history on key assets. This trend often is dangerous because, in these cases, the GIS grows beyond what is manageable.

Unfortunately, most co-ops do not have the level of data quality they assume. GIS data quality issues are related primarily to:

- Gaps, e.g., certain key data are missing
- Redundancies with other systems, e.g., data are captured in many systems and so are inconsistent or require duplicate data entry to update
- Lack of currency with system "as-built," e.g., untimely work order completion/backlog
- Inaccuracies in relation to the field, e.g., GIS has data but does not represent the actual system in the field
- Inaccurate or unavailable landbase, e.g., varying degrees of accuracy of landbase data, based on the source
- Customer-to-transformer connectivity by phase is uncertain

Improving data quality is not the sole responsibility of the GIS group. This group should position itself as the facilitator of a process that enables engineering and operations, and allows member services employees to add and update GIS data in a time-efficient manner. Simply stated, the end-users of the data should become the data owners.

First and foremost, improved GIS data quality can provide tremendous operational benefits.

2

With improved data quality, the co-op will see increased efficiencies in the following areas:

- Improved safety due to more accurate facilities records
- Reduction in the overall cost of maintaining the GIS system as a whole
- Efficiencies in implementing and troubleshooting Advanced Metering Infrastructure (AMI) communications issues
- Improved OMS and Distribution Management System (DMS) benefits, e.g., reduced outage duration
- Improved crew efficiencies due to improved distribution system representation
- Improved load forecasting
- More accurate system planning
- Reduced work order cycle times

While these benefits are of obvious interest to any co-op, there is a bigger driver looming that makes data quality important. With the advent of AMI, DMS, and the Smart Grid, distribution companies can no longer ignore poor data quality. In many cases, utilities are finding that their capital-intensive Smart Grid investments are not yielding anticipated benefits simply because they do not have an accurate enough representation of the distribution system. In more extreme cases, the safety of employees and the public has been compromised due to misrepresented facilities in the GIS.

The basic building block of any Smart Grid strategy is an understanding of the connectivity model and consequently what is where. The GIS is the enabling technology in co-ops that provides location-based information to other systems, such as outage management, distribution management, load forecasting, and system planning applications. While the GIS itself will not play a real-time role in the utility of the future, the data it supplies will help co-ops better manage and understand the changing behavior of the distribution system and their members.

This section provides co-ops with the tools to understand what data belongs in the GIS, how to assess data quality, and how to bridge any gaps. To achieve these goals, the following subsections are provided:

- GIS Data Definition – Defines data typically in a co-op's GIS
- GIS Data Attributes – Describes GIS data and data attributes
- GIS Data Relationships – Indicates the dependencies between GIS data
- GIS Data Management Processes – Describes data maintenance processes

Appendix A contains a self-assessment template, the GIS Data Self-Assessment. Co-ops can use this template to assess their data objectively. When using the template, it is sometimes helpful to have a third party facilitate the review to ensure that an honest assessment is provided. Appendix C, GIS Background Information, provides additional useful information about GIS.

GIS Data Definition

The first topic to be addressed is the definition of the data included within the GIS. Figure 2.1 provides the core definition of the scope of data within the typical cooperative's GIS database; this database commonly is referred to as the Spatial Data Registry.

When considering the data, it is important to remember that all assets need a unique means of referencing them. To effectively manage efficient accounting programs (both asset and customer), as well as maintenance and inspection (M&I) programs, cooperatives need to identify and tag each asset under maintenance with a unique asset identifier, or ID. Examples of assets that need tagging include poles, transformers, and switches. While the initial tagging of assets in the field may be viewed as a monumental task, in the long term it brings numerous benefits to the cooperative. A cooperative has several options for starting a program to tag and provide a GPS for all assets:

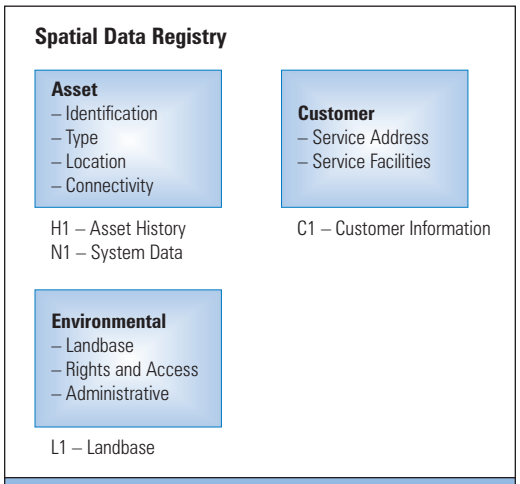

FIGURE 2.1: Conceptual GIS Data Definition

- Engage a specialized firm
- Use internal resources on light duties
- Use the activity as filler work
- Address assets as they are replaced, maintained, or installed
- A combination of these approaches

For the physical implementation of a GIS, the following unique identifiers may be used to identify a piece of equipment:

- Application-specific hidden key
- Manufacturer-provided equipment serial number (typically poorly suited to function as a corporate-wide asset reference number)
- Common corporate asset designation referenced on the asset in a numeric or alphanumeric code, barcode, or radio-frequency identification (RFID) tag

To determine if they are best suited for inclusion within the scope of the GIS, the data must meet the following criteria:

- Object to be represented is characterized by an X, Y location
- Attribute information of interest to the GIS user (identifier, size, type, vintage, status, nameplate information, and manufacturer are minimal requirements)
- Necessary for identifying how customers are connected to network
- Necessary for identifying connections among facilities (line segments, transformers, fuser/switches, etc.)

Certain rules also can be applied to determine if data are not suitable for the GIS:

- Three-dimensional in nature (other than contour lines)
- Require precision drawing (e.g., plan and profile drawings)
- Include information not routinely accessed by target GIS user (not dependent on X, Y location)
- Describe relationships among relatively large numbers of equipment within a small geographic region

In some cases, confusion may still arise when considering converting data into a GIS environment. Table 2.1 identifies typical areas of confusion and recommendations that point to the most appropriate system in which to store the data (System of Record). Table 2.1 gives a description of how this information relates to the GIS environment. In all of the cases described in this table, the data should be updated only in their principal system of record, even if the GIS stores a copy of the data. For example, Customer Information should only be updated using the CIS system. It is important to note that this table identifies typical areas of confusion; detailed definitions of where data should reside are in other sections of this report. As with other aspects of the report, the recommendations of Table 2.1 provide guidelines only, and co-ops should apply professional judgment when determining what works in their particular context.

TABLE 2.1: Typical Areas of Confusion for Geospatial and Non-geospatial Data			
	Information	**Principal System of Record**	**Link to GIS**
1	Detailed engineering drawings (i.e., station or equipment)	CAD System	Through to Document Management System/Depository
2	3-D data	CAD System / Custom Application	May represent link to region or structure within GIS
3	Maintenance and inspection	Maintenance Management (MM)	Reference equipment in GIS through unique identifier
4	Load information	CIS	Duplicate within GIS with periodic update
5	Customer information	CIS	Duplicate within GIS with periodic update
6	Compatible units (labor and materials)	Work Management System (WMS) and MM	Duplicate within GIS with periodic update
7	Engineering analysis (EA) data	GIS or analysis application	May be maintained within GIS or application package
8	Non-destructive and destructive test results	CMMS	Reference equipment in GIS through unique identifier
9	Outage statistics	OMS	Through OMS representation of network
10	Project estimation	GIS or WMS	Dependent on staking/graphical work design system implementation
11	Joint use data	GIS for location information	CIS or specific application for accounting
12	Meter records	GIS for locations	CIS, custom meter tracking database, or CMMS
13	Protection device settings	Engineering analysis tool	GIS for device information with link to identify settings
14	Poles	GIS for location	CMMS for maintenance and inspection-related information
15	Transformers	GIS for location	CMMS for maintenance and inspection-related information, CIS for customer-to-transformer connectivity
16	Meter	GIS for location	CIS or Meter Data Management System (MDMS) for asset data
17	Premise	GIS for location	CIS for physical address

GIS Data Attributes

The key role of the GIS in co-ops is to present an accurate representation of the assets and the aggregate of the assets in the form of a connectivity model. In the case of distribution cooperatives, this includes the distribution system and substations owned and/or operated by the co-op. In the case of G&Ts or co-ops with transmission or sub-transmission assets, this includes the transmission and substation assets, where applicable. In summary, all of the co-op's electrical assets should be represented in the GIS. Table 2.2 provides:

- The electrical facilities and infrastructure information typically included within the GIS representation of the electrical network
- Data attributes for each grouping of GIS
- Data attributes further defined as usage, criticality, quality, and security requirements

The Table 2.2 definitions of usage, criticality, quality, and security requirements can be clarified further:

1. **Usage.** How will the GIS data be used? Which GIS and non-GIS functionality will this set of data support?
2. **Availability.** How important is this data set to the successful implementation of the GIS system?
   - *Mandatory* – This set of data is imperative to the implementation of a functional and effective system. It is independent of cooperative size or level of technological sophistication. There should be no gaps in the data; gaps may cause a dependent system to function inappropriately.
   - *Desirable* – This set of data is recommended but can be provided at a later date with limited compromises to the initial GIS implementation. It should be noted that some desirable core GIS and non-GIS functions may not be available until these data are provided. It should be the goal of every cooperative to collect these pieces of data eventually.
   - *Optional* – Inclusion of this set of data with the GIS implementation will provide added value but is not necessary for the integrity of the core GIS functions.
3. **Quality.** At what level of completeness, correctness, and currency must this set of GIS data be maintained on a day-to-day basis? Experienced utility GIS administrators perceive the difficulty of assigning a numerical value to determine data quality. Instead, data quality must be maintained at a level sufficiently high to ensure that users will utilize and depend on the GIS for its intended functions.
   - *Critical* – A high quality level must be maintained to support critical GIS and specialized non-GIS functions. Experience gained from utilities with mature GIS systems indicates that a data error rate of less than 5% must be achieved during initial system start-up and continuously maintained so as not to erode user confidence in using the GIS, e.g., 5% mismatch between field and GIS.
   - *Standard* – This level of quality usually is assigned to data sets that support utility mapping and map information distribution functions. A 25% or less data error rate is deemed sufficient by experienced GIS administrators to maintain user confidence.

   The quality recommendations presented here are based on a statistical spread (even distribution) of error across all of the asset data stored in a GIS (poles, cross-arms, wires, switches, etc.); that is, a 5% data error rate in GIS data means that 95% of all asset data stored in a GIS are accurate and correct. Users should not interpret this as a 5% error rate in a particular GIS attribute class, such as poles or wire. For example, a 5% error in GIS data does not mean that a crew searching for a pole would not find it one out of twenty times or that the pole class is incorrect. Both calculation of error rates and random sampling techniques to validate data quality are discussed in Appendix D, Measuring Data Quality and Random Sampling.

   See "**Data Relationships**" (page 16) for further discussion on data quality, data maintenance recommendations, and industry best practices.
4. **Security.** What level of data security or accessibility should be maintained for this set of GIS Data?
   - *Highly Confidential* – Highly sensitive information. Unauthorized disclosure of this information would cause exceptional damage. Examples include personnel information that could alienate a significant number of employees; commercially sensitive information; or information on significant security vulnerabilities, medical records, breaches of regulatory mandates, or confidentiality agreements.
   - *Proprietary* – Sensitive information. Disclosure of this information could cause

harm to the cooperative and its employees or partners. Examples include information that would cause considerable embarrassment or loss of reputation, or personnel records.

- *Internal Use Only* – No loss of reputation or embarrassment will result from disclosure, but the data owner may be inconvenienced. External parties may find this information useful as a stepping-stone to gathering more sensitive information. Examples include internal phone books and some policy documents.

When considering Table 2.2, it is important to remember that, regardless of the data quality, certain systems require mandatory data to function—whatever the quality, the data need to be available and adhere to certain rules for a system to function. Many utilities populate the mandatory data with a "best guess" to ensure that they can use dependent systems, but apply professional judgment when interpreting the results: some co-ops include a flag on key attributes to indicate trustworthiness of the data. Specific to the GIS, the following systems are dependent on the availability of mandatory data:

- OMS requires the following mandatory data:
  - A complete connectivity model (100% connectivity)
  - No parallel circuits unless a network is supported
  - In excess of 80% customer–to-transformer matching
  - Phasing is consistent with fundamental engineering practices, e.g., no phase mismatches
  - Substation data are not mandatory, nor is substation modeling possible in all GIS, but the breaker configuration at the substation can be useful in avoiding false outage predictions
  - Customer-to-transformer relationships
  - Transmission data are not mandatory, nor is transmission modeling possible in all GIS, but transmission modeling allows the automated inclusion of transmission-level outages
- Engineering Analysis (EA) requires the following mandatory data:
  - A complete connectivity model (100% connectivity)
  - Mapping of transformers, conductors, capacitors, and regulators to their associated electrical parameters
  - Mapping of protective devices to their protective characteristics. Substation data are not mandatory, nor is substation modeling possible in all GIS, but the breaker configuration at the substation can be useful in avoiding false outage predictions
  - Transmission data are not mandatory, nor is transmission modeling possible in all GIS, but transmission modeling allows the automated inclusion of transmission-level outages
- CIS requires alignment of the addresses with the GIS. Typically, this is a complicated process but necessary to enable more accurate outage predictions.

An area of emerging interest for co-ops is more accurate modeling of the customer, service point, and premise relationships. Co-ops are finding that these relationships need to be put in place to ensure more effective implementation and troubleshooting of AMI initiatives, as well as accurate outage predictions. The relationships among customer, service point, and premise are particularly complicated when modeling corporate campuses, trailer parks, and any facility with multiple services fed by different circuits.

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
***Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential
Data Grouping	**Data Description**	**Data Attributes**			
		Usage	**Availability**	**Quality**	**Security**
Asset Information					
H1 – Asset Historic Data	Asset description, geographic location, and date of installation. Note: • All assets except items 1, 2, 6, 8, and 9 will have a unique identifier affixed to the asset and common across all information systems. • Each physical location where an asset is housed will have a work or functional location identifier.				
	1. Poles	Data to enable core GIS functions and support advanced non-GIS applications, including CMMS, CIS, EA, Staking/Graphic Design, and OMS	Desirable	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Standard • To support EA application: Standard • To support CMMS application: Critical • To support CIS application: NA	Proprietary
	2. Cables		Mandatory	• To support core GIS functions: Standard	
	3. Conductors		Mandatory	• To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support EA application: Standard • To support CMMS application: Critical • To support CIS application: NA	

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
***Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential
Data Grouping	**Data Description**	**Data Attributes**			
		Usage	**Availability**	**Quality**	**Security**
H1 – Asset Historic Data (cont.)	4. Substructures – ductbanks/manholes, vaults, handholes, terminators/pedestals, etc. Note: 1) Underground structures that are needed to have a concept of connectivity 2) This applies only to co-ops with an extensive downtown underground network		Mandatory	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support EA application: Standard • To support CMMS application: Critical • To support CIS application: NA	
	5. Major Line Equipment (overhead [OH] and underground [UG]) – switches (all types)/fuses/capacitors/ regulators/reclosers/transformers, network protectors, etc.		Mandatory	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support EA application: Standard • To support CMMS application: Critical • To support CIS application: NA	
	6. Ancillary Line Equipment (OH and UG) – cable elbows/taps/jumpers/ risers/grounding (rods, wires, moldings), cross arms, guys and anchors, splices, bird guards, etc.		Desirable	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: NA • To support EA application: NA	

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security

***Usage Code:**

AM = Account Management
CM = Credit Management
PM = Portfolio Management
UCM = Usage/Consumption Management
RB = Rates & Billing
CSC = Customer Service & Care
SAM = Service Address Management
CC = Customer Choice
C&C = Customer Service & Care
MM = Meter Management
SOM = Service Order Management

Data Grouping	Data Description	Usage	Availability	Quality	Security
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential

Data Grouping	Data Description	Usage	Availability	Quality	Security
H1 – Asset Historic Data (cont.)				• To support CMMS application: Critical • To support CIS application: NA	
	7. Controls and Apparatus – control units inclusive of current transformers (CTs), potential transformers (PTs), ancillary transformers, and wiring, i.e., regulator control, load tap changers, capacitor control, recloser control, sectionalizer control, relay control		Optional	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: NA • To support EA application: NA • To support CMMS application: Critical • To support CIS application: NA	
	8. Secondary Systems		Desirable	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: NA • To support EA application: NA • To support CMMS application: Critical • To support CIS application: NA	
	9. Customer-owned motor, generators (sufficient detail to model)		Optional	• To support core GIS functions: Standard • To support Staking/Graphic Design application: NA	

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
***Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential
Data Grouping	**Data Description**	**Data Attributes**			
		Usage	**Availability**	**Quality**	**Security**
H1 – Asset Historic Data (cont.)				• To support OMS applications: NA • To support EA application: Critical • To support CMMS application: NA • To support CIS application: NA	
	10. Revenue Meter (self-contained and CT type). Information also includes service location to enable link to CIS		Mandatory	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support EA application: NA • To support CMMS application: Critical • To support CIS application: Critical	
	11. Street and Dusk-to-Dawn (D/D) Lights – poles/arms/luminaires/ bulbs/photocells and controls/wiring		Desirable	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: NA • To support EA application: NA • To support CMMS application: Critical • To support CIS application: NA	

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security

***Usage Code:**

AM = Account Management
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Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential

Data Grouping	Data Description	Data Attributes			
		Usage	Availability	Quality	Security
Connectivity and System History					
N1 – System Data	Configurations, connectivity, and parameters: • As designed • As operated (temporary)	Data to enable core GIS functions and support advanced non-GIS applications, including EA, Staking/Graphic Design, and OMS	Mandatory	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support EA application: Critical	Proprietary
	Protection & Coordination: • Substation protection relay scheme and settings • Circuits and systems sectionalizing schemes	Protection relay and fuses/ sectionalize devices (recloser, etc.), locations, and sizes to enable Protection Coordination/ EA applications	Substation Data: Optional Circuits Data: Desirable	• To support EA application: Critical • To support core GIS functions: Standard	Proprietary
	Failures: • Incident location • Isolation devices and location • Detailed failure codes • Corrective actions • Remedy • Service restoration activities (incident/outage report) • Operations impact (interrupted load, duration, etc.).	Failure incident location information to support Distribution Planning and Reliability Analysis	Desirable	Standard	Proprietary
	Program: • Infrared thermography program • Annual line patrol program • Overhead line maintenance	Program activity location information to support administration of Facility Maintenance Program	Desirable	Standard	Proprietary

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
***Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential
Data Grouping	**Data Description**	**Data Attributes**			
		Usage	**Availability**	**Quality**	**Security**
N1 – System Data (cont.)	• Underground line maintenance • Vegetation management Note: Many cooperatives are managing vegetation only manually, not with automation. The increased use of GIS for vegetation management is a recent trend.				
	Operations: • Switching • Load shedding • Maintenance	To support Distribution Automation and Load Control	Desirable	Critical	Proprietary
	Engineering and Analytical: • Load flow & loading (load, voltage, fault current, tie capacity/reliability) • Load balancing	Case files storage and version management to support EA functions	Optional	Critical	Internal Use
	Engineering and Analytical: • Protection & coordination	Line protection devices' locations and connectivity to support EA tasks and enable the use of EA application	Desirable	Critical	Highly Confidential
Customer Information (Specific to the GIS)					
C1 – Customer Data	• Service addresses – geographic reference • Service facilities (transformer, meter, service drop, etc.) • Premise – location land or building served by the co-op • Service point – physical location of the service (optional)	Data to enable core GIS functions, OMS, Staking/Graphic Work Design applications	Mandatory	• To support core GIS functions: Standard • To support Staking/Graphic Design application: Critical • To support OMS applications: Critical • To support CIS application: Critical	Highly Confidential

Continued

TABLE 2.2: Scope and Attributes of GIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security

***Usage Code:**

AM = Account Management
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Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential

Data Grouping	Data Description	Data Attributes			
		Usage	Availability	Quality	Security
Spatial Information					
L1 – Landbase Data	• Topography w/Contours • GPS Control Points • Parks (federal, state, city/county) • Federal Land • Communities/Municipalities • Reference Maps (lots, legal monuments) • Quarter-section Grid • Indian Reserves • Easements • Leases • Photographic Images • Transportation • Governmental and Federal Boundaries • License Areas • Franchise Area • Operating Districts • Flood Lines • Catchment Basins • Resource Areas • Hydro • Geotechnical • Non-electrical Utility Infrastructure • Ecological • Meteorological • Property and Land Use	Data to enable core GIS functions if available. Core landbase topographical data usually can be procured from an outside government or private agency	Mandatory	• Land rights, easement, license, and property/ boundary data: Critical • Other L1 Landbase data: Standard	Internal Use

2

Data Relationships

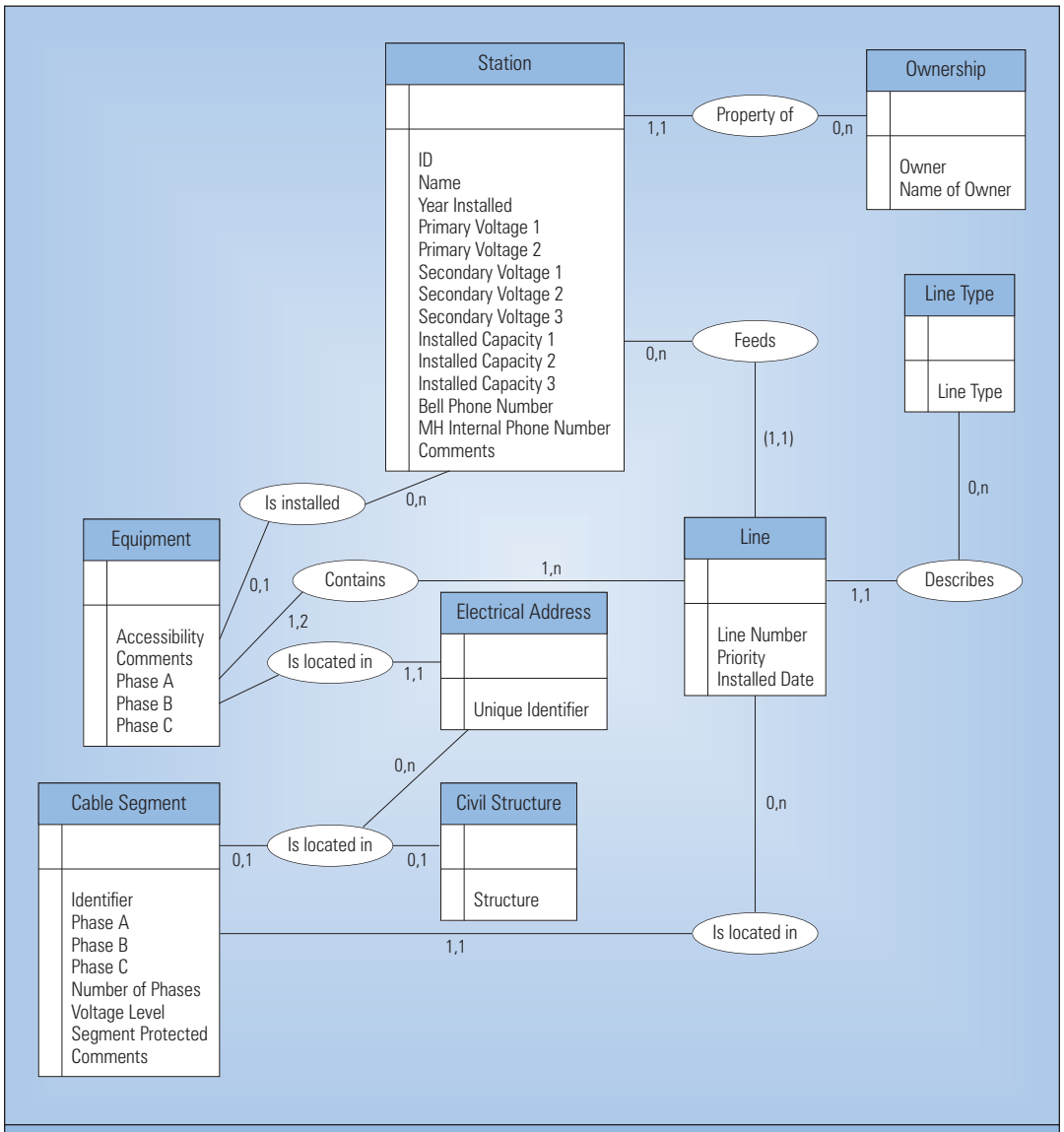

FIGURE 2.2: Electric Network Conceptual Representation in the GIS

Figure 2.2 shows how the electric network typically is represented in a GIS. This representation identifies the relationships between station, lines, and equipment. As the system connectivity plays an important role, Figure 2.3 describes the conductor line segments. These relationships typically are stored in the GIS. Other systems, such as OMS and EA, will access these data via integration.

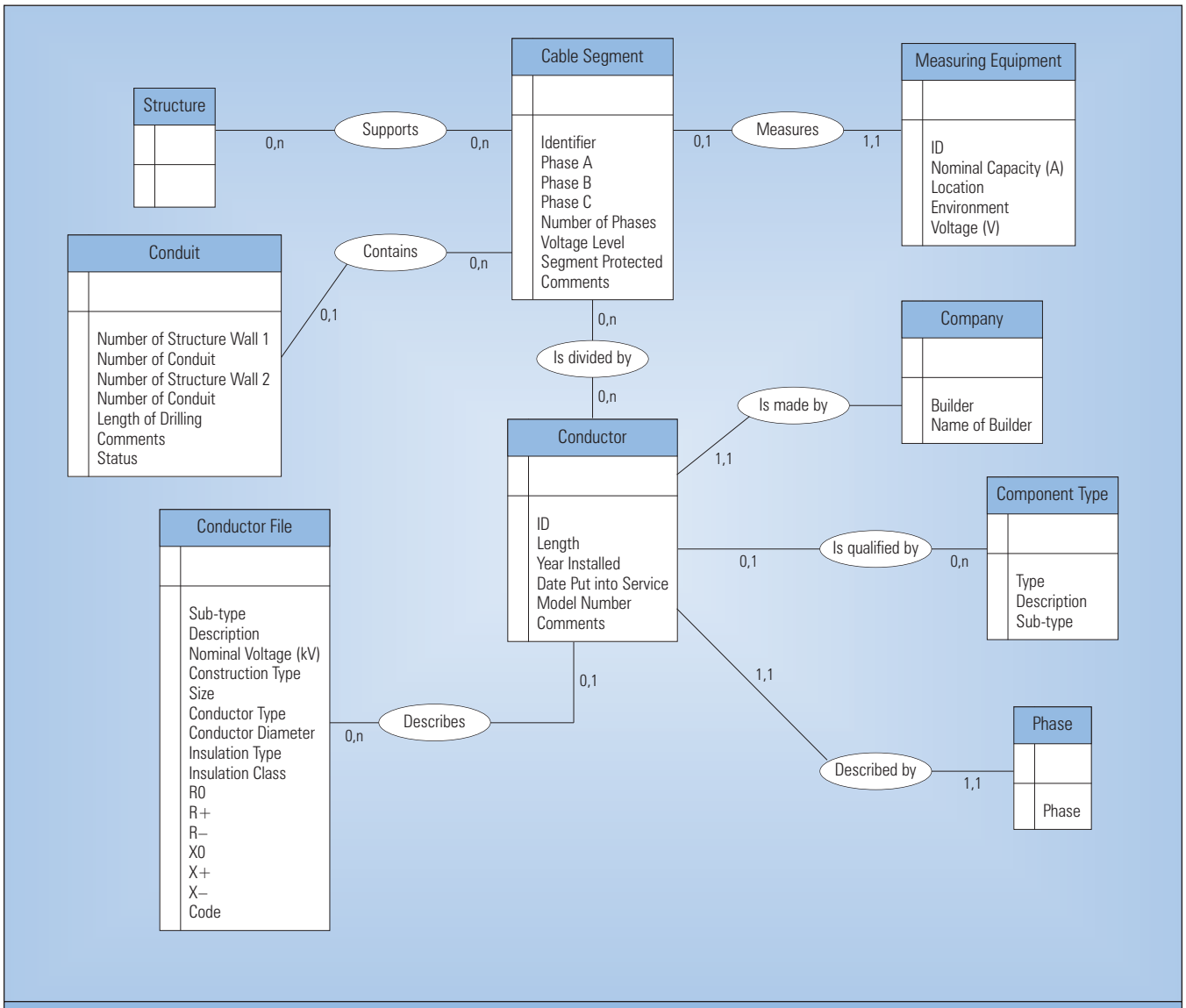

FIGURE 2.3: Conductor Conceptual Representation in the GIS

Figure 2.2 and 2.3 provide a field that identifies whether the data are captured at the transmission or distribution system levels. Figure 2.4 shows the civil infrastructure for a typical GIS underground electric representation: typically, this is used only in an extensive downtown underground network, something that many co-ops do not have. The civil infrastructure data typically are stored in the GIS and supported by detailed (AutoCAD) drawings.

2

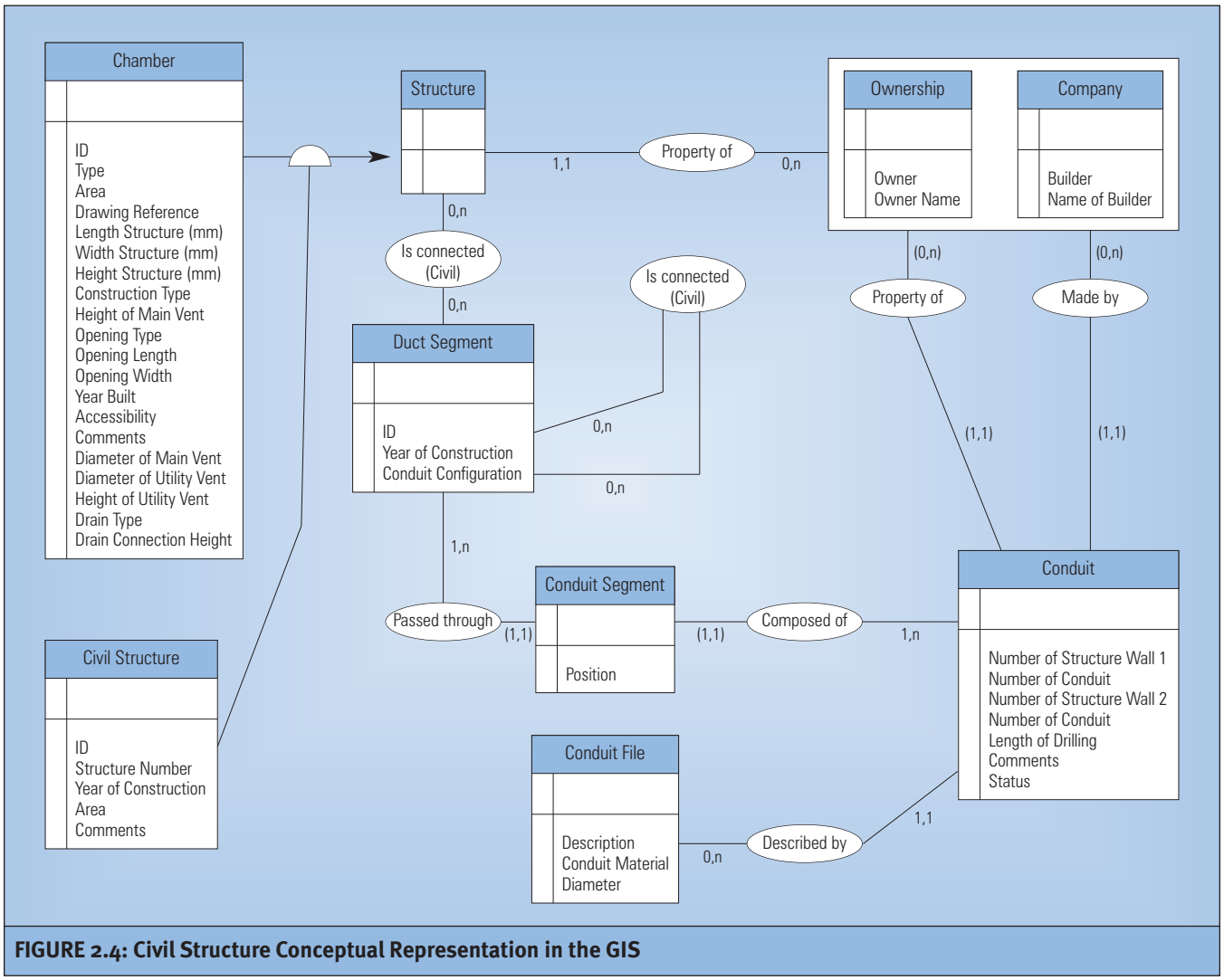

FIGURE 2.4: Civil Structure Conceptual Representation in the GIS

GIS Data Management Processes

Many co-ops with mature GIS find the data management and update process time-consuming and costly. Even with the integration of graphical staking tools with the GIS, the time required for validation and quality assurance and quality control (QA/QC) of data to ensure adherence to cartographic standards is well beyond what co-ops typically anticipate when justifying the GIS investment. This section discusses how co-ops can put into place tools and processes to make the GIS self-supporting—that is, how the GIS and associated staking tool can maintain the data over the course of employees' day-to-day work processes. It is critical that the GIS data be kept current; otherwise, the GIS will suffer from credibility issues:

- Extensive customization makes cost-effective and timely support, maintenance, and evolution impossible
- Software and data quality often are compromised
- Many end-user groups are excluded from the benefit of spatially enabled applications and data
- Diversion of resources from system evolution to data capture, quality control, and cleansing activities
- GIS initiatives are met with frustration and skepticism by both users and IT support staff

This section provides a series of industry lessons learned and best practices to support full lifecycle GIS data management. Best practices and lessons learned recommendations are provided at each phase of the data lifecycle.

GIS DATA LIFECYCLE

Figure 2.5 provides an overview of the five-phase lifecycle of GIS data within the cooperative. Understanding this lifecycle and industry best practices can give electric cooperatives insights into how an effective data management program can be designed and implemented. The five phases include:

- Initial load – when the GIS initially is populated with data (only applicable for co-ops implementing a GIS)
- Data acceptance – when the initial data load is validated, or when co-ops want to validate the quality of their data
- Data maintenance – the steady-state life of the GIS data
- Data migration – moving the GIS data to a new or upgraded GIS
- Data retirement – should the data no longer be required

INITIAL DATA LOAD

Data Model

The Initial Data Load phase includes activities from the selection of the GIS data model through the actual GIS data conversion, migration, and field data inventory. Most major GIS vendors have credible data models. Some of the more advanced features described in Table 2.3, however, are not available in all GIS products without customization; e.g., transmission, substation, and underground networks may not be available. When selecting a target data model, cooperatives should require, at a minimum, that sufficient data will be captured in the model to perform a three-phase unbalanced load flow.

Recommendation

At a minimum, co-ops should populate the GIS with the data identified as "Mandatory" in Table 2.2.

Data Conversion/Data Capture

This is the first of a series of tasks in any GIS implementation project. The data conversion/data capture process, although straightforward by definition, is actually very complicated and time-consuming for the inexperienced. Many projects have failed due to incorrect execution of this phase of the project.

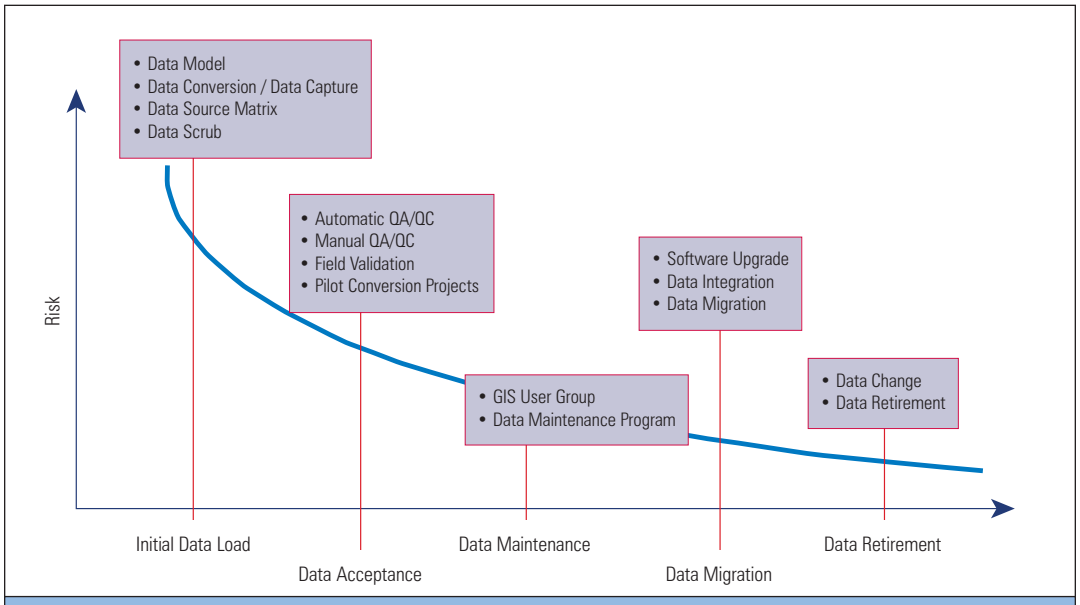

FIGURE 2.5: GIS Data Lifecycle

Recommendation

To minimize risks in cost and schedule overruns, it is recommended that data conversion/data capture tasks be conducted with the close assistance of, or outsourced entirely to, a reputable data conversion vendor. Usually, the GIS software solution vendor also will perform the data conversion/data capture tasks as part of its implementation service. When outsourcing data, it is important to remember that state and federal statutes often restrict the data that can be sent offshore so as to protect privacy and critical infrastructure. The price of onshore work has come down, so U.S.-based conversion or migration have become cost competitive with work performed in India.

The first step of the data conversion/data capture process is deciding who will identify the data to be converted—this should be determined on the basis of employees' knowledge of the organization and its needs. The resources assigned to this task should include employees who are knowledgeable about the business functions and workflows of the organization and know the location of specific sources of information.

Recommendation

It is strongly recommended that potential GIS users within the cooperative be responsible for identifying the data they require to perform their function within the organization, as well as the data they will need to support future functions. This approach makes the GIS functionality design user-driven and therefore more readily accepted.

Identifying Sources of Information to be Converted. Cooperatives record facility information in various forms of documentation. Although each co-op may do this differently, these documents typically include:

- Wall maps
- Circuit maps
- Aerial photographs
- System one- and three-line diagrams
- Construction work order drawings/diagrams
- Various card files and records
- Various equipment databases

The analysis of potential data sources for a GIS implementation includes matching the needs of GIS users with source data availability. Moreover, it must be confirmed that the source identified for each attribute covers a cooperative's entire service territory.

Existing Data Sources. It is important that those individuals within the cooperative responsible for preparing the initial data conversion and other planning activities conduct a thorough analysis of the existing maps and documents that will become inputs in the data conversion process. Any manual card files, tabular records, existing digital data, or other available information that could be of value to the data conversion effort also must be included in this pre-conversion analysis. The fundamental objective of the analysis is to prevent surprises later on.

New Data Sources. Another key task in this data conversion/capture project phase is identifying source data that need to be created. For example, a cooperative may elect to have new aerial photographs taken to serve as the source for pole locations, padmount transformers, and some other facility features. The photographs may be a better source for the conversion of these items into data than existing distribution maps or pole cards. In some cases, utilities can develop a series of heuristic rules to make best-guess estimates at fixing bad data or filling gaps. These heuristics can be very effective in correcting customer-to-transformer issues, transformer sizing, phasing, and incorrect distribution hardware.

Field Inventory/Survey. Some data sources examined during the data identification phase will be found obsolete, incomplete, or unreliable and will not warrant conversion. Cooperatives may need to secure additional data capture by means of a field inventory that gathers and records information in support of the facilities' data conversion efforts. A field inventory also can be used as a tool to field-check source documents before data conversion and collect missing or new information. In these cases, GPS techniques are recommended to establish positional reference data.

The data conversion/data capture phase for a typical GIS implementation includes the following activities:

- Digital-to-digital data migration of all electronic data sources
- Paper-to-digital conversion of all non-electronic data sources

- Field data inventory of certain overhead facilities and underground structures (with or without GPS positioning of facilities)
- Alignment of all facilities with the landbase

Data Source Matrix

The output of the data identification effort is the Data Source Matrix. Table 2.3 provides a sample of a typical data source matrix format.[1]

TABLE 2.3: Sample Data Source Matrix

Entity	Attribute	Street Light Map	OH Inventory Map	UG Inventory Map	Circuit Map	UG Work Orders	Field Work	Field/Existing Records	Aerial Photos
		Sources							
Pole (nonwood joint)			2						1
	Pole Number		1						
	Height		1						
	Year		1						
OH Primary Conductor Segment			1		2				
	Pole #1, #2		1		2				
	Phase A Size		1		2				
	Phase A Material		1		2				
	Phase B Size		1		2				
	Phase B Material		1		2				
	Phase C Size		1		2				
	Phase C Material		1		2				
	Neutral Size		1		2				
	Neutral Material		1		2				
	Number of Phases		1		2				
	Type		1		2				
	Operating Circuit Voltage		1		2				
	Circuit Number		1		2				
	Insulation Type		1		2				
UG Primary Conductor Segment			1			2			
	Size		1			2			
	Material		1			2			
	Number of Phases		1			2			
	Type		1			2			

[1] GIS Conversion Handbook, GIS World Inc.

Recommendation
It is recommended that data scrub or preparation of all the source data be conducted before the data conversion activities begin. All source data need to be retrieved from storage, verified and updated, cross-referenced with indices, copied, and packaged. Collecting, verifying/updating, organizing, and copying information are often time consuming. These activities therefore should be performed in phases as the data conversion project progresses. Data scrub also includes improving data clarity. Many maps and records may need extensive work to make them legible before the data conversion process can proceed.

DATA ACCEPTANCE

During this phase of the Data Lifecycle, the GIS administrator will act as the team leader to review the data set produced during the data conversion/data capture phase to determine whether the data have been migrated, converted, or field captured accurately and completely. Data quality assurance and quality control procedures usually are performed to assist the GIS administrator in determining whether the data produced meet the objectives of the program. The QA/QC procedures typically consist of:

- Automated QA/QC
- Manual QA/QC
- Field validation
- Pilot conversion projects

Since most data conversion/data capture projects produce a large volume of data, statistical data quality sampling methodology commonly is used to support the manual QA/QC and field-validated processes in an efficient manner.

Automated QA/QC

Automated QA requires the use of commercially available or GIS/conversion vendor-provided software or scripts designed to validate the integrity of the GIS data. Automated QA/QC tests can be run either on demand by users or triggered to run automatically as configured, typically upon posting to a master or "Top" GIS version. The following is a typical subset of automated test routines required for most GIS data conversion/data capture projects:

- Each GIS database record must represent a facility feature, as specified in the GIS data specifications document (for example, proper layer, symbology, color, etc.)
- Attributes containing calculated values must correspond to the values resulting from the application of the appropriate formula or algorithm
- For feature records requiring network connectivity, all attributes describing relationships with other network components must be logically consistent. For example, an overhead line section cannot be connected directly to an underground system without going through a riser system, and a three-phase device cannot be connected to a single-phase system

These scripts typically are executed to validate the ongoing integrity of the GIS data as well.

Manual QA/QC

To conduct the manual QA/QC process, the GIS data acceptance team, usually consisting of the individuals within the cooperative who prepared the initial data sources, will compare GIS database check plots to the source documents to verify that the following requirements have been met. The QA/QC Team should include a designated GIS resource, as well as representatives from the end-user groups that will be affected. The following are typical manual QA/QC objectives:[2]

- Absolute/relative positioning of facilities must be within acceptable tolerances
- Text offsets and orientations must be correct and in accordance with the graphic specifications
- Features spanning multiple plots must be edge-matched correctly
- Obsolete source record symbology must be translated correctly into GIS standard symbology in accordance with GIS data specifications

Field Validation

Cooperatives can conduct field validation to supplement the automated and manual QA/QC process in situations where object attributes requiring verification do not appear on graphic check plots or when the specific GIS data originate from a field inventory. Field validation also is

[2] GIS Conversion Handbook, GIS World Inc.

recommended when no automated test routines are available to validate a particular set of data attributes.

Recommendation

Lessons learned indicate that a high level of initial data quality is critical to ensuring long-term user acceptance and confidence in the GIS. GIS administrators agree that users' acceptance and confidence are difficult to regain if they get a poor first impression of a GIS. It is recommended that the co-op carefully develop a detailed set of data conversion/data capture QA/QC specifications with the assistance of the GIS solution vendor. The converted data should be at least 95% free of error for those errors that can require manual validation and 100% accurate for errors that can be validated programmatically. These quality requirements are necessary to establish the initial credibility of the GIS. Errors or anomalies are described as incorrect attributes, symbology, cartography, facility data, or network connectivity created during the migration. Cooperatives should maintain data to this level of accuracy throughout the life of the GIS. Appendix D, Measuring Data Quality and Random Sampling, provides a description of random sampling techniques.

Pilot Project

The pilot project is one of the most important steps in the implementation of a GIS. The basic concept of a pilot area is to convert a small geographic area into GIS data to assess if the data obtained from the pilot project meet deployment objectives. Typical pilot objectives to be accomplished include the following:

- Test database structure and content
- Test suitability of sources
- Test document preparation and data cleansing activities
- Test data conversion process
- Test quality assurance process
- Test data acceptance process
- Confirm data conversion cost estimates and schedule

The development of a pilot plan generally coincides with the development of the data conversion specifications. The pilot plan amplifies each of the mentioned objectives and clearly delineates responsibilities.

Recommendation

The inclusion of one or more pilot projects is strongly recommended in any complex GIS deployment because a properly developed pilot project also will satisfy another need. It will take the users of the intended GIS through a very valuable learning curve, allowing them to take the next step: a full implementation of the GIS.

DATA MAINTENANCE AND CONTINUOUS IMPROVEMENT

The GIS User Group and Data Maintenance Program

The GIS data enter the maintenance and continuous improvement phase of the Data Lifecycle with the successful conclusion of the data acceptance phase. The primary challenge in the data maintenance phase is maintaining sufficient data quality to ensure user confidence. As previously described, the primary means of assessing the success of any GIS is the confidence and willingness of users to depend on the GIS data to support their everyday duties. It is imperative that a data quality maintenance and continuous improvement program be implemented so that management has a clear understanding of how the GIS is performing and what actions could be taken to further improve user confidence.

Recommendation

Although automated (software) QA/QC tools provided by the GIS solution vendor can and should be executed periodically to assess data quality, it also is imperative to establish a structured maintenance program to assess and improve data quality and solicit user feedback. This program should include:

- The establishment of a GIS User Group—consisting of key GIS users and the GIS Administrator—to establish usage guidelines, share ideas about data/system improvement and enhancement, and solicit periodic user feedback
- The execution of automated QA/QC procedures upon posting a design or GIS version to the master version, as well as bi-annually, using software solution or conversion services from vendor-provided tools (software)
- The provision of field operating guidelines understood by all stakeholders to ensure that any permanent changes to field equipment

(transformer, pole, fuse, etc.) and system connectivity and phasing (opening and closing of switches to change direct of feed, etc.) are reported to the GIS Administrator within an agreed-upon period (three days is an accepted standard)
- The preparation of procedures to allow GIS users and field personnel to report any GIS data error/anomalies to the GIS Administrator so that quick data correction can be made
- The provision of procedures to ensure that the Staker/Designer will field validate GIS data used in all service and work orders. GIS data errors and anomalies should be reported to the GIS Administrator when noticed, within a reasonable time period (two days is an accepted standard)

Another challenge GIS Administrators often face is how to manage and incorporate changes to GIS data generated by service and work orders in a timely manner.

Recommendation

GIS data updates should be made within a reasonable time period—three working days following completion of a work order is a commonly accepted standard.

Recommendation

The actual end-users of the data should be responsible for the update process as well as data integrity. In an ideal environment, the end-users would have a field red-line tool to perform data correction graphically and use an integrated graphical staking application to create new facilities. There is still the need for a GIS coordinator or group, however. The role of the GIS coordinator or group is to validate accuracy, manage versions, and ensure adherence to cartographic standards when posting versions.

SYSTEM CHANGE/UPGRADE AND DATA MIGRATION

During the lifecycle of the GIS and its data, system changes, upgrades, or even a migration to another vendor solution will occur. Planned and managed proactively, these changes should not impose any undue risk to the integrity of the GIS.

Recommendation

The following procedures are recommended:

- **Software Upgrades.** The cooperative should follow the recommendations of the GIS vendor. It is recommended that the cooperative back up all databases before any software upgrade or system acceptance test.
- **Data Integration.** *System changes involving data sharing with other application(s)* – The cooperative should carefully consult with both the GIS and the new application vendor and request that a detailed project plan be developed jointly. The cooperative should then follow the recommendations of the vendors. Adhering to standards published by MultiSpeak usually will minimize many of the integration risks. It is recommended that the co-op back up all databases before any system changes or performing system acceptance tests.
- **Data Migration.** *Migration to a different system/solution* – The cooperative should seek and follow the recommendations of the new solution vendor. As migration to a new solution usually requires migrating all GIS data to a new data store/model, it is recommended that the cooperative re-evaluate and once again implement the series of procedures presented in this report.

DATA RETIREMENT

Similar to customer data maintained in the Customer Information System, GIS data are extremely dynamic, as such changes occur continuously. Although data retirement can be categorized as a specific phase of the Data Lifecycle, from a system data maintenance perspective, data retirement as a result of removal of facilities in the field can be handled as a form of data change.

Recommendation

Specific processes to address data retirement are not required. Data retirement as a result of removal of facilities in the field is best processed as a form of data change.

3 CIS Data

In This Section:

- CIS Functionality
- CIS Data Categories
- CIS Data Alignment
- CIS Data Attributes
- Data Source for Other Systems
- Data Maintenance Challenges

The Customer Information System (CIS) is perhaps the system most critical to the distribution cooperative. While all cooperatives have some form of CIS in place, it should not be a foregone conclusion that CIS data are accurate or current. Many co-ops find that having their bills paid does not mean they now have the accurate data that have become a requisite to enabling the Smart Grid.

CIS Functionality

Co-ops often deploy CIS functionality within the scope of a more comprehensive Enterprise Resource Planning (ERP) system. For example, National Information Solutions Cooperative's (NISC) iVue system and SEDC's UtilityPOWERnet (UPN) offer such broad-reaching enterprise systems to the co-op marketplace. These systems offer functionality extending well beyond the member/customer and revenue cycle processes considered crucial to traditional CIS functionality.

Figure 3.1 depicts the core CIS functionality in a co-op operation environment.

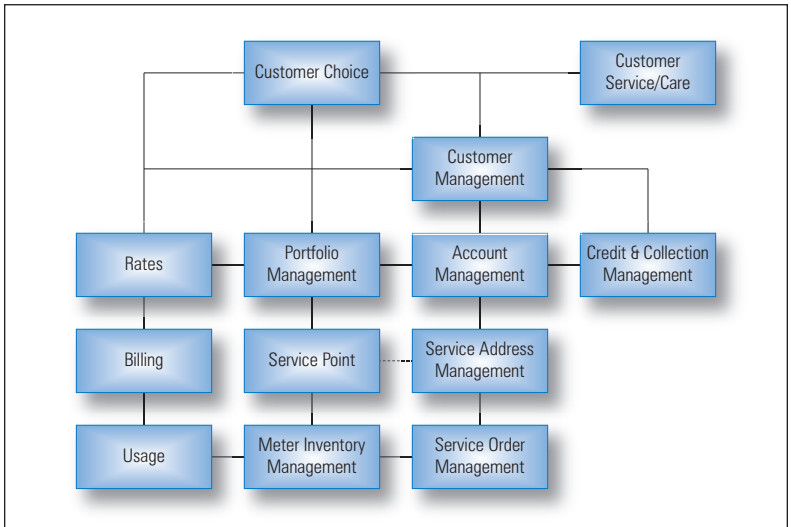

FIGURE 3.1: Core CIS Functionality. *(Source: TMG Consulting, Inc.)*

3

CIS Data Categories

The information store within a CIS consists of Account Data (A1), which describe the characteristics and history of each account; Customer Data (C1), which contain all necessary information about each customer; Equipment Data (E1), which contain information on revenue meters and associated equipment; Premise Data (P1), which contain information about service address and service points; Service Data (S1), which contain information on service portfolio, options, and orders; and Rates & Billing Data (R1), which provide information on rates/fees/charges, policy, billing practices, and consumption. These data categories are illustrated in Figure 3.2.

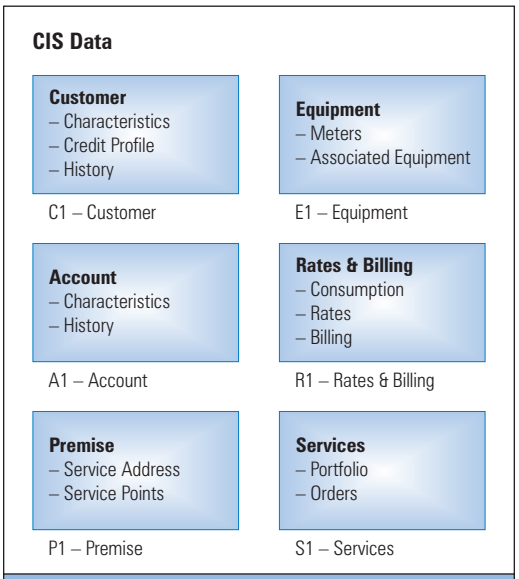

FIGURE 3.2: CIS Data Groupings

CIS Data Alignment

Table 3.1 describes the core CIS functions and the data required to support such functionality.

TABLE 3.1: CIS Data Alignment

Functions	Function Code	Functional Task Summary	Associated Data Categories
Account Management	AC	• An account is created to reflect the establishment of a financial agreement for the provision of a product or service. • The account is the primary path for accessing and viewing customer account-related information. • An account can be defined as a single account, a master account, or a temporary account. • It reflects available and installed service offerings, product offerings, equipment offerings, and program offerings. • It supports a wide array of account views into account transactions, consumption, payments, billings, adjustments, and account-specific notes.	A1 – Account C1 – Customer E1 – Equipment P1 – Premise R1 – Rates & Billing S1 – Services
Rates & Billing (Meter Data Management)	RB (MDM)	• This function supports cycle- , date- , and event-driven billing schedules. • The process inputs time- and volume-based consumption and provides for consumption validation and estimation algorithms. • The process identifies appropriate contract clauses and utilizes associated rate schedules and pricing plans. • The billing process provides for flexible billing periods and accommodates proration. • In addition to batch billing, the system provides for online account billing for "what-if" analysis and adjusted billing. • With the advent of the Smart Grid and Advanced Metering Infrastructure (AMI) system deployment in the co-op environment, co-ops increasingly are assessing the need to expand the CIS's Rates & Billing module to a full-function Meter Data Management (MDM) system.	A1 – Account E1 – Equipment P1 – Premise S1 – Services R1 – Rates & Billing

Continued

TABLE 3.1: CIS Data Alignment (cont.)

Functions	Function Code	Functional Task Summary	Associated Data Categories
Rates & Billing (cont.)		Co-ops may find that they need to deploy an MDM to be able to support the increased revenue cycle metering complexity of the Smart Grid/AMI environment. Whether co-ops choose to utilize a CIS Rates and Billing module or a standalone MDM, they need to ensure that sufficient quantity and quality of data are made available to either system, as recommended in this report.	
Credit & Collections	C&C	• This function establishes an extensive customer credit profile for use in managing account credit and necessary collection activities. • The functionality supports credit checking, credit references, credit bureau interface, and a flexible credit scoring process. • It accommodates third-party, guarantor, and co-signer relationships. • The function offers quick viewing of outstanding account balances, transfer of account balance across accounts, and the freezing of accounts for dispute resolution. • A flexible collection process is created regarding notification and cut-off activities, collection agency interface, and public assistance agency interface. • This module also supports processing late-payment penalties and returned checks and creating and managing payment arrangements. • It supports the processing of bad debt accounts, accounts in bankruptcy, accounts with a deceased customer and executor, and account liens.	A1 – Account C1 – Customer E1 – Equipment R1 – Rates & Billing
Customer Management	CM	• This module allows the capability of identifying and tracking customers in the system, independent of the account. • It allows for the identification of existing customers and the input of extensive profile and demographic information. • An existing customer may have a single or multiple accounts, and the module provides the ability to track specific information at the customer level across all customer accounts.	A1 – Account C1 – Customer E1 – Equipment P1 – Premise S1 – Services
Customer Service & Care	CSC	• This module supports the management of customer contacts received through various media, including telephone, integrated voice response, computer telephone integration, fax, email, the Internet, customer correspondence, the bill, and various payment mechanisms. • The system allows for recording, scripting, and managing the contact. • This module provides for marketing and sales to both current and prospective customers. • It allows for the identification and measurement of user performance, customer satisfaction, and the determination of program effectiveness.	A1 – Account C1 – Customer R1 – Rates & Billing S1 – Services
Meter Management (Meter Data Management)	MM (MDM)	• The identification, access, and management of meter, equipment, and product inventory. • The function supports meter-based billing activities, inventory-based activities, and meter testing programs with applicable interfaces to external meter inventory systems. • With the advent of the AMI system deployment in the co-op environment, co-ops increasingly are assessing the need to expand the CIS's Meter Management (MM) module to a full-function Meter Data Management (MDM) system. Many co-ops are finding the need to deploy an MDM to support the increased meter management complexity of the AMI operating environment. Whether a co-op is utilizing a CIS MM module or a standalone MDM, the co-op needs to ensure that sufficient quantity and quality of data are made available to either system.	E1 – Equipment R1 – Rates & Billing
Portfolio Management	PM	• This module provides the ability to view all available programs, products, and services (the portfolio) that the utility can provide to the customer, including diversified services. • It will support a wide variety of implied and special negotiated service contracts. Various rates and pricing plans can be associated with each portfolio item.	A1 – Account C1 – Customer R1 – Rates & Billing S1 – Services

Continued

TABLE 3.1: CIS Data Alignment (cont.)

Functions	Function Code	Functional Task Summary	Associated Data Categories
Service Address Management	SAM	• Co-ops use this function to identify legal parcel information and the service address for purposes of account management. • The module provides a process to support the establishment of new service for both permanent and temporary addresses, with the ability to associate current and historic information (i.e., meters, customers, equipment) with the address. • Multiple service points are associated with a service address; these points may be metered or unmetered.	A1 – Account C1 – Customer E1 – Equipment P1 – Premise
Service Order Management	SOM	• This module allows co-ops to process requests to initiate service- and meter-based work orders. It accommodates pending order processes, updating of orders, the dispatching and closing of orders, and the viewing of historical orders.	A1 – Account E1 – Equipment S1 – Services
Usage/ Consumption Management	UCM	• The module gives co-ops the capability of capturing consumption based on a passage of time, as well as a measured flow. • It allows for creating a route with automatic rerouting features. • The module allows initiation of readings and an interface with the hand-held or other meter reading devices. • This function validates consumption, processes reads, and tracks unauthorized usage.	A1 – Account E1 – Equipment P1 – Premise R1 – Rates & Billing S1 – Services
Customer Choice	CC	• Within a competitive retail market, this module provides for the registration of market participants and the customer registration and termination process. • The system accommodates marketers going out of business (certification revoked, merger, etc), with reassignment of customers back to the utility or other marketers. • The function provides for invoicing charges to the marketer for billing or the receipt of invoice items from the marketer for billing, processing payments, settlement processes, and resolution of disputes. • The module also provides for an industry standard interface to accommodate the communication of information between the utility and marketers.	A1 – Account C1 – Customer R1 – Rates & Billing S1 – Services

CIS Data Attributes

This section provides the details of CIS data for the core CIS functions depicted in "**CIS Data Categories**" (page 26). In summary, the primary role of the CIS is to serve as a repository for customer, accounts, metering, and billing information. Table 3.2 provides:

- The information associated with the core function of the CIS
- Data attributes for each grouping of information
- Data attributes further defined as usage, availability, quality, and security requirements

The Table 3.2 definitions of usage, availability, quality, and security requirements can be clarified further:

1. **Usage**. How will the CIS data be used? Which core CIS functionality will this set of data support?
2. **Availability.** How important is this data set to the successful implementation of a CIS system?
   - *Mandatory* – This set of data is imperative to the implementation of a functional and

effective system. It is independent of co-op size or level of technological sophistication.

- *Desirable* – This set of data is recommended but can be provided at a later date, with limited compromises to CIS implementation; however, some desirable core CIS and non-CIS functions may not be available until these data are provided. It should be the goal of every co-op to collect these pieces of data eventually.
- *Optional* – Inclusion of this set of data with the CIS implementation will provide added value but is not a necessity for the integrity of the core CIS functions.

3. **Quality.** At what level of completeness, correctness, and currency must this set of CIS data be maintained on a day-to-day basis? Experienced utility CIS administrators perceive the difficulty of assigning a numerical value to determine data quality. Instead, data quality must be maintained at a level sufficiently high to ensure that users will use and depend on the CIS for its intended functions.

   - *Critical* – A high quality level must be maintained to support critical CIS and specialized non-CIS functions. Experience gained from utilities with mature CIS systems indicates that a data error rate of less than 2% must be achieved during initial system start-up and continuously maintained so as not to erode user confidence in using the CIS.
   - *Standard* – This level of quality is usually assigned to data sets that support utility mapping and map information distribution functions. An error rate of 10% or less is deemed sufficient by experienced CIS administrators to maintain user confidence.

   It is important to note that the quality recommendations presented here are based on a statistical spread (even distribution) of error across the entire spectrum of asset data stored in a CIS (manufacturers, sizes, name plate information, PO numbers, etc.). This means that a 2% data error rate in a CIS data class translates to 98% of all asset data stored in a CIS within this data class being accurate and complete. The information should not be interpreted as a 2% error rate in each or any particular CIS data class, such as customer name or account address.

   See "**Data Source for Other Systems**" (page 43) for further discussion on data quality, data maintenance recommendations, and industry best practices.

4. **Security.** What level of data security or accessibility should be maintained for this set of CIS Data?

   - *Highly Confidential* – Highly sensitive information. Unauthorized disclosure of this information would cause exceptional damage. Examples include personnel information that could alienate a significant number of employees; commercially sensitive information; and information on significant security vulnerabilities, medical records, breaches of regulatory mandates, or confidentiality agreements.
   - *Proprietary* – Sensitive information. Disclosure of this information could cause harm to the cooperative and its employees or partners. Examples include information that would cause considerable embarrassment or loss of reputation, or personnel records.
   - *Internal Use Only* – No loss of reputation or embarrassment will result from disclosure but the data owner may be inconvenienced. External parties may find this information useful as a stepping-stone to gathering more sensitive information. Examples include internal phone books and some policy documents.
   - *Disclosed as Appropriate* – This category applies mainly to publicly disclosed information, such as a co-op's rate class, service extension policies, and collection/turn-off policies.

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management; CM = Credit Management; PM = Portfolio Management; UCM = Usage/Consumption Management; RB = Rates & Billing; CSC = Customer Service & Care; SAM = Service Address Management; CC = Customer Choice; C&C = Customer Service & Care; MM = Meter Management; SOM = Service Order Management					
Customer Information					
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**				
	Personal Information: Name	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trading as Name	AM, C&C, CM, CSC	Mandatory	Critical	Highly Confidential
	Alias Names	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Driver's License	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Social Security Number	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Co-op Member ID	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Customer's Primary Language	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Special Conditions	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Spouse or Significant Other Names, Roommates	AM, C&C, CM, CSC, SAM, CC	Desirable	Standard	Highly Confidential
	Spouse or Significant Other Names, Roommates' Contact Information	AM, C&C, CM, CSC, SAM, CC	Desirable	Standard	Highly Confidential
	Customer Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Customer Mailing Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Deposit Information	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Theft and Tampering History (diversions)	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management; CM = Credit Management; PM = Portfolio Management; UCM = Usage/Consumption Management; RB = Rates & Billing; CSC = Customer Service & Care; SAM = Service Address Management; CC = Customer Choice; C&C = Customer Service & Care; MM = Meter Management; SOM = Service Order Management					
C1 – Customer Data (cont.)	Account(s) in Effect	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Banking Information	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Date of Birth	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Phone Number(s) (cell phone, unlisted phone, etc.)	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Email Address(es)	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Fax Number(s)	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Dangerous Animals/People/Situation	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Internal Use
	Confidentiality Requested	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	History Information by Account(s): Billing History	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Payment History	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Consumption History	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Product/Service History	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Customer Contact/Calls Information: Customer Response to Messages/ Inserts/Programs Customer Correspondence	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Open/Close Accounts	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Update Account Information	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	General Inquiry	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Billing Inquiry	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Complaints	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Credit Inquiry	AM, C&C, CM, CSC, SAM, CC	Mandatory	Critical	Highly Confidential
	Trouble Calls	AM, C&C, CM, CSC, SAM, CC	Desirable	Critical	Highly Confidential
	Customer Credit Information: Credit Profile	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Credit Checking	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Credit References	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Third Party/Guarantor/Co-signer	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Collections	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Notification and Cut-off for Non-payment	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Returned Checks (a credit perspective)	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	Payment Arrangements	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
	Bankruptcy	AM, C&C, CM, CSC, CC	Mandatory	Critical	Highly Confidential
	User's Comments	As Appropriate	Optional		Highly Confidential
Account Information					
A1 – Account	**Information in the account file is maintained or is associated with information from other data files.**				
	Account Name	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Information: Account Number	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Types	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Status	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Tax and Penalty Status	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Exemptions	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Collection Status	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Penalty	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Payment Arrangements	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Liens	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Customer Name/ID	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	County Parcel ID	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
A1 – Account (cont.)	• State • Zip Code				
	Land Parcel Number	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Special Codes (i.e., life-support)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Premise ID	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Customer Account Representative	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Customer Account Representative Contact Information	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Co-op Account Representative	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Internal Use
	Federal Business Identification Number	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	DBA (doing business as) Name	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	GIS X, Y Coordinate	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Account History Information: Payments Information History	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Consumption History	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Product/Services History	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	Service Order History (including turn-off)	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	Account Call/Contacts: Trouble Calls	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	Open/Close Accounts	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Update Account Information	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	General Inquiry	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	Billing Inquiry	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	Credit Inquiry	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Account Response to Messages/ Inserts/Programs	AM, RB, C&C, CM, CSC, UCM, CC	Desirable	Critical	Highly Confidential
	User's Comments	As Appropriate	Optional	Critical	Highly Confidential

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management; CM = Credit Management; PM = Portfolio Management; UCM = Usage/Consumption Management; RB = Rates & Billing; CSC = Customer Service & Care; SAM = Service Address Management; CC = Customer Choice; C&C = Customer Service & Care; MM = Meter Management; SOM = Service Order Management					
Service Address and Service Point Information					
P1 – Premise	**Service Address Information:** Premise or Location Number	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Account Name History	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Highly Confidential
	Keyword or Phrase/Name or Title (e.g., First Bank Building)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Highly Confidential
	Address (standard components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code	AM, RB, CC, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Intersecting Roads	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Internal Use
	Map Book Number Reference	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Geographical Location (X, Y coordinates)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Legal Parcel Number	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Internal Use
	Geopolitical Area (e.g., voting district, special tax district, census tract)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Read Route Number for Specific Services	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Internal Use
	Subdivision Name, Apartment Name, etc.	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Internal Use
	Date of Service for the Address	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Date First Meter Set	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Past and Present Classifications (regardless of meter status by service)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management; CM = Credit Management; PM = Portfolio Management; UCM = Usage/Consumption Management; RB = Rates & Billing; CSC = Customer Service & Care; SAM = Service Address Management; CC = Customer Choice; C&C = Customer Service & Care; MM = Meter Management; SOM = Service Order Management					
P1 – Premise (cont.)	Multiple Contact Information (third party) related to the service address. The owner, manager, management company, etc. may be contacted to provide access to the premise, verification of tenant move-in/-out dates, handling of returned mail, etc.	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Highly Confidential
	User-defined Premise Information	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Optional		
	Areas of the Premise Where Damage Claims Have Been Filed	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Service Address History: Meters/Equipment Located at a Premise/Account	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Previous and Present Accounts at a Premise/Account	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Highly Confidential
	Usage History (monthly and peak); Consumption and Billing/Payment	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Service Point (Premise) Information: Service Address/Premise ID	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Proprietary
	Non-metered Service Points at the Service Address: 1) Each service point's characteristics include GIS coordinates 2) Each service point's connectivity to distribution transformer	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Proprietary
	Metered Service Points at the Service Address: 1) Each service point's characteristics include GIS coordinates 2) Unique meter ID(s) for each meter 3) Each meter's connectivity to distribution transformer	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Proprietary
	Master Meters at a Service Address: 1) Each service point's characteristics include GIS coordinates 2) Unique meter ID(s) for each meter 3) Sub-meter connected – unique ID	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Proprietary
	Service Address Classifications at the Service Point	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Proprietary

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
P1 – Premise (cont.)	Past and Present Classifications of the Premise for the Service Point	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Rate(s) at the Service Point	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Co-op Order History for the Service Point	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	Consumption History at a Service Point (by meters and/or non-metered connection)	AM, RB, C&C, CM, CSC, SAM, UCM, CC	Desirable	Critical	Proprietary
	User's Comments	As Appropriate	Optional	Critical	Proprietary
Usage Information					
R1 – Rates & Billing	**Consumption/usage information, including time-of-use data by metered and non-metered service. Information entered by means of:** Manual Data Entry	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Hand-held Meter Data Collection Devices Data Entry via Computer Interface	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Automated Meter Reading (AMR) Data Entry via Computer Interface	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	Outsourced Meter Data Entry	AM, RB, C&C, CM, CSC, UCM, CC	Mandatory	Critical	Highly Confidential
	User's Comments	As Appropriate	Optional	Critical	Highly Confidential
Meter Information					
E1 – Equipment	**Meter Information:** Unique Meter ID	AM, RB, C&C, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Internal Use
	Meter Type	AM, RB, CC, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Internal Use
	Meter Size	AM, RB, CC, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Internal Use
	Meter Manufacturer	MM	Desirable	Critical	Internal Use
	Meter Manufacturer Model	MM	Desirable	Critical	Internal Use
	Meter Cost	MM	Desirable	Critical	Proprietary
	Purchase Order Number	MM	Desirable	Critical	Proprietary
	Delivery Date	MM	Desirable	Critical	Proprietary
	Warranty Information	MM	Desirable	Critical	Proprietary
	Test History	AM, CC, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Proprietary

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
E1 – Equipment (cont.)	Tested By	MM	Desirable	Critical	Proprietary
	Installation/Turn-on Date	AM, RB, CC, CM, MM, SAM, SOM, UCM	Desirable	Critical	Proprietary
	Installed By	MM	Desirable	Critical	Proprietary
	Remove Date	MM	Desirable	Critical	Proprietary
	Removed By	MM	Desirable	Critical	Proprietary
	Register ID Number (AMR)	MM	Mandatory	Critical	Proprietary
	Register Type (AMR/Direct Read)	RB, MM	Mandatory	Critical	Proprietary
	Meter Transceiver/Telemetering Interfaces	RB, MM	Mandatory	Critical	Proprietary
	Meter Constant/Stationary Dial	RB, MM	Mandatory	Critical	Proprietary
	Meter Status: • Inventoried • Received into Inventory • Deleted from Inventory • Service (active) • Service (inactive) • In Shop (meter shop) • Meter Stolen/Missing • Damaged • On Truck • Retired/Junked • Other Co-op Defined Status	AM, RB, MM	Mandatory	Critical	Proprietary
	Premise or Service Address	AM, RB, C&C, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Proprietary
	User's Comments	As Appropriate	Optional	Critical	Proprietary
Metering Equipment Information					
E1 – Equipment	**Equipment Information:** Unique Equipment Identification	MM, RB, SAM, SOM	Mandatory	Critical	Internal Use
	Premise or Location	MM, RB, SAM, SOM	Mandatory	Critical	Internal Use
	Equipment Type	MM, SAM, SOM	Mandatory	Critical	Internal Use
	Equipment Manufacturer	MM	Desirable	Critical	Internal Use
	Equipment Manufacturer Model	MM	Desirable	Critical	Internal Use
	Equipment Cost	MM	Desirable	Critical	Proprietary
	Purchase Order Number	MM	Desirable	Critical	Proprietary

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
E1 – Equipment (cont.)	Delivery Date	MM	Desirable	Critical	Proprietary
	Warranty Information	MM	Desirable	Critical	Proprietary
	Test History	AM, CC, CM, MM, SAM, SOM, UCM	Mandatory	Critical	Proprietary
	Tested By	MM	Desirable	Critical	Proprietary
	Installation/Turn-on Date	AM, RB, CC, CM, MM, SAM, SOM, C&C, UCM	Desirable	Critical	Proprietary
	Installed By	MM	Desirable	Critical	Proprietary
	Remove Date	MM	Desirable	Critical	Proprietary
	Removed By	MM	Desirable	Critical	Proprietary
	Equipment Status: • Inventoried • Received into Inventory • Deleted from Inventory • Service (active) • Service (inactive) • In Shop • Equipment Stolen/Missing • Damaged • On Truck • Retired/Junked • Other Co-op Defined Status	AM, RB, MM	Mandatory	Critical	Proprietary
	Premise or Service Address	MM	Mandatory	Critical	Proprietary
	User's Comments	As Appropriate	Mandatory	Critical	Proprietary
Portfolio Information					
S1 – Services	**Service Offerings Information:** Services Available for Each Class of Customer: Residential Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Industry/Commercial Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Multi-family Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Industrial Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Local Government and School Districts	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
S1 – Services (cont.)	Federal Government	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Irrigation Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Other Co-op Defined Classes of Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Program Offerings Information: Programs Available for Each Class of Customer: Residential Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Industry/Commercial Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Multi-family Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Industrial Customers	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Local Government and School Districts	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Federal Government	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Irrigation Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	Other Co-op Defined Classes of Customer	AM, RB, CM, CSC, PM, SOM, UCM, CC	Desirable	Critical	Internal Use
	User's Comments	As Appropriate	Optional	Critical	Internal Use
Order Information					
S1 – Services	**Information about the customer order for a predetermined retention period for each active and non-active account:** Service Orders	AM, RB, C&C, CSC, MM, PM, SAM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	Meter Orders	AM, RB, C&C, CSC, MM, PM, SAM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	Equipment Orders	AM, RB, C&C, CSC, MM, PM, SAM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	Collection Orders	AM, RB, C&C, CSC, MM, PM, SOM, UCM, CC	Mandatory	Critical	High Confidential

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)					
Data Grouping	**Data Description**	**Data Attributes**			
		Usage*	**Availability**	**Quality**	**Security**
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
S1 – Services (cont.)	Energy Audit Orders	AM, RB, C&C, CSC, PM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	Trouble/No Lights Orders	AM, C&C, CSC, PM, SAM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	Special Assistance	AM, RB, CSC, PM, SOM, CC	Mandatory	Critical	High Confidential
	Other (co-op defined)	AM, RB, C&C, CSC, MM, PM, SAM, SOM, UCM, CC	Mandatory	Critical	High Confidential
	User's Comments	As Appropriate	Optional	Critical	High Confidential
Rates and Charges					
R1 – Rates & Billing	**Rate classes, usage volumes, number of dwelling units, rate schedules, etc. for the following classes of customers:** Residential Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Commercial Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Multi-family Customer	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Industrial Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Wholesale Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Local Government and School Districts	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Federal Government	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Irrigation Customer	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Customer Classes Defined by the Co-op	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Service charges, program charges, etc. for the following classes of customers: Residential Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Commercial Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Multi-family Customer	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
R1 – Rates & Billing (cont.)	Industrial Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Wholesale Customers	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Local Government and School Districts	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Federal Government	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Irrigation Customer	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Customer Classes Defined by the Co-op	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Fees, Charges, Taxes, Surcharges Information: Interest Rate on Past-due Amounts	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Late Payment Charges (penalties)	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Security Deposit	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Returned Check Fees	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Reconnect Fees	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Permitting Fees	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Taxes	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	After-hours Fees	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Meter Tampering or Diversion Penalties or Fees	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Co-op Defined Categories	AM, RB, C&C, CM, CSC, PM, CC	Mandatory	Critical	Disclosed as Appropriate
	User's Comments	As Appropriate	Optional	Critical	Disclosed as Appropriate

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management					
Billing Information					
R1 – Rates & Billing	**Billing Category:** • Time-based Billing • Volume-based Billing • Other Co-op Categories	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Billing and Billing Option Policies: Time-based Billing Cycle	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Volume-based Billing Determinants	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Rebill an Adjusted Bill	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Final Bill	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Billing Due to Late and Early Reading	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Special Billings	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Cancel/Rebills for Consumption Corrections	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Co-op Determined Billing Options	AM, RB, CM, CSC, SAM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Payment Program Information: Prepayment	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Deferred Payment	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Landlord/Owner/Third Party	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Low-income Assistance	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Senior/Disabled Discount	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Bank Drafting or Credit Card Drafting and All Electronic Payments	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Co-op Defined Programs	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate

Continued

TABLE 3.2: Scope and Attributes of CIS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage*	Availability	Quality	Security
*** Usage Code:** AM = Account Management CM = Credit Management PM = Portfolio Management UCM = Usage/Consumption Management		RB = Rates & Billing CSC = Customer Service & Care SAM = Service Address Management CC = Customer Choice		C&C = Customer Service & Care MM = Meter Management SOM = Service Order Management	
R1 – Rates & Billing (cont.)	**Conditions for Non-Turn-off of Service:** Pre-determined Days (holidays, winter, summer, etc.)	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Weather (very cold – very hot)	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Payment Arrangements (automatic)	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Bankruptcy Proceedings – Pre-petition Account	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Fire-line Service (automatic)	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Life Support (automatic)	AM, RB, C&C, CM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	High Bill Investigation/Bill Disputes	AM, RB, C&C, CM, SOM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Re-Read Order Pending	AM, RB, C&C, CM, SOM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	Other Conditions as Defined by the Co-op	AM, RB, C&C, CM, SOM, UCM, CC	Mandatory	Critical	Disclosed as Appropriate
	User's Comments	As Appropriate	Optional	Critical	Disclosed as Appropriate

Data Source for Other Systems

The CIS database includes perhaps the most extensive integration with other systems at the cooperative. In addition to enabling core CIS functionality, CIS data also enable and provide key information for co-ops to offer additional services and products to both members and non-members. The functionality and systems dependent on CIS data typically include:

- Financial and Accounting Management, including Capital Credit Management
- Bill production and distribution
- Electronic Bill Presentment and Payment (EBPP), increasing customer self-service capability
- Customer Web Services (Customer ePortal), reducing demands on internal customer service staff
- Service Order Management (SOM), linking customers' requests directly to maintenance management
- Automated Meter Reading (AMR/AMI), initiating an electronic link between consumption and billing
- Interactive Voice Response (IVR), increasing customer self-service options and enhancing OMS effectiveness
- Electronic payment options (EFT, credit card, phone pay, web pay) management

- Customer Relationship Management (CRM), an extension of the core Customer Care/ Customer Choice functionality to further enable marketing of existing and design of new product/services to co-op defined customer segments
- Executive Information System (EIS), enabling consolidation and visualization of critical business and operational performance in a dashboards format
- Geographic Information System (GIS/Graphic Design System), providing customer, account, and service address/service point characteristics and historical information to enable core GIS and design functions
- Outage Management System (OMS), providing revenue meter and non-metered service connectivity information to enable out analysis
- Engineering Analysis (EA application), providing account/service point consumption load profile to enable circuit performance analysis

Data Maintenance Challenges

Interviews with customer service managers of small- to medium-sized co-ops (fewer than 15,000 customers) have indicated that most co-ops are satisfied with their core CIS functionality, including the quality of the data. All indicated that their co-ops have implemented programs to validate and improve the accuracy of the system data. The most common practice is to ask customers to provide their current contact information (telephone numbers—including cell phone, and all pertinent address information—including email addresses) whenever a customer contact is made. Customers usually identify data errors involving billing, which the co-op then corrects expeditiously when notified.

The challenges co-ops encounter in the operations and maintenance of a CIS include:

1. **System Upgrade or Change-out Decision.** Many co-ops are finding that their current CIS is either rapidly coming to the end of its technical life, being phased out by their vendors, or not having the desired functionality to support the changing utility environment, especially with the advent of the Smart Grid. Figure 3.3 summarizes the current

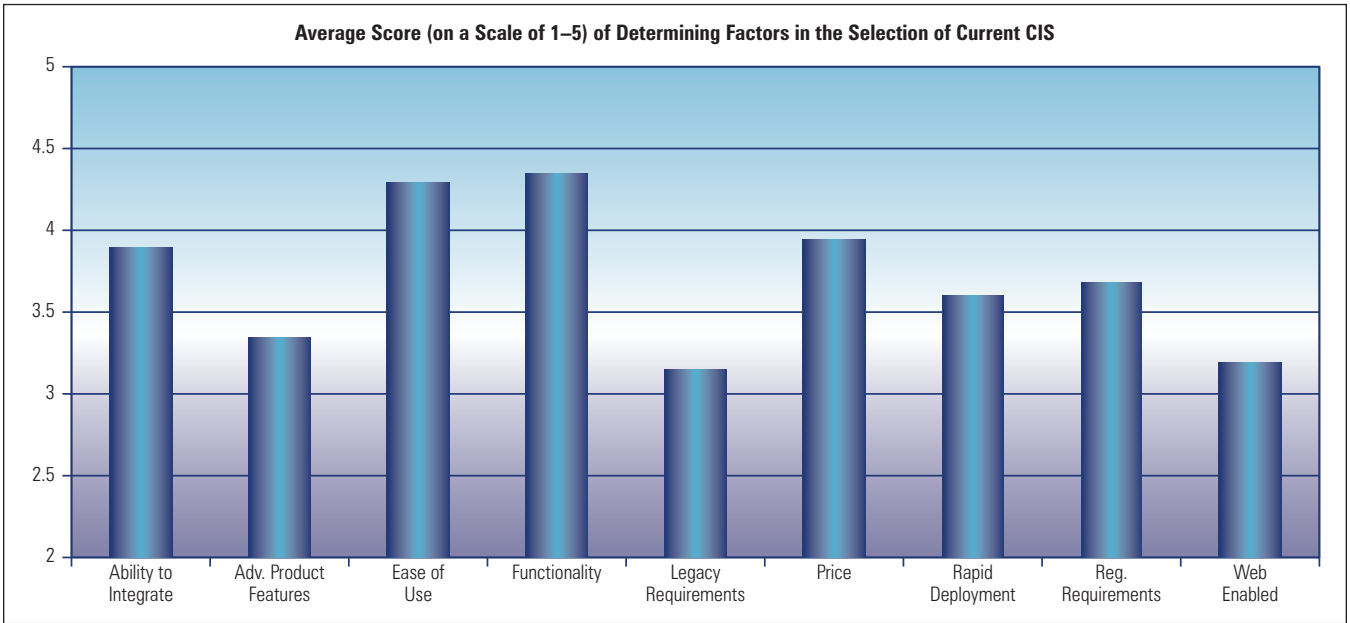

FIGURE 3.3: CIS Selection Factors. *(Source: UtiliPoint International, Inc.)*

determining factors utilities use as a basis for selecting a new CIS.

2. **Data Source Identification.** One of the first challenges in selecting a new CIS is to decide what new/additional functions should be added or exploited. In addition to the information stored in the CIS, co-ops often use spreadsheets and simple databases to capture additional customer and account information. The analysis of potential data sources for a CIS upgrade and functional extension includes matching the needs of the CIS users with source data availability. Having the appropriate data—either in paper or electronic format—to support such functionality is often the basis of this decision. Creating a data source description document (Data Source Matrix) with the assistance of the CIS vendor is a good first step in planning a CIS upgrade.
3. **Data Migration.** The challenge co-ops most often fail to take into account when planning a CIS upgrade or system change-out is to understand how the current CIS is storing critical data. Co-ops increasingly are finding that critical data, including account numbers, addresses, and account contact names, are stored as free-form text in comment fields instead of in the specific intended fields. Although this data storage practice is sufficient to support current CIS functions and experienced users of the existing system, it makes system upgrade and data conversion very difficult. While an automatic routine can be designed to extract and migrate the data correctly, it often is time-consuming, costly, and requires substantial manual re-work if conversion routines are not identified and designed in advance of the actual date conversion.
4. **Report Migration.** Most co-ops have developed a large number of standard and custom reports. Many of these reports were developed for ad-hoc purposes which are no longer in use or required. Since migration of reports from an existing to a new system is often costly and time-consuming, co-ops should carefully assess and evaluate which reports are still in use and thus required to be migrated to the new system. It should be noted that established CIS vendors have on file a large number of pre-formatted standard reports suitable for co-ops' uses. These standard reports often can be configured cost effectively to replace custom reports.
5. **Customers with Multiple Services Accounts.** CIS planners should conduct Service Address/Point Management carefully to ensure that service orders can be dispatched, the GIS can provide the correct service location, and OMS can correctly associate the specific service with the correct distribution transformer.
6. **Premise with Multiple Service Points.** An example of this case is a multi-use commercial/industrial complex with a single address but numerous services from one or more transformers. The challenges are similar to those of Number 5, customers with multiple services accounts. Service address/point delineation information must be recorded completely and accurately in the CIS.
7. **Customer Relationship Management System (CRM).** These are comprehensive systems that will help bring together information about customers, sales and marketing effectiveness, responsiveness, and market trends. Technology is a key component for CRM. Many utilities, including co-ops, have avoided the implementation of a CRM in the long-held belief that the traditional utility CIS provides adequate tools to manage customer relationships. With the proliferation of customer choice and the advent of the Smart Grid, utilities are rethinking the role of the CRM. When considering a CRM solution, a co-op needs to develop a detailed financial analysis to justify the implementation. Soliciting assistance from a competent consultant for such financial services is strongly recommended.

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4 CMMS Data

In This Section:

- Core CMMS Functionality
- The CMMS Solution Model—CMMS Integration with Other Systems
- Technology Solution—CMMS Options Available to Cooperatives
- CMMS Data—Data Definition and Quality
- Full-cycle CMMS Data Quality Management

A Computerized Maintenance Management System (CMMS) is a computer database of information about an organization's assets and maintenance history. The information within the CMMS is intended to help workers do their jobs more efficiently and help management make informed decisions (e.g., calculating the cost of maintenance for each piece of equipment used by the organization, possibly leading to better allocation of resources). The information also may be useful when dealing with third parties; for example, if an organization is involved in a liability case, the data in a CMMS database can serve as evidence that the co-op has performed proper safety maintenance.

Each industry has its own interpretation of how a CMMS can be used to more effectively operate its business—even within the same industry, there are many different interpretations of CMMS uses. From the perspective of the electric co-op, a CMMS helps to manage the full-cycle maintenance of transmission and distribution assets across the co-op's entire service territory, from planning and initiating activities to closing out and reporting maintenance performance.

Core CMMS Functionality

An asset management program for electric utilities typically consists of three integrated components: operations management, maintenance management, and planning/capacity management. Traditionally, a CMMS is deployed by utilities to support as well as automate the key maintenance management tasks.

Different CMMS packages offer a wide range of capabilities and cover a correspondingly wide range of prices. A typical CMMS package suitable for utility and co-op application includes some or all of the following:

- **Work orders (WO):** Scheduling jobs, assigning personnel, reserving materials, recording costs, and tracking relevant information, such as the cause of problems, any downtime involved, and recommendations for future action.
- **Preventive maintenance (PM):** Keeping track of PM inspections and jobs, including step-

4

by-step instructions or checklists, lists of required materials, and other pertinent details. Typically, the CMMS schedules PM jobs automatically, based on schedules and/or equipment counter readings. Different software packages use different techniques for reporting when inspection and maintenance tasks should be performed.

- **Asset management:** Recording data about equipment and property, including specifications, warranty information, service contracts, spare parts, purchase date, expected lifetime, and any other information that might be helpful to management or maintenance workers. The CMMS also may generate asset management metrics, such as the Facility Condition Index, or FCI.
- **Inventory control:** By means of interfacing with the utility Materials Management System (MMS), the CMMS coordinates the management of spare parts, tools, and other materials, including the reservation of materials for particular jobs, recording where materials are stored, determining when more materials should be purchased, tracking shipment receipts, and taking inventory.
- **Safety:** Management of permits and other documentation required for the processing of safety requirements. These safety requirements can include lockout-tagout, confined space, operations safety, and others.
- **CMMS packages:** These can produce status reports and documents giving details or summaries of maintenance activities. The more sophisticated the package, the more analytics are available.

With the advent of the Smart Grid, the maintenance management component of asset management plays an even greater role in utility operations. Many utilities are now looking at using maintenance management as the program to digest the large volume of asset condition and operations information made available by the automated Smart Grid technology. Instead of being a passive equipment database, CMMS increasingly are being considered for upgrade to support asset maintenance analysis on a pseudo-real-time basis.

ENABLING A COMPREHENSIVE ASSET MAINTENANCE PROGRAM

The role of CMMS within the electric utility industry has evolved from an asset information database to becoming the cornerstone of a structured asset management program, and often a fundamental element of a Smart Grid program. Although a CMMS often is deployed as a standalone system, many utilities have concluded that they can increase the effectiveness of an asset management program substantially when employing the CMMS in coordination with a suite of asset management systems, especially a GIS. It is common for utilities to designate the CMMS as the source of non-spatial asset information and depend on the GIS for spatial or location information. Together, CMMS and GIS form the complete asset information database. Many CMMS packages can be either web-based, meaning that they are hosted on an outside server by the company selling the product, or LAN-based, meaning that the company buying the software hosts the product on its own server.

MOBILE ENABLEMENT OF CMMS

Many utilities are extending office-based CMMS applications into the field and not deploying specialized field-based applications; thus, workers in the field will have access to the same CMMS data that they do in the office. The mobile CMMS module within the core CMMS solution is an excellent application for taking CMMS information into the field.

The CMMS Solution Model—CMMS Integration with Other Systems

Despite the relative maturity of CMMS technology, co-ops are only now beginning to understand and embrace the CMMS solution concept. Utilities that have deployed CMMS successfully generally agree that the solution can provide a means to analyze and objectively balance budgets for improvement programs such as:

- Reliability
- Customer service
- Speed of service
- Equipment lifecycle cost of ownership
- Equipment criticality determination
- Utilization of staff based on skill set
- Capital versus O&M expenditure optimization

DATA RELATIONSHIP WITH OTHER ASSET MANAGEMENT SYSTEMS

Table 4.1 identifies core CMMS functions and the other key asset management systems/applications a CMMS database can support.

INTEGRATION WITH OTHER SYSTEMS

CMMS typically has links or interfaces to the following systems:

- GIS/Staking or Graphic Design system for asset locations and connectivity
- Work Management System (WMS)/Mobile Workforce Management System (MWMS) for manual or automated maintenance work order initiation
- OMS to provide equipment maintenance and failure information
- MMS for coordination of asset inventory and spare parts
- Project or program management application for report generation

TABLE 4.1: CMMS Functionality and Data Relationships

	Function	CMMS Role	Primary Applications
1	Non-spatial asset database – Asset information, including asset specifications and history	Core CMMS Functions	CMMS
2	Asset maintenance program and maintenance activity management, including reliability-centered maintenance	Core CMMS Functions	CMMS
3	Inspection and maintenance order creation	Core CMMS Functions	CMMS
4	Inter- and intra-maintenance program (including regulatory) reporting	Source of non-spatial asset and maintenance program information	GIS/CMMS/Reporting systems
5	Facility/infrastructure inventory coordination with MMS	Core CMMS Function	CMMS – Non-spatial analysis GIS – Spatial analysis
6	Facility inspection/first response order initiation	Source of non-spatial asset information	CMMS – Asset information GIS – Asset location MWMS/WMS – Order generation
7	Vegetation management	Source of non-spatial inspection and maintenance information	CMMS – Program information GIS – Vegetation location
8	Facility map creation and maintenance	Source of non-spatial asset information	GIS
9	System planning – capacity and reliability analysis	Source of non-spatial asset capacity, operations, inspection, and maintenance information	EA Applications
10	Real-time and pseudo real-time asset operations analysis	Source of non-spatial asset maintenance, capacity, and loading/failure information	SCADA/DMS and EA Program
11	Outage management	Source of non-spatial asset information	OMS/DMS
12	System power quality analysis	Source of non-spatial asset information	CIS and CRM

4

Technology Solution—CMMS Options Available to Cooperatives

This section provides a broad view of various approaches to implementing a CMMS within the electric cooperative environment. It is not the objective of this report to provide an assessment of the functional and technical merits of specific vendor CMMS solutions.

CMMS SOLUTIONS FOR ELECTRIC COOPERATIVES

CMMS is an increasingly popular maintenance concept in asset-intense industries. While there are a plethora of CMMS applications in the marketplace today, more often than not they are costly and labor intensive to implement and maintain. In the large utility arena, the market is dominated by SAP, IBM, and Mincom, with their Enterprise Asset Management (EAM) solutions. In the smaller utility segment, the three big vendors very rarely use EAM solutions. Standalone CMMS solutions, such as Cascade (Digital Inspection) and CityWorks (Azteca), are gaining popularity, however. Both NISC and SEDC offer CMMS functionality/modules suitable for the co-op market as part of their co-op enterprise solutions. Whether co-ops choose to deploy a standalone system or expand their existing enterprise solution to incorporate CMMS functionality, they should validate the vendor's CMMS functionality to ensure consistency with the co-op's specific maintenance needs. The first challenge in selecting a CMMS is not to over-buy. Most established CMMS designed for the utility market are full featured and provide much more functionality than a co-op can feasibly utilize. Another challenge for co-ops deploying a CMMS solution is to decide how the CMMS functionality should be phased, and what software is best suited for such phased implementation. Soliciting assistance from a reputable asset management consultant in selecting the correct solution size is recommended.

Implementing a "lite" solution that focuses on the basic functions will allow co-ops to delay purchasing an expensive commercial off-the-shelf software (COTS) solution until they have the opportunity to scale up their CMMS program. Co-ops can choose to move to a fully featured solution at a later time, when sufficient asset data have been collected.

DATA REQUIREMENTS

From a data requirements perspective, it is important to note that the selection of different CMMS vendor solutions has very little impact on data requirements for solution implementation in an electric cooperative environment. Most major CMMS vendors have developed and deployment-tested similar electric data models that feature data structure and requirements consistent with MultiSpeak data specifications. If a CMMS model can support integration with GIS products and correlate asset characteristics to a physical location, it should be considered sufficiently robust and probably will support present and future cooperative needs.

CMMS Data—Data Definition and Data Quality

While the use of maintenance management functionality is more familiar at the substation level, CMMS should be considered a key to implementing a successful distribution asset management program. The asset information stored within a CMMS consists of both the Technical File (T1) that describes the characteristics of each asset and the Asset History (H1), as depicted in Figure 4.1. A prerequisite to performing quantitative analysis and trending is the development of a credible set of asset information that is both accurate and updated in a timely manner.

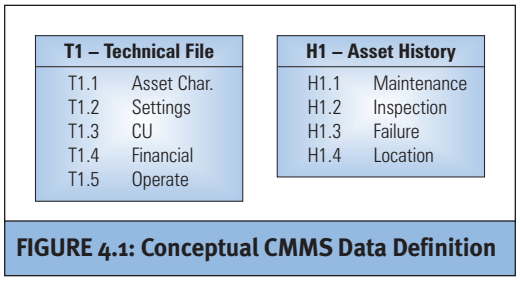

FIGURE 4.1: Conceptual CMMS Data Definition

CMMS STAGES AND ASSET CATEGORIES

Within the framework of an asset management program, utilities typically strive to manage the asset from distribution substation to customer revenue meters. The asset categories described in Table 4.3 currently are considered typical targets for utilities and co-ops implementing an asset management program. Non-spatial or location and connectivity information related to assets typically are stored in the CMMS, as depicted in Figure 4.1.

TABLE 4.2: CMMS Stages and Asset Categories		
CMMS Stage	**Asset Class**	**Implementation Recommendation**
1	Class A: Major substation equipment, including transformers, circuit breakers, regulators, and switches	CMMS Stage 1 represents an entry into CMMS and contains mainly substation-level assets. Co-ops wanting to deploy CMMS should consider this as an initial deployment step
	Class B: Controls and Apparatus: Control units inclusive of CTs, PTs, ancillary transformers, and wiring; i.e., regulator control, load tap changers, capacitor control, recloser control, sectionalizer control, relay control	
2	Class A: Substation control/protection and communications equipment: Substation protection relays, meters/recorders, Intelligent Electronic Devices (IEDs), Remote Terminal Units (RTUs), CPUs, communications equipment/radios	CMMS Stage 2 should be the co-op's target for deployment of a full-function CMMS
	Class B: Major line equipment (OH and UG): Switches (all types), capacitors, regulators, reclosers, line transformers, etc.	
	Class C: Poles and OH structures	
3	Class A: Revenue meter (self-contained and CT type)	CMMS Stage 3 represents an advanced asset management program for co-ops
	Class B: Substructures: Ductbanks/manholes, vaults, handholes, terminators/pedestals, etc).	
	Class C: Street and D/D lights: Poles/arms/luminaires/ bulbs/photocells and controls/wiring	
4	Class A: Primary cables and conductors	Using CMMS to manage CMMS Stage 4 asset classes is not recommended for cooperatives
	Class B: Ancillary line equipment (OH and UG): Cable elbows/taps/jumpers/risers/grounding (rods, wires, moldings), cross arms, guys and anchors, splices, bird guards, etc.	
	Class C: Secondary systems	

To effectively manage an efficient accounting system (for both assets and customers), as well as a maintenance and inspection program, co-ops should strive to identify and tag each asset under maintenance with a unique asset identifier. Examples of assets to be tagged with a unique identifier include poles, transformers, and switches. While the initial tagging of assets in the field may be viewed as a monumental task, in the long term it brings numerous benefits to the cooperative. Cooperatives have several options for starting a program to tag and GPS all assets:

- Engage a specialized firm
- Use internal resources—personnel on light duties
- Use the activity as filler work
- Address assets as they are replaced, maintained, or installed
- Use a combination of all approaches

Within the physical implementation of an asset management/CMMS system, the following unique identifiers may be used to identify a piece of equipment:

- Application-specific hidden key
- Manufacturer-provided equipment serial number (typically poorly suited as a corporate-wide asset reference number)
- Corporate common asset designation referenced on the asset in a numeric or alphanumeric code, barcode, or RFID tag

4

CMMS DATA ATTRIBUTES

The key role of the CMMS within the co-op is to provide an accurate accounting of the T&D electric network asset characteristics and historic information. Table 4.3 provides:

- The information on each class of asset under management typically included within the CMMS
- Data attributes for each grouping of assets under management
- Data attributes further defined as usage, availability, quality, and security requirements

The asset attributes presented in Table 4.3 are intended for each asset class the co-op decides to include in the CMMS. If the co-op decides to manage maintenance of all substation equipment (CMMS Stage 1, Class A), the data attributes depicted in Table 4.3 will need to be established in the CMMS separately for each asset class, including transformers, circuit breakers, regulators, and switches.

The Table 4.3 definitions of usage, availability, quality, and security requirements can be clarified further:

1. **Usage.** How will the CMMS data be used? Which CMMS and non-CMMS functionality will this set of data support?
2. **Availability.** How important is this data set to the successful implementation of a CMMS system?
   - *Mandatory* – This set of data is imperative to the implementation of a functional and effective system. It is independent of co-op size or level of technological sophistication.
   - *Desirable* – This set of data is recommended but can be provided at a later date with limited compromises to the initial CMMS implementation. It should be noted that some desirable core CMMS and non-CMMS functions may not be available until these data are provided. It should be the goal of every co-op to collect these pieces of data eventually.
   - *Optional* – Inclusion of this set of data with the CMMS implementation will provide added value but is not a necessity for the integrity of the core CMMS functions.
3. **Quality.** At what level of completeness, correctness, and currency must this set of CMMS data be maintained on a day-to-day basis? Experienced utility CMMS administrators perceive the difficulty of assigning a numerical value to determine data quality. Instead, data quality must be maintained at a level sufficiently high to ensure that users will utilize and depend on the CMMS for its intended functions.
   - *Critical* – A high quality level must be maintained to support critical CMMS and specialized non-CMMS functions. Experience gained from utilities with mature CMMS systems indicates that a data error rate of less than 2% must be achieved during initial system start-up and maintained continuously so as not to erode user confidence in using the CMMS.
   - *Standard* – This level of quality is usually assigned to data sets that support utility mapping and map information distribution functions. A data error rate of 10% or less is deemed sufficient by experienced CMMS administrators to maintain user confidence.

   It is important to note that the quality recommendations presented here are based on a statistical spread (even distribution) of error across the entire spectrum of asset data stored in a CMMS (manufacturers, sizes, name plate information, purchase order [PO] numbers, etc.). Therefore, a 2% data error rate in a CMMS asset data class means that 98% of all asset data stored in a CMMS within this data class are accurate and complete. This should not be interpreted as a 2% error rate in each CMMS attribute class or any particular class, such as transformer capacity and last maintenance date. For example, a 2% error in CMMS data does not mean that crews searching for a transformer size will not find it 2 out of 100 times or that the last maintenance information is incorrect.

See "**Full-cycle CMMS Data Quality Management**" (page 55) for further discussion on data quality, data maintenance recommendations, and industry best practices.

4. **Security.** What level of data security or accessibility should be maintained for this set of CMMS Data?
   - *Highly Confidential* – Highly sensitive information. Unauthorized disclosure of this information would cause exceptional damage. Examples include personnel information that could alienate a significant number of employees; commercially sensitive information; and information on significant security vulnerabilities, medical records, breaches of regulatory mandates, and confidentiality agreements.
   - *Proprietary* – Sensitive information. Disclosure of this information could cause harm to the cooperative and its employees or partners. Examples include information that would cause considerable embarrassment or loss of reputation or personnel records.
   - *Internal Use Only* – No loss of reputation or embarrassment will result from disclosure but the data owner may be inconvenienced. External parties may find this information useful as a stepping-stone for gathering more sensitive information. Examples include internal phone books and some policy documents.

TABLE 4.3: Scope and Attributes of CMMS Data in the Cooperative

Data Grouping	Data Description	Data Attributes			
		Usage	Availability	Quality	Security
CMMS Stage 1 • Asset Group A – Major substation equipment: Transformers, circuit breakers, regulators, switches, etc. • Asset Group B – Controls and apparatus: CTs, PTs, ancillary transformers, and wiring; i.e., regulator controls, load tap changers, capacitor controls, recloser controls, sectionalizer controls, etc. **CMMS Stage 2** • Asset Group A – Substation control/protection and communications equipment: Substation protection relays, meters/recorders, IEDs, RTUs, CPUs, communications equipment/radios, etc. • Asset Group B – Major line equipment (OH and UG): Switches (all types), capacitors, regulators, reclosers, line transformers, etc. • Asset Group C – Poles and OH structures **CMMS Stage 3** • Asset Group A – Revenue meter (self-contained and CT type) • Asset Group B – Substructures: Ductbanks/manholes, vaults, handholes, terminators/pedestals, etc. • Asset Group C – Street and D/D lights: Poles/arms/luminaires/bulbs/photocells and controls/wiring					
1 – Asset Technical Data	1. Asset Type	Data to enable CMMS functions and support other asset and operations management applications, including GIS, OMS, EA, and Staking/Graphic Design	Mandatory	Critical	Proprietary
	2. Asset ID		Mandatory	Critical	
	3. Purchase Order ID		Desirable	Standard	
	4. Environmental-related Information		Desirable	Critical	
	5. Utility Standard (page and ID)		Desirable	Critical	
	6. Manufacturer Identification (make, model)		Mandatory	Critical	
	7. Manufacturer Catalog and Serial Numbers		Optional	Standard	
	8. Rating with Operating Parameters (utility and manufacturer)		Mandatory	Critical	Highly Confidential
	9. Manufacturer Date		Desirable	Standard	
	10. Utility Acceptance/Received Date		Desirable	Standard	

Continued

TABLE 4.3: Scope and Attributes of CMMS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes			
		Usage	Availability	Quality	Security
	11. Manufacturer Warranty		Optional	Critical	Proprietary
	12. Operational Instructions		Mandatory	Critical	
	13. Maintenance Instructions		Mandatory	Critical	
	14. Parts List (material, design, assemblies)		Mandatory	Critical	
	15. Construction Unit (CU)		Desirable	Critical	
H1 – Asset Historic Data	1. Current and Historical Work or Functional Location (date, WO, etc.)	Data to enable Stage 1 core CMMS functions and to support other asset and operations management applications, including GIS, OMS, EA, and Staking/Graphic Design	History: Desirable Forward info collection: Mandatory	History: Standard Forward info collection: Critical	Proprietary
	2. Delivery Date and Receiving Location		Optional	Standard	Highly Confidential
	3. Settings		History: Desirable Forward info collection: Mandatory	History: Standard Forward info collection: Critical	
	4. Maintenance Program		Mandatory	Critical	Proprietary
	5. Inspection Results/History (date, WO, etc.)		History: Desirable Forward info collection: Mandatory	History: Standard Forward info collection: Critical	Highly Confidential
	6. Maintenance Results/History (date, WO, etc.)		History: Standard Forward info collection: Mandatory	History: Standard Forward info collection: Critical	
	7. Operations Counters		History: Standard Forward info collection: Mandatory	History: Standard Forward info collection: Critical	Proprietary
	8. Failure (including specific failed component)		History: Standard Forward info collection: Mandatory	History: Standard Forward info collection: Critical	Highly Confidential
	9. Defect (including specific defective component)		History: Standard Forward info collection: Mandatory	History: Standard Forward info collection: Critical	

Full-cycle CMMS Data Quality Management

This section provides a series of industry lessons learned and best practices to support full lifecycle CMMS data management. Recommendations for best practices and lessons learned are provided at each phase of the data lifecycle.

Implementing a CMMS system is fundamentally different from implementing other data-intensive software systems, such as GIS and CIS, in the following ways:

- CMMS implementation can be phased effectively without compromising the system's integrity. Therefore, co-ops can start managing the maintenance of a selected class of asset, such as substation transformers or circuit breakers in a CMMS, without having to convert all other maintenance activities to the system. Other asset classes can be added as data are collected and added to the CMMS. This phased approach often is preferred by utilities and co-ops implementing a CMMS.
- The analytics of a CMMS, while dependent on historic performance and maintenance data, can be functional with only a minimal data set and often without historical data. Certain CMMS functions, such as Reliability Centered Maintenance (RCM), may not be available to the co-op until historical data are entered into the system. This deployment approach will allow co-ops to start deploying a CMMS at the same time they are initiating a data collection program without compromising the integrity of the CMMS.
- Additionally, initial data load and data acceptance processes often are less complex and time intensive because CMMS data conversion can be effectively phased to reduce the level of staff requirements.

The CMMS has a similar data lifecycle to the GIS, as identified in Figure 2.5.

INITIAL DATA LOAD

Data Model

The initial data load phase includes activities that vary from the selection of the asset class to be managed to the actual asset data conversion, migration, and field data collection. Most major CMMS vendors have credible data models. When selecting a target data model, cooperatives should require, at a minimum, that sufficient data will be captured in the model to perform the function desired by the co-op.

Recommendation

Table 4.3 lists the asset classes that can be maintained effectively using CMMS. The selection of the asset classes for maintenance at the point of initial CMMS implementation often depends on the available asset characteristics and maintenance information. Unless otherwise motivated, co-ops should focus on selecting the asset classes for which they have maintenance information on file as the initial step to implementing the CMMS.

Data Conversion/Data Capture

The first step of the data conversion/data capture process is identifying who will identify the data to be converted, based on their knowledge of the organization and its needs. The resources assigned to this task will be employees who are knowledgeable about the business functions and workflows of the organization and know the location of certain source information.

Recommendation

It is strongly recommended that potential CMMS users within the co-op be responsible for identifying the data they require to perform their function within the organization and the data they need for supporting future functions. This approach makes the CMMS functionality design user driven and therefore more readily accepted.

Identifying Sources of Information to be Converted. Most co-ops have in place a series of pre-defined maintenance programs with information recorded in various forms of documentation. Often spreadsheets and simple databases are used to capture asset- and equipment-specific and maintenance information, even though there may not be a link between the program planning and the results or the consequences of the program's effectiveness. The analysis of potential data sources for a CMMS implementation includes matching the needs of the CMMS users with source data availability.

Existing Data Sources. It is important that those individuals within the co-op responsible for preparing the initial data conversion and other planning activities conduct a thorough analysis of the existing assets and information that will become inputs in the data conversion process. Any manual card files, tabular records, existing

digital data, or other available information that could be of value to the data conversion effort must also be included in this preconversion analysis. The fundamental objective of the analysis is to prevent surprises later.

New Data Sources. Another key task in the CMMS data conversion/capture phase is identifying source data that need to be created. For the CMMS initial implementation, co-ops most likely will find that much of the needed information, especially performance history, is not available. Co-ops should implement a structured CMMS data collection program so that there will be a continuous collection of asset characteristics, maintenance, and history information.

The data conversion/data capture phase for a typical CMMS implementation includes the following activities:

- Digital-to-digital data migration of all electronic data sources
- Paper-to-digital conversion of all non-electronic data sources
- Capture of new asset and maintenance information

Recommendation

Keep on working. For co-ops, implementation of a CMMS should be considered a work in progress. After the initial conversion of the existing data into the CMMS has been completed, new data entry can be as simple as entering a small amount of information on a regular but structured basis. Over time, the CMMS will get populated. Some co-ops enter the information when confronted with the need to perform maintenance on a specific piece of equipment. Others elect to populate the CMMS all at once. Any of these methods work. The important point is to develop a culture in which maintenance personnel want the system to succeed. Achieving this can be one of the surest avenues to success.

Recommendation

New asset data collection is conducted most effectively when the asset undergoes inspection and/or maintenance. This data collection methodology will ensure that the required data for all individual assets within the asset class can be collected within a maintenance cycle (period).

Recommendation

Conduct data scrub or preparation of all the source data before the data conversion activities begin. All source data should be retrieved from storage, verified and updated, cross-referenced with indices, copied, and packaged. Co-ops often find collecting, verifying/updating, organizing, and copying information to be time-consuming. Therefore, these activities should be performed in phases as the data conversion project progresses. Data scrub also includes improving clarity. Many maps and records may need extensive work to make them legible and clear before the data conversion process can proceed.

DATA ACCEPTANCE

During this phase of the data lifecycle, the CMMS administrator will act as the team leader to review the data set produced during the data conversion/data capture phase. The administrator will determine whether the data have been migrated, converted, or field captured accurately and completely. Data QA/QC procedures usually are performed to assist the administrator in determining whether the data produced meet the objectives of the program. The QA/QC procedures typically consist of:

- Automated QA/QC
- Manual QA/QC
- Field validation

Automated QA/QC. Depending on the volume of data co-ops convert initially—or at another time—automated software QA scripts can be established to validate the CMMS data integrity. Users can run automated QA/QC tests on demand or these tests can be triggered to run automatically as configured, typically upon posting to a master CMMS database.

Automated test routines for most CMMS data conversion/data capture projects typically include:

- Check if data have been populated in the required/intended CMMS data fields
- Check that data converted are in the prescribed format and of the proper resolution (free-form data field, address field, number fields, etc.)
- Check if there are any data blocks (range) missing

- Check that the converted data are within prescribed numerical range (dates range, number strings, work order numbers, etc.)
- Check that attributes containing calculated values correspond to the values resulting from the application of the appropriate formula or algorithm

These scripts typically are executed to validate the ongoing integrity of the CMMS data as well.

Manual QA/QC. For a time-phased implementation of the CMMS in which a small amount of data are to be converted at a time, manual QA/QC is sufficient and often most effective. Those co-op personnel who prepared the initial data sources should compare CMMS database printouts to the source documents to verify that the data converted accurately.

Field Validation. Co-ops may want to conduct field validation to supplement the automated and manual QA/QC processes in situations where asset attributes requiring verification do not appear on graphic check plots or specific asset data originate via field inventory. Field validation also is recommended where there are no automated test routines available to validate a particular set of data attributes.

Recommendation

Lessons learned from CMMS implementations indicate that a high level of initial data quality is critical to ensure long-term user acceptance and confidence in the system. CMMS administrators agree that users' acceptance and confidence is difficult to regain if they receive a poor first impression of a CMMS. It is recommended that the co-op carefully develop a detailed set of data conversion/data capture QA/QC specifications with the assistance of the CMMS solution vendor, as appropriate. The converted data should be at least 95% free of error for those errors that can require manual validation and 100% accurate for errors that can be validated programmatically. These quality requirements are necessary to establish the initial credibility of the CMMS. The cooperative should maintain data to this level of accuracy throughout the life of the system.

Pilot Project. The basic concept of a pilot project is to convert a small set of asset data to assess if the data obtained from the pilot meet CMMS deployment objectives. Typical pilot objectives to be accomplished include the following:

- Test database structure and content
- Test suitability of sources
- Test document preparation and data cleansing activities
- Test data conversion process
- Test quality assurance process
- Test data acceptance process
- Confirm data conversion cost estimates and schedule

The development of a pilot plan generally coincides with the development of the data conversion specifications. The pilot plan amplifies each of the mentioned objectives and clearly delineates responsibilities.

Recommendation

A pilot project can be effective if co-ops decide to convert a large volume of data in a short period; timing of the completion is essential. The inclusion of one or more pilot projects is strongly recommended in any complex CMMS deployment because a properly developed pilot project also satisfies another need. It will take the users of the intended CMMS through a very valuable learning curve, allowing them to take the next step: a full implementation of the CMMS.

DATA MAINTENANCE AND CONTINUOUS IMPROVEMENT

The CMMS data enters the maintenance and continuous improvement phase of the data lifecycle with the successful conclusion of the data acceptance phase. Unlike the data conversion of a GIS implementation, may utilities and co-ops choose to implement a CMMS in stages (see "**CMMS Stages and Asset Categories**," page 50). In this case, there may be not a discrete conclusion of the data conversion phase. Rather, this conversion phase will be more like a work in progress, with blocks or classes of asset data converted and accepted at one time.

Similar to the implementation of other data-intensive software applications, the primary challenge in the data maintenance phase is determining how to maintain sufficient data quality to ensure user confidence. As previously identified in this report, the primary means of assessing the success of any CMMS is its user confidence and the willingness of users to depend on the data to support their everyday duties. It is imperative that a data quality maintenance and continuous improvement program be implemented so that management has a clear understanding of how the CMMS is performing and what actions could be taken to further improve user confidence.

Recommendation

Although automated (software) QA/QC tools (see "**Automated QA/QC**," page 56) can and should be executed periodically to assess data quality, it is imperative to establish a structured maintenance program to assess and improve data quality and solicit user feedback. This program should include:

- The establishment of a CMMS User Group—consisting of key users and the CMMS Administrator—to establish usage guidelines and share ideas about data/system improvement and enhancement and solicit periodic user feedback
- The execution of automated QA/QC procedures upon completion of data conversion of an asset class within a CMMS category, as well as bi-annually, using software solution and/or conversion services from vendor-provided tools (software)
- The provision of field operating guidelines understood by all stakeholders to ensure that any permanent changes/modifications to a CMMS asset and the conduct of inspection and maintenance task are reported to the CMMS Administrator within an agreed-upon period (three days is an accepted standard)
- The preparation of procedures to allow CMMS users and field personnel to report any data error/anomalies to the CMMS Administrator so that quick data correction can be made
- The provision of procedures to ensure that all inspection and maintenance personnel will field validate the CMMS data during any I&M activities. Data errors and anomalies should be reported to the CMMS Administrator when noticed, within a reasonable time period (two days is an accepted standard)

Recommendation

CMMS data should be updated within a reasonable time period—three working days following the completion of any maintenance order is a commonly accepted standard.

SYSTEM CHANGE/UPGRADE AND DATA MIGRATION

During the lifecycle of the CMMS and its data, system changes, upgrade, or even a migration to another vendor solution will occur. Planned and managed proactively, these changes should not impose any undue risk to the integrity of the CMMS.

Recommendation

The following procedures are recommended:

- **Software Upgrades.** The cooperative should follow the recommendations of the CMMS vendor, or the designer if the system is custom designed. It is recommended that the co-op back up all databases before performing any software upgrade or system acceptance test to validate system performance.
- **System Changes Involving Data Sharing with Other Application(s).** The cooperative should carefully consult with both the CMMS and the new application vendor and request that a detailed project plan be developed jointly. The co-op should then follow the recommendations of the vendors. Adhering to standards published by MultiSpeak usually will minimize many integration risks. It is recommended that the co-op back up all databases before any system changes or performing system acceptance tests.
- **Migration to a Different System/Solution.** The co-op should seek and follow the recommendations of the new solution vendor. As migration to a new solution usually requires the migration of all CMMS data to a new data store/model, it is recommended that the cooperative re-evaluate and once again implement the series of procedures presented in this report.

5 OMS Data

In This Section:

- **OMS Data Definition**
- **OMS Data Characteristics and Asset Categories**
- **OMS Data Attributes**
- **OMS Data Load**
- **Common OMS Data Challenges**

Co-ops implementing or operating an Outage Management System (OMS) should recognize that the accuracy of the OMS functions can only be as accurate as the source data provided. The data must include the link from customer to transformer and the connectivity to substation. It is strongly recommended that cooperatives retain professional services to migrate all facilities and landbase information into the target OMS data models.

OMS Data Definition

The asset information stored within an OMS consist of the Technical File (T1), which describes the characteristics of each asset; the Network System (N1), which depicts system connectivity; Landbase (L1), which provides geographic references; Customer (C1), which provides customer information; and Administrative (A1), which provides operations, crew, and safety information.

These categories of data are illustrated in Figure 5.1.

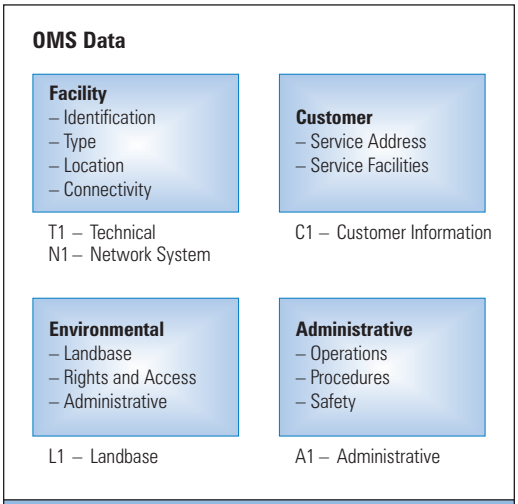

FIGURE 5.1: Conceptual OMS Data Definition

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OMS Data Characteristics and Asset Categories

The OMS database is mostly a warehouse of facility connectivity and customer information. This information is not created in the OMS database, however. Such information typically is downloaded into the database from other systems to support system functionality on a real-time or non-real-time basis. Within the framework of the outage management program, utilities typically strive to automate outage identification, notification, and restoration dispatch from distribution substation to customer service point. The attributes, types, and sources of data required to enable an OMS described in Table 5.1 currently are considered typical targets for utilities and co-ops implementing such a system. It should be noted that OMS is a critical operations support system, in that it requires real-time information.

TABLE 5.1: OMS Data Source Matrix

Information Class	Attributes	Type	Source
T1 – Technical Data	Network Facility Characteristics	Non-real-time	GIS
N1 – T&D System Data	As-designed Network Facility Connectivity	Non-real-time	GIS
	As-operated Network Facility Connectivity	Real-time	GIS, SCADA, CIS, PMU, Smart Meter (MDM) Manual information entry
	Line Switch Status	Real-time	SCADA
	Line Protection Devices (circuit switchers, reclosers, etc.)	Real-time	SCADA
	Substation Circuit Breaker Status	Real-time	SCADA
	Network Status	Real-time	PMU/SCADA
C1 – Customer Data	Name and Service Information	Real-time and Non-real-time	CIS
	Outage Call Information	Real-time	CIS
	Automated Call Information	Real-time	IVR Interface/Integration
	Service Point (smart meter) Status	Real-time	CIS and MDM
L1 – Landbase	Landbase Data	Non-real-time	GIS
A1 – Administrative	Operating Standards and Policies	Non-real-time	Manual information entry or links to source files

OMS Data Attributes

The key role of the OMS within the co-op is to give an accurate accounting of the T&D electric network and customer service point connectivity information. Table 5.2 provides:

- The electrical facilities and infrastructure information typically required to enable operation of an OMS
- Attributes for each grouping of OMS data
- Data attributes further defined as usage, criticality, quality, and security requirements

The definitions of usage, availability, quality, and security requirements in Table 5.2 can be clarified further:

1. **Usage.** How will the OMS data be used? Which OMS functions will this set of data support?
2. **Availability.** How important is this data set to the successful implementation of an OMS system?
   - *Mandatory* – This set of data is imperative to the implementation of a functional and effective system. It is independent of co-op size or level of technological sophistication.
   - *Desirable* – This set of data is recommended but can be provided at a later date with limited compromises to the initial OMS implementation. It should be noted that some desirable core OMS functions may not be available until these data are provided. It should be the goal of every co-op to collect these pieces of data eventually.
   - *Optional* – Inclusion of this set of data with the OMS implementation will provide added value but is not necessary for the integrity of the core OMS functions.
3. **Quality.** At what level of completeness, correctness, accuracy, and timeliness must this data set be maintained on a day-to-day basis? Experienced utility OMS administrators perceive the difficulty of assigning a numerical value to determine data quality. Instead, data quality must be maintained at a level sufficiently high to ensure that the OMS can function effectively and accurately. It is imperative that safety surrounding service restoration tasks based on the OMS information not be compromised by poor data quality.

   It is important to recognize that, as an operations support system, the OMS depends on some real-time information to enable its functionality. Data quality must be expressed in two categories.

   a. ***Timeliness*** – This data quality category describes the promptness with which data are made available to OMS:
      - *Real-time Data* – This data set must be available to the OMS system in real time to support OMS functionality, typically via system interfaces.
      - *Near Real-time Data* – This data set must be available within a short period of time to support OMS functionality. The industry standard is to make near real-time data available to the OMS via scheduled batch runs hourly or semi-hourly.
      - *Non-real-time data* – The industry standard is to provide non-real-time data to the OMS via scheduled batch runs, as deemed adequate by the OMS system administrator, typically weekly.

   b. ***Accuracy*** – This quality category describes the completeness, correctness, and accuracy of data made available to the OMS. Data quality should be maintained at the original source system, as depicted in Table 5.1, OMS Data Source Matrix.
      - *Critical* – A high data quality level must be maintained to support critical OMS functions. Experience gained from utilities with mature OMS systems indicates that an error rate of less than 2% must be achieved during initial system start-up and maintained continuously to ensure that the OMS can function correctly.
      - *Standard* – This level of quality is usually assigned to data sets that provide location references and are not critical to support core OMS functions. A data error rate of 10% or less is deemed sufficient by experienced OMS administrators to maintain user confidence.
4. **Security.** What level of data security or accessibility should be maintained for this set of CMMS data?
   - *Highly Confidential* – Highly sensitive information. Unauthorized disclosure of this information would cause exceptional damage. Examples include personnel information that could alienate a significant number of employees; commercially sensitive information; and information on significant security vulnerabilities, medical records, breaches of regulatory mandates, or confidentiality agreements.
   - *Proprietary* – Sensitive information. Disclosure of this information could cause harm to the cooperative and its employees or partners. Examples include information that would cause consider

able embarrassment or loss of reputation, or personnel records.

- *Internal Use Only* – No loss of reputation or embarrassment will result from disclosure but the data owner may be inconvenienced. External parties may find this information useful as a stepping-stone to gathering more sensitive information. Examples include internal phone books and some policy documents.

TABLE 5.2: Scope and Attributes of OMS Data in the Cooperative

Data Grouping	Data Description	Data Attributes				
		Usage	Availability	Quality		Security
				Timeliness	Accuracy	
Facility Information from GIS						
T1 – Asset Technical Data	• Poles	To provide physical reference for network facility location	Desirable	Non-real-time information	Standard	Proprietary
	• Cables	To establish electric facility network connectivity	Mandatory	Non-real-time information	Critical	Proprietary
	• Conductors	To establish electric facility network connectivity	Mandatory	Non-real-time information	Critical	Proprietary
	• Substructures – ductbanks/ manholes, vaults, handholes, terminators/pedestals, etc.; Note: underground structures to have a concept of connectivity	To establish electric facility network connectivity	Desirable	Non-real-time information	Critical	Proprietary
	• Line Equipment (OH and UG) – transformers	To establish electric facility network connectivity	Mandatory	Non-real-time information	Critical	Proprietary
	• Line Equipment (OH and UG) – capacitors, regulators, etc.	To establish electric facility network connectivity	Desirable	Non-real-time information	Critical	Proprietary
	• Switching Equipment (OH and UG) – switches (all types)	To identify network switching (isolation and tie) points	Mandatory	Non-real-time information	Critical	Proprietary
	• Protection Equipment (OH and UG) – fuses/reclosers/network protectors, etc.	To enable OMS prediction of outage	Mandatory	Non-real-time information	Critical	Proprietary
	• Revenue Meter (self-contained and CT type) – information to include service location and connectivity to service (distribution) transformer	To establish meter service point location and electrical connectivity	Mandatory	Non-real-time information	Critical	Proprietary
Connectivity Information from GIS						
N1 – Network System Data	Configurations, Connectivity, and Parameters: • As designed	To establish electric facility network connectivity	Mandatory	Non-real-time information	Critical	Proprietary
	Configurations, Connectivity, and Parameters: • As operated (temporary) if available in GIS	To establish basis to formulate as-operated electric facility network connectivity	Optional	Non-real-time information	Critical	Proprietary

Continued

TABLE 5.2: Scope and Attributes of OMS Data in the Cooperative (cont.)

Data Grouping	Data Description	Data Attributes				
		Usage	Availability	Quality		Security
				Timeliness	Accuracy	
Customer Information from CIS						
C1 – Customer Data	1. Service Addresses (geographic reference) 2. Service Facilities (transformer, meter, service drop, etc.)	To establish customer service point/location and electrical connectivity	Mandatory	Non-real-time information	Critical	Highly Confidential
	Service Turn-off (nonpayment, change of account, etc.)	To prevent errant outage log-in if reported by customer	Mandatory	Real- or near-time information	Critical	Highly Confidential
	Outage Call Taking	To enable outage log-in and trigger	Mandatory	Real-time information	Critical	Highly Confidential
Spatial Information from GIS						
L1 – Landbase Data	• Topography w/Contours • GPS Control Points • Streets • Parks (federal, state, city/county) • Federal Land • Communities/Municipalities • Reference Maps (lots, legal monuments) • Quarter-section Grid • Indian Reserves • Easements • Leases • Photographic Images • Transportation • Governmental and Federal Boundaries • License Areas • Franchise Area • Operating Districts • Flood Lines • Catchment Basins • Resource Areas • Hydro • Geotechnical • Non-electrical Utility Infrastructure • Ecological • Meteorological • Property and Land Use	To provide physical location reference to network facilities Landbase attributes presented in this data set are typical of a GIS system landbase; depending on the OMS solution selected, the OMS may require only a subset of this data to establish physical location references	Mandatory	Non-real-time information	Standard	Internal Use
Customer Information from IVR						
C1 – Customer Data	Automated Outage Call Taking	To enable automated outage log-in and trigger	Optional	Real-time-information	Critical	Highly Confidential

Continued

TABLE 5.2: Scope and Attributes of OMS Data in the Cooperative (cont.)						
Data Grouping	**Data Description**	**Data Attributes**				
		Usage	**Availability**	**Quality**		**Security**
				Timeliness	**Accuracy**	
Network Information from SCADA						
N1 – Network System Data	Switch Status (on/off and tagging)	To establish as-operated network connectivity	Desirable	Real-time-information	Critical	Highly Confidential
	Substation Circuit Break Status (on/off and tagging)	To enable automated outage log-in and trigger	Desirable	Real-time-information	Critical	Highly Confidential
	SCADA Controlled Line Protection Devices (circuit switchers, reclosers, etc.) Status (on/off and tagging)	To enable automated outage log-in and trigger	Desirable	Real-time-information	Critical	Highly Confidential
Administrative Information						
A1 – Administrative Data	Operations and Safety Policies	To enable automated generation of switch plans	Optional	Non-real-time information	Critical	Highly Confidential
	Crew Schedule and Crew Personnel Information	To enable crew assignment recommendations	Optional	Near real-time and non-real-time information	Critical	Highly Confidential

OMS Data Load

Implementing an OMS system is fundamentally different from implementing other data-intensive software systems such as GIS and CIS, in that the OMS database is mostly a warehouse of facility, connectivity, and customer information. Such information typically is downloaded into the OMS database from other systems to support system functionality on a real-time or non-real-time basis. OMS data load typically can be accomplished by:

- A means of performing the initial customer data load from the CIS into the proposed OMS data model.
- A means of performing the incremental customer data update from the CIS into the proposed OMS data model.
- A means of performing the initial network load of the electrical connectivity information from the GIS into the proposed OMS.
- A means of performing the incremental update of electrical connectivity information from the GIS into the proposed OMS.
- An interface with the CIS (or a specific outage call-taking application) and the proposed OMS application to enable the creation, modification, and deletion of trouble tickets.
- An interface with the IVR and the proposed OMS application to allow the IVR to create, modify, and delete trouble tickets.
- An interface between the IVR and the proposed OMS application to create callback lists based on restored outages.
- An interface between the IVR and the proposed OMS application to provide real-time feedback about outage status to IVR callers (i.e., whether or not they are part of an outage, estimated time of restoration, and outage status).
- An interface between the SCADA and the proposed OMS application to provide a real-time device status update.
- An interface between the PMU controller and the proposed OMS application to provide a real-time line status update.
- An interface between the CIS/MDM and the proposed OMS application to provide a real-time service status update.

Figure 5.2 illustrates how OMS data typically can be loaded from the CIS and GIS in a co-op environment.

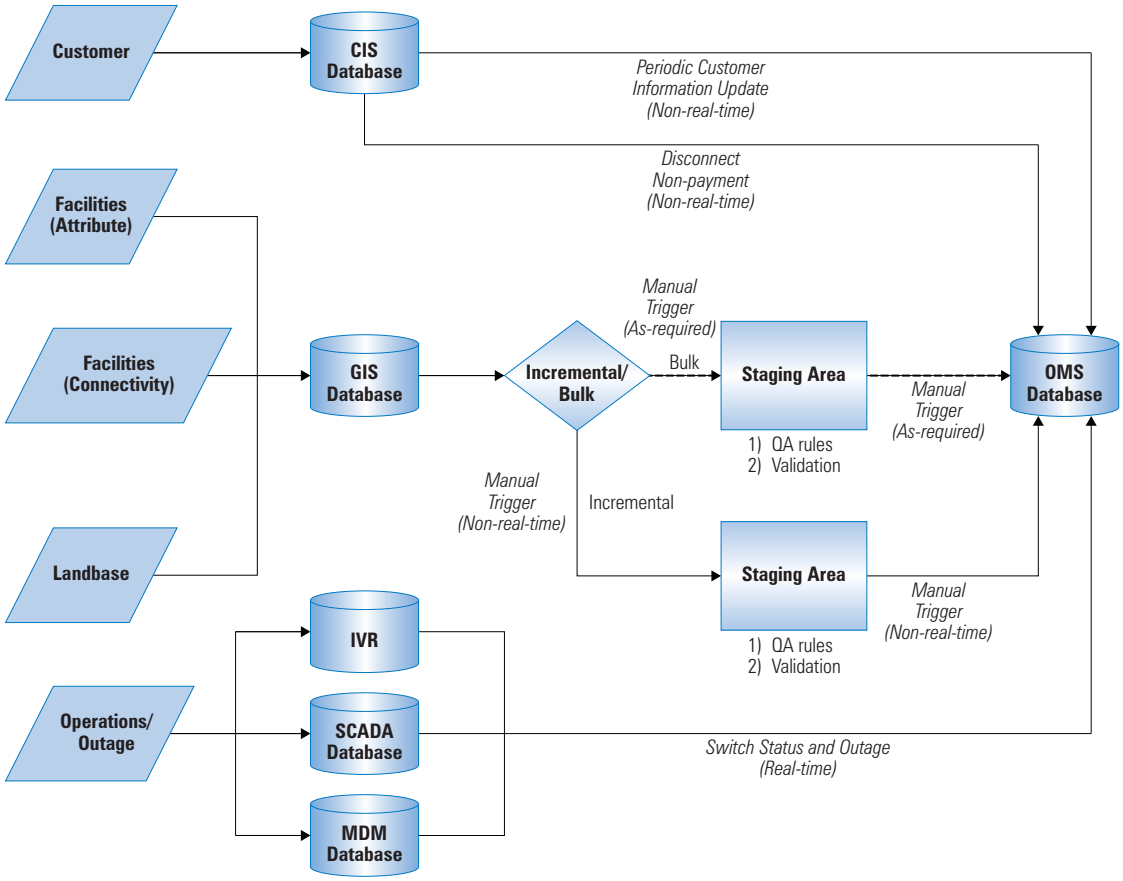

FIGURE 5.2: Typical OMS Data Load Scheme

Common OMS Data Challenges

Understanding the specifics of the OMS data limitations and challenges will give co-ops insights into how a data management program can be designed and implemented to enable effective OMS functionality.

Some of the challenges encountered by a typical OMS implementation are:

1. **Association of customer meters or service address (premise) to service (distribution) transformation.** The accuracy of OMS outage prediction is dependent on correctly associating premise/meter connectivity to distribution transformer. A large number of co-ops implementing OMS have found that this information often is missing from their CIS or GIS databases. Cooperatives can implement a simple software routine to establish connectivity information by associating premise/meter to the closing transformer. Although not perfect, when implemented on a regular basis, this software routine can improve connectivity information sufficiently to allow the OMS to function effectively.
2. **Customer with multiple services accounts.** The cooperative's CIS, IVR, and GIS must record clear service delineation information so that the OMS can associate the specific service (meter) with the correct transformer.
3. **A single premise with multiple service points.** An example of this is a multi-use commercial/industrial complex with a single address but numerous services from one or more transformers. This is similar to the pre-

vious challenge. Service delineation information must be recorded in the CIS, IVR, and GIS so that the OMS can associate the specific service (meter) with the correct transformer.

4. **Maintenance of accurate as-operated network connectivity information.** As-designed network connectivity information is stored in a GIS and periodically downloaded to populate the OMS database. To maintain an accurate snapshot of the current electrical network topology, the OMS operator updates the topology and stores all temporary system changes—such as switch closings and openings and load transfer from one circuit to another—in a network model called the as-operated network model. Care must be taken during the periodic OMS database refresh (information download from the GIS) so that the as-operated network change information is not overwritten and lost. Unless the GIS download application has been designed to accommodate retention of as-operated change information, this information will need to be re-entered to the OMS network model each time the OMS database is refreshed.

6 Common Mistakes

The initial implementation and subsequent upgrades of the GIS, CIS, CMMS, or OMS usually are complicated processes and require careful planning and execution. Often, ensuring ongoing data maintenance and subsequent system integrity are no less complicated. However, some co-ops, after the initial deployment of the system, fail to dedicate sufficient resources to "care and feed" for the system, and thus greatly diminish the return on their technical investments.

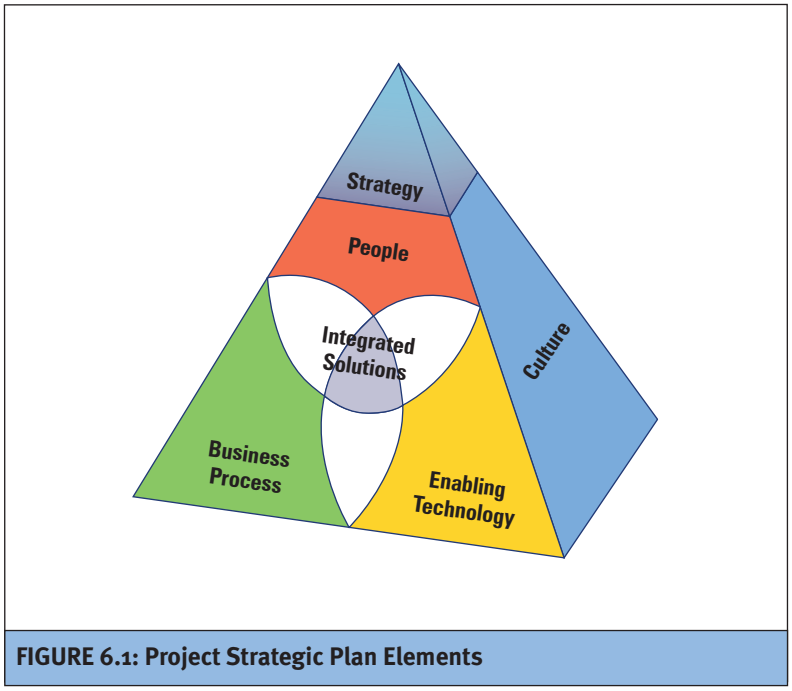

FIGURE 6.1: Project Strategic Plan Elements

Successfully implementing a system requires the establishment of a clear project strategic plan that considers the key co-op and technology attributes depicted in Figure 6.1.

Specific lessons learned, challenges, and recommendations for the deployment and maintenance of GIS, CIS, CMMS, and OMS are presented in the respective system sections of this report. In addition to facing the identified challenges, co-ops also need to be mindful of the mistakes common to these processes. The following is a list of common data-related mistakes cooperatives should avoid in the planning, deployment, and maintenance phases of a GIS, CIS, CMMS, or OMS program. These mistakes can lead directly or indirectly to the degradation of data quality and system integrity.

1. Not consulting a vendor or consultant when needing technical assistance for deployment planning and developing detailed system specifications.
2. Insufficient end-user involvement in system deployment and data maintenance planning; it is imperative that co-ops involve end-users to establish data quality criteria and system integrity expectations.
3. Insufficient resources assigned for adequate data quality maintenance.
4. Insufficient end-user training to maintain data quality.
5. Not establishing a clear scope of work and budgets in vendor contracts.

6

6. Insufficient or weak vendor contract terms and conditions for adequate risk management.
7. Not identifying system/data acceptance testing procedures and acceptance criteria.
8. Not performing system or data acceptance testing.
9. Not establishing clear specifications for system/data integration.
10. Insufficient planning to establish a complete system data model and identification of associated data sources.
11. Not performing data cleansing before loading data into system.
12. Not creating a project management plan to manage deployment risks.
13. Not performing field data inventory when adequate quality data are not available on existing records.
14. Not establishing a system and data maintenance program before deployment of system.
15. Too much customization to vendor's data model.
16. Creating too many customer reports and not fully utilizing "canned" vendor-supplied reports.
17. Length of system deployment or data migration schedule—the schedule is too long or too short; system deployment schedule is not optimized to adequately support data backlog maintenance.
18. Not implementing an organization change management program to manage user perceptions and acceptance of system data.

A GIS Data Self-Assessment

In addition to making network data available in the GIS, representation of the facilities' electric network in an accurate and secure manner is important. This section provides the cooperative with a template to assess the state of its GIS data in the areas of availability, quality, and security. This template is intended to be used as a data load guide for the initial GIS implementation, as well as for the assessment of data quality in an existing system in a continuous data quality improvement process. Green, Yellow, and Red light conditions are defined to enable the cooperative to identify data quality quickly in a measure relative to other cooperatives. To perform this assessment, it is recommended that the cooperative establish a committee, chaired by an objective third party (either internal or external). The committee should consist of all stakeholder groups. Each data area should be discussed openly, with a consensus being derived by the Chairperson. Using the committee will avoid a situation in which a cooperative's data assessment is biased by one or more individuals. The cooperative should strive for a healthy data assessment.

1. **Availability.** This attribute assesses the availability of the GIS data.
   - *Green Light* – This data set is included in the GIS and is available to GIS users.
   - *Yellow Light* – Current plan is underway to make these data available to GIS users within 12 months.
   - *Red Light* – The data set will not be available within 12 months, or the data are mandatory (based on Table 2.2) and are not present.
   - *NA* – Data are not applicable to the cooperative's GIS. There is no plan to provide this data set in the GIS.
2. **Quality.** This data attribute accounts for the completeness, correctness, and currency of GIS data.
   - *Green Light* – The GIS users have a high degree of confidence in this set of data. A data quality QA/QC plan is in place to assess and enhance data quality continuously.
   - *Yellow Light* – The GIS users do not have a high degree of confidence in this set of data. A data QA/QC plan with improvement milestones is in place to enhance the data quality.
   - *Red Light* – The GIS users do not have a high degree of confidence in this set of data. No plan has been established to improve the quality of this data set.
   - *NA* – This data set is not currently in the GIS.
3. **Security.** This attribute assesses whether adequate security procedures have been implemented to safeguard data content.
   - *Green Light* – The current data security procedures allow the co-op to maintain the necessary levels of data security.
   - *Yellow Light* – Security procedures are being developed to allow the cooperative to maintain the necessary levels of data security within 12 months.
   - *Red Light* – No security procedures are currently in place or being developed within 12 months to allow the cooperative to maintain the necessary levels of data security.

A

TABLE A.1: Self-assessment: Asset Information				
Data Grouping	**Data Description**	**Data Quality Assessment**		
		Availability	**Quality**	**Security**
Asset Information				
H1 – Asset Historic Data	Asset description, geographic location, and date of installation Note: • All assets, except items 1, 2, 6, 8, and 9, will have a unique identifier affixed to the asset and common across all information systems. • Each physical location of an asset will have a work or functional location identifier.			
	1. Poles			
	2. Conductors			
	3. Cables			
	4. Substructures – ductbanks/manholes, vaults, handholes, terminators/pedestals, etc.; note: UG structures have a concept of connectivity			
	5. Major Line Equipment (OH and UG) – switches (all types)/ fuses/capacitors/regulators/reclosers/transformers, network protectors, etc.			
	6. Ancillary Line Equipment (OH and UG) – cable elbows/taps/ jumpers/risers/grounding (rods, wires, moldings), cross arms, guys and anchors, splices, bird guards, etc.			
	7. Controls and Apparatus – control units inclusive of CTs, PTs, ancillary transformers, and wiring (i.e., regulator control, load tap changers, capacitor control, recloser control, sectionalizer control, relay control)			
	8. Secondary Systems			
	9. Customer-owned Motors, Generators (sufficient detail to model)			
	10. Revenue Meter (self-contained and CT type)			
	11. Street and D/D Lights – poles/arms/luminaires/bulbs/photocells and controls/wiring			
Connectivity and System History				
N1 – System Data	Configurations, Connectivity, and Parameters: • As designed • As operated (temporary)			
N1 – System Data	Protection & Coordination: • Substation Protection Relay Scheme and Settings • Circuits and Systems Sectionalizing Schemes			

Continued

TABLE A.1: Self-assessment: Asset Information (cont.)				
Data Grouping	**Data Description**	**Data Quality Assessment**		
		Availability	**Quality**	**Security**
N1 – System Data	Failures: • Incident Location • Isolation Devices and Location • Detailed Failure Codes • Corrective Actions • Remedy • Service Restoration Activities (incident/outage report) • Operations Impact (interrupted load, duration, etc.).			
N1 – System Data	Program: • Infrared Thermography Program • Annual Line Patrol Program • Overhead Line Maintenance • Underground Line Maintenance • Vegetation Management			
N1 – System Data	Operations: • Switching • Load Shedding • Maintenance			
N1 – System Data	Engineering and Analytical: • Load Flow & Loading (load, voltage, fault current, tie capacity/ reliability) • Load Balancing			
N1 – System Data	Engineering and Analytical: • Protection & Coordination			
Customer Information				
C1 – Customer Data	• Service Addresses (geographic reference) • Service Facilities (transformer, meter, service drop, etc.)			
Spatial Information				
L1 – Landbase Data	• Topography w/Contours • GPS Control Points • Parks (federal, state, city/county) • Federal Land • Communities/Municipalities • Reference Maps (lots, legal monuments) • Quarter-section Grid • Indian Reserves • Easements • Leases • Photographic Images • Transportation • Governmental and Federal Boundaries • License Areas • Franchise Area			

Continued

A

TABLE A.1: Self-assessment: Asset Information (cont.)				
Data Grouping	**Data Description**	**Data Quality Assessment**		
		Availability	**Quality**	**Security**
L1 – Landbase Data (cont.)	• Operating Districts • Flood Lines • Catchment Basins • Resource Areas • Hydro • Geotechnical • Non-electrical Utility Infrastructure • Ecological • Meteorological • Property and Land Use			

B Acronyms

AM	Account Management
AMI	Advanced Metering Infrastructure
AMPS	Asset Management & Planning System
AMR	Automated Meter Reading
API	Application Programming Interface
CAD	Computer Aided Design
CAD/MDT	Computer Aided Dispatch/ Mobile Data Terminal
C&C	Credit & Collection
CC	Customer Choice
CDM	Conceptual Data Model
CIM	Common Information Model
CIS	Customer Information System
CM	Credit Management/ Customer Management
CMMS	Computerized Maintenance Management System
COTS	Commercial-Off-the-Shelf Software
CP	Cathodic Protection Application
CPU	Central Processing Unit
CRM	Customer Relationship Management
CRN	Cooperative Research Network
CSC	Customer Service & Care
CT	Current Transformers
CU	Compatible Unit/ Construction Unit
D/D	Dusk to Dawn
DMS	Distribution Management System
EA	Engineering Analysis Application
EAM	Enterprise Asset Management
EBPP	Electronic Bill Presentment and Payment
EIS	Executive Information System
EMS	Energy Management System
ERP	Enterprise Resource Planning System
ESRI	Environmental Systems Research Institute
FCI	Facility Condition Index
GIS	Geographic Information System
GPS	Global Positioning System
GWD	Graphic Work Design
IED	Intelligent Electronic Devices
IG/SG	Intelligent Grid/Smart Grid
I&M	Inspection and Maintenance
IVR/IVRU	Interactive Voice Response Unit
MDMS	Meter Data Management System
M&I	Maintenance and Inspection
MM	Materials Management/ Meter Management
MMS	Materials Management System

B

MWMS	Mobile Workforce Management System
NISC	National Information Solutions Cooperative
NRECA	National Rural Electric Cooperative Association
OCR	Optical Character Recognition
OH or O/H	Overhead
OMS	Outage Management System
OVHD	Overhead
PM	Portfolio Management/ Preventive Maintenance
PO	Purchase Order
PT	Potential Transformers
QA/QC	Quality Assurance/ Quality Control
RB	Rates & Billing
RCM	Reliability Centered Maintenance
RFID	Radio-Frequency Identification
RTU	Remote Terminal Unit
SAM	Service Address Management
SOA	Service Oriented Architecture
SOM	Service Order Management
SCADA	Supervisory Control and Data Acquisition
SG	Smart Grid
UCM	Usage/Consumption Management
UG or U/G	Underground
UPN	UtilityPOWERnet (SEDC)
VRU	Voice Response Unit (IVRU)
WMS	Work Management System
WO	Work Order
XFMR	Transformer

C GIS Background Information

In This Section:

- GIS Trends—A Review of Current Industry Directions
- The GIS Solution Model—GIS Integration with Other Systems
- Technology Solution—GIS Options Available to Cooperatives

GIS Trends—A Review of Current Industry Directions

Using a commercial-off-the-shelf (COTS) GIS solution is the most effective way for electric cooperatives to deploy GIS because COTS solutions offer significant savings in implementation, upgrades, evolution, and ongoing maintenance, as compared to in-house developed solutions. COTS generally refers to software that is ready-made and available for sale, lease, or license to the general public. COTS GIS applications often are used as alternatives to in-house development.

A GIS captures, stores, analyzes, manages, and presents data that are linked to location. The location is referenced by an X, Y coordinate that relates to some real-world location, and in some cases includes an elevation. A GIS includes a location-referenced database, mapping software, and associated applications to provide functionality related to land surveying, aerial photography, mathematics, geography, and data maintenance. In the strictest sense, the term GIS describes any information system that integrates, stores, edits, analyzes, shares, and displays geographic information. In a more generic sense, GIS applications are tools that allow users to create interactive searches, analyze spatial information, edit data, create maps, and present the results of all of these operations. In summary, a GIS merges graphic entities and databases.

Each industry has its own interpretation of how a GIS can be used to operate its businesses more effectively. Even within the same industry, there are many different interpretations of how a GIS can be used. From an electric cooperative perspective, a GIS helps to manage transmission and distribution assets across a large geographic area.

CORE GIS FUNCTIONALITY

Electric utilities were among the first users of GIS technology. Today, geospatial technologies are used extensively to automate the creation, storage, and retrieval of detailed maps and records associated with transmission and distribution facilities, including the phasing and connectivity of line assets. In addition to automating their mapping functions, electric cooperatives increasingly are deploying GIS to enable more advanced operations management and analytical functions, either within the core GIS system or as the spatial data source for other specialized non-GIS applications. In fact, many consider an accurate GIS a critical success factor for AMI and Smart Grid implementations.

It is important to establish the concept that a GIS is a spatial database (spatial asset registry) that captures data with reference to a specific geographic location. From the perspective of an electric cooperative, the GIS provides the following base functionalities:

- Locate assets geographically
- Reference physical characteristics and properties
- Create reports by themes or subjects
- Visualize and analyze based on location

The GIS allows the definition of the following data types:

- Points
- Lines
- Polygons (areas)
- Relationships
- Descriptions or structure of data
- Links to other systems, applications, and databases
- Objects/features by themes and classification (e.g., by load density, load type, or service classification)

SPATIALLY ENABLED NON-GIS APPLICATIONS

The role of GIS within an electric cooperative has evolved from being an automated mapping tool to the cornerstone of a structured asset management program and a fundamental element of a Smart Grid program. A discussion of advanced applications of GIS and related technologies is presented in the NRECA CRN Report, "How to Get Added Value from GIS." The more common core GIS applications and the applications a GIS database can support are identified in Table C.1.

MOBILE ENABLEMENT OF GIS

Many utilities are extending office-based GIS applications into the field and not deploying specialized field-based applications any further—workers in the field will have access to the same GIS data as in the office. The mobile GIS solution is an excellent application for taking GIS information into the field.

TABLE C.1: GIS Applications and Spatial Information

	Function	Role	Primary Applications
1	Spatial Database (asset registry)	Core GIS function	GIS
2	Facility Map Creation and Maintenance	Core GIS function	GIS
3	Facility/Infrastructure Inventory	Core GIS function	GIS
4	Facility Inspection/First Response	Core GIS function	GIS
5	Underground Facility Location	Core GIS function	GIS
6	Line Routing	Core GIS function	GIS
7	Vegetation Management	Core GIS function and GIS as source of spatial information	CMMS
8	Inter- and Intra- (including regulatory) Company Reporting	GIS as source of spatial information	Reporting Systems
9	Work Order Creation	GIS as source of spatial information	Electronic Staking/Graphic Work Design System (GWD)
10	Facility Maintenance Management	GIS as source of spatial information	CMMS
11	System Planning – Spatial Load Forecasting	Advanced GIS function	GIS
12	Real-time and Non-real-time Load Flow Analysis	GIS as source of spatial information	SCADA/DMS and EA program
13	Outage Management	GIS as source of spatial information	OMS/DMS
14	Client/Member Account Analysis	GIS as source of spatial information	CIS and CRM

The GIS Solution Model—GIS Integration with Other Systems

One of the primary benefits of a GIS is the ability to correlate assets and facilities through geographic location. In this way, assets and facilities in the field can be related geographically to other assets and facilities. This functionality will help electric cooperatives to answer questions about electric line location, land ownership, and rights of way in a particular geographic region or assets in a specific township.

GIS DATA ARCHITECTURE

Figure C.1 is a conceptual representation of the typical data layers in a cooperative GIS. Within Figure C.1, one can visualize how the spatial reference between layers provides the spatially referenced queries that the GIS and other specialized domain applications will rely on.

INTEGRATION WITH OTHER SYSTEMS[4]

The key to integrating or exchanging information between GIS with other systems is an application programming interface (API) computer code that allows any program in the integrated system to interact with any other program. APIs can be accessed over a network such as the Internet and executed on a remote host. MultiSpeak (www.multispeak.org) provides a standard means of data interchange between applications. MultiSpeak-compliant applications include an API consistent with the MultiSpeak standard so that data exchange or integration between applications can be performed without the need for expensive integration development. MultiSpeak is a software specification designed to help small electric utilities, such as electric cooperatives, automate their business processes and exchange data among software applications. The MultiSpeak specification ensures that software products from different vendors can work together without requiring custom interfaces. MultiSpeak 3, the latest version, now offers real-time system integration, using web services. MultiSpeak 3 supports such software applications as CIS, AMR, outage detection, OMS, field design software, GIS, EA, CRM, load management, and SCADA. The other integration standard is the IEC Common Information Model (CIM) (IEC 61970-301). While the CIM model is more mature for SCADA/EMS-type (Energy Management System) applications applicable to G&Ts, MultiSpeak is more mature and feature-rich for distribution applications.

Figure C.2 describes the Multispeak System Integration Architecture.

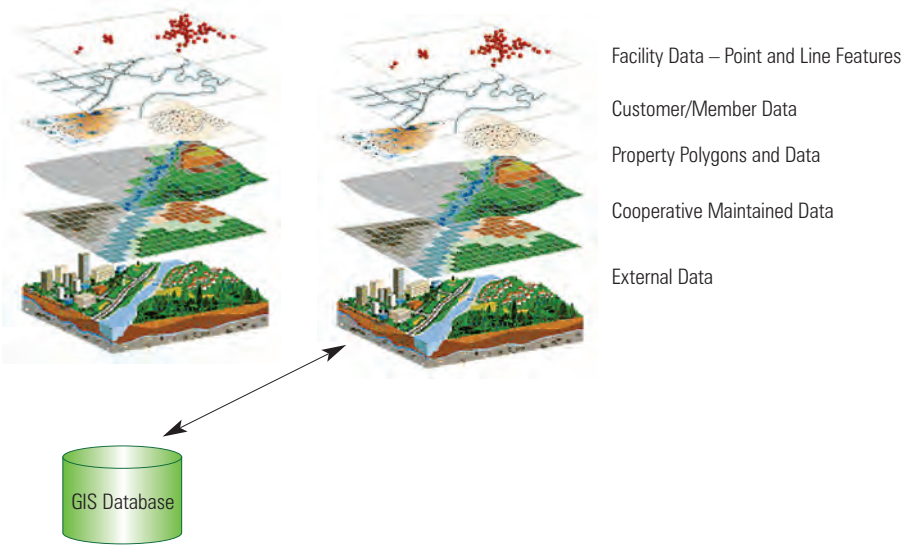

FIGURE C.1: Data Layers of a Typical GIS

[4] NRECA CRN Report, "Preparing for Tomorrow's Technology."

C

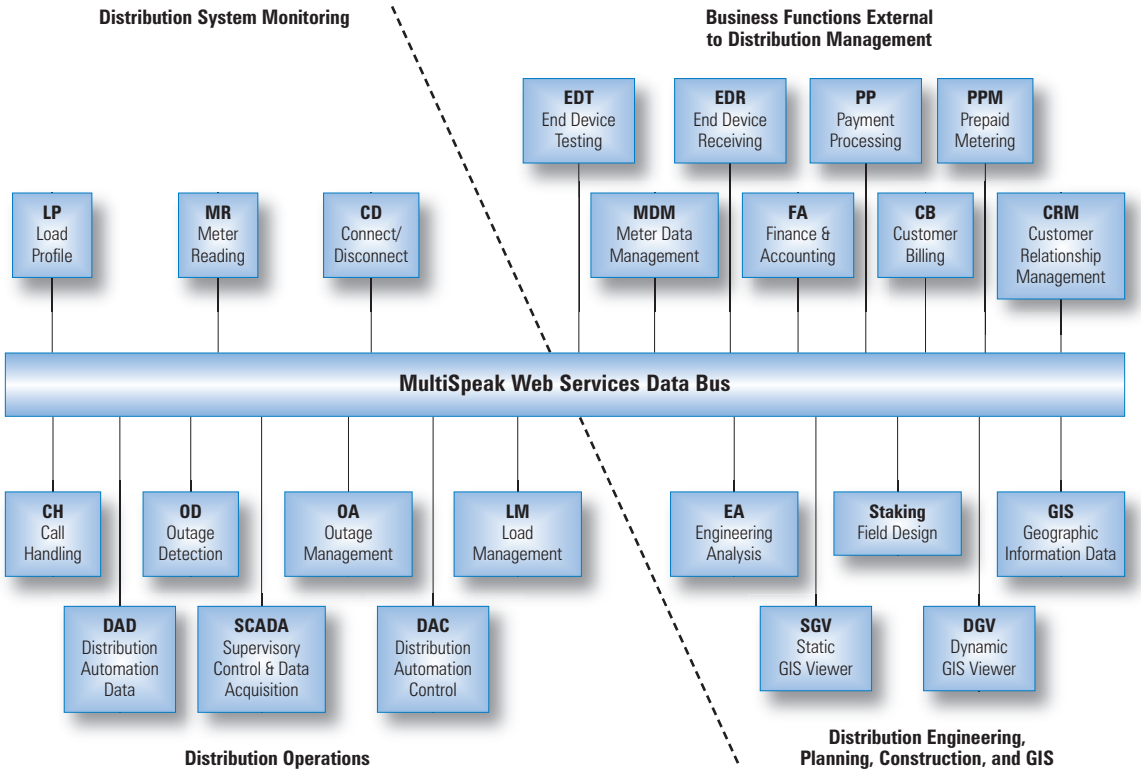

Figure C.2: MultiSpeak System Integration Architecture *(Source: NRECA.)*

Technology Solution—GIS Options Available to Cooperatives

This section provides a broad view of various approaches to implementing a GIS within the environment of an electric cooperative. It is not the objective of this report to provide an assessment of the functional and technical merits of specific vendor GIS solutions.

SOLUTION DEVELOPMENT—BUY VERSUS DEVELOP

Using Commercial-Off-the-Shelf (COTS) GIS solutions is the most effective way for electric cooperatives to deploy GIS because COTS solutions offer significant savings in implementation, upgrades, evolution, and ongoing maintenance, as compared to in-house developed solutions. COTS describes ready-made software available for sale, lease, or license to the general public. COTS GIS applications often are used as alternatives to in-house developments or one-off private or government-funded developments. Since COTS software applications are written by external sources, some utilities, especially investor-owned utilities with more than one million meters, traditionally have been wary of these products; they tend to worry that future changes to the product will not be under their control. It is important to note that utilities of all sizes increasingly are moving toward COTS solutions to reduce overall cost of ownership. Despite the COTS trend, there are still utilities that will buy a generic GIS platform and build their own data model, applications, and graphical design tool. These cooperatives struggle to justify the high ongoing costs. A COTS solution is a desirable option for most cooperatives.

GIS SOLUTIONS FOR ELECTRIC COOPERATIVES

Figure C.3 provides an overview of the current GIS market segmentation for utilities with more than 100,000 meters.[5] The market dominance of ESRI-based (Environmental Research Institute) solutions for utilities with greater than 100,000 meters is also true in the smaller utility segment. While the overwhelming ESRI market share does not in itself justify an ESRI-based solution, there are numerous benefits that a cooperative can gain from understanding ESRI solution features. The ESRI-based GIS solution can be implemented as a standalone system or as an integrated module from vendors such as NISC or SEDC.

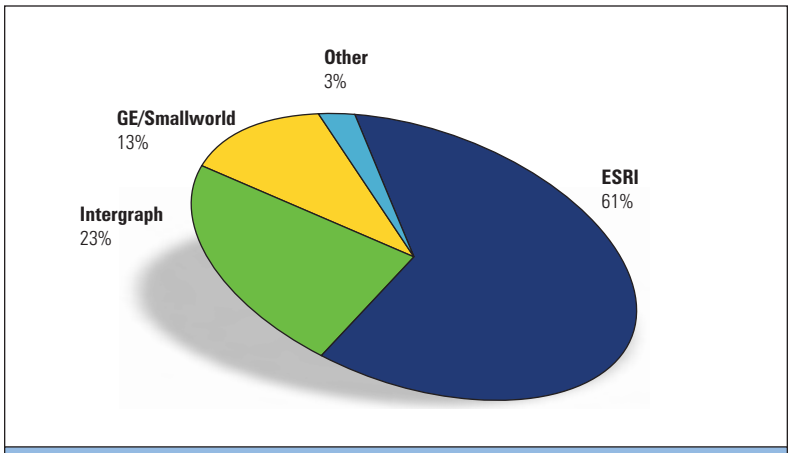

FIGURE C.3: GIS Market Segmentation for Utilities with >100k Meters

All major GIS vendors have now embraced Oracle Spatial as the future direction for their underlying database technology. In a future version, ESRI itself promises to allow users to connect directly with data stored in native Oracle Spatial format. Autodesk also has re-entered the GIS marketplace with Topobase, a product with Swiss origins that deploys an AutoCAD-like front end with an Oracle Spatial back end. While Microsoft SQL Server 2008 delivers a comprehensive suite of geospatial-enabling features, it is likely that the Microsoft offering trails Oracle Spatial by at least four to seven years.

DATA REQUIREMENTS

From a data requirements perspective, it is important to note that selecting a GIS vendor solution has very little impact on data requirements for solution implementation in an electric cooperative environment. Most major GIS vendors have developed similar electric data models and deployment tested them. These models have data structure and requirements consistent with MultiSpeak data specifications (see "**GIS Data**" page 3). If a GIS model can support integration with an engineering analysis product and a load flow can be performed on a multi-phase model, it should be considered sufficiently robust and should support present and future cooperative needs.

[5] 2007 Sierra Energy Group Intelligent Utility Enterprise (IUE) Study.

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D Measuring Data Quality and Random Sampling

This section provides a sample of data quality measurement criteria. The formula for calculating the accuracy rate percentage is as follows:

$$\frac{\text{Total number of attributes and graphic elements found to be in error in a delivery}}{\text{Total number of attributes and graphic elements included in a delivery}}$$

Table D.1 provides a sample of a quality test that a cooperative put in place to assess the quality of its GIS data and the criteria that it considered to be minimal.

In most cases, the co-op does not have the resources to perform a complete validation of its data. Under these circumstances, it is necessary to use random sampling techniques to assess

TABLE D.1: Sample Data Acceptance Criteria

Quality Test	Quality Criteria
Validate devices/equipment/facilities connectivity in database.	100%. All connectivity records for entities must be present in accordance with the requirements of the GIS data model.
Validate all code-listed attribute values.	100%. All code-listed attributes will contain a valid code-list value.
Graphically validate connectivity between devices/ equipment/facilities.	100%. All devices/equipment/facilities must be graphically connected in accordance with their portrayal on the Source Data Records.
Check for presence of sheet edge nodes.	100%. All network devices/equipment/facilities that intersect a batch boundary must be terminated in an edge node. Edge nodes must not be present elsewhere in the batch.
Sample landbase base completeness.	≤ 10 landbase base features per 1,000 sampled are omitted from captured provisional landbase base.
Sample landbase base accuracy of feature coding and attributes.	≤ 20 feature codes for landbase base features per 1,000 sampled are incorrect.
Sample devices/equipment/facilities for completeness (presence in database).	98% on an entire delivery, based on the elements described to the left and below.

Continued

D

TABLE D.1: Sample Data Acceptance Criteria (cont.)	
Quality Test	**Quality Criteria**
Sample devices/equipment/facilities for accuracy of values for attributes (i.e., where the values of mandatory attributes are valid but in error, or where values of optional attributes as shown on the original Source Data Records are in error or omitted).	
Sample relevant devices/equipment/facilities for accuracy of any optional connectivity or ownership records that can be inferred from the original Source Data Records.	
Sample devices/equipment/facilities for accuracy of placement relative to the landbase [+/–10' at real scale(1:1)].	
Sample devices/equipment/facilities for presence and accuracy of label point positions.	
Sample all map sheets in batch to check accuracy of the attributes in provenance record (date of conversion, conversion vendor, class of map record, scale of map vendor).	

data quality. Most data projects rely on a random sampling technique identified in MIL-STD-105E. This standard prescribes a minimum number of features to sample to achieve a level of confidence in the data. Applying this approach requires the use of a random number generator to identify which assets to validate.

- The co-op starts by identifying the level of confidence in the data required.
- Each feature class should be within a specific lot for inspection. For example, all poles will be a lot, all transformers will be a lot, all fuses will be a lot, etc. This will be true for all feature classes in the GIS.
- The co-op samples the features to meet the confidence level required, the features being selected by a random number generator.
- Each delivery will be broken down into lots by feature class, with a count of the number of features in that class. Using the MIL-STD-105E Standard, a sample size for each feature class will be determined using 105E Standard Table I General Inspection level III (tightened sampling) alpha code. Also, a sample size and acceptable quality level for each feature class will be determined using the 105E Standard Table II-A.
- Feature inconsistencies will constitute an error and will count toward the number of rejections for that lot. Table D.2 provides an overview of the number of features, the number to be sampled, and the number of defects allowed in an example case.

TABLE D.2: Sample Table for Random Sampling			
Lot	**Number of Features**	**Sample Size**	**Number of Defects Allowed**
Poles	34,000	500	10
Transformers	5,643	315	8
Cut-outs	6,867	315	8

E

CIS Data Quality Self-Assessment Template

This section provides the cooperative with a template to assess the state of its CIS data in the areas of availability, quality, and security. This template is intended to be used as a data load guide for the initial implementation of the CIS and assessment of data quality in an existing system for continuous data quality improvement. Green, Yellow, and Red light conditions are defined to enable the cooperative to quickly identify data quality in a measure relative to other co-ops.

1. **Availability.** This attribute assesses the availability aspect of the CIS data.
   - *Green Light* – This data set is included in the CIS and is available to the CIS users.
   - *Yellow Light* – Current plan is underway to make these data available to CIS users within the next scheduled inspection and maintenance cycle for this asset type.
   - *Red Light* – The data set will not be available within the next scheduled inspection and maintenance cycle for this asset type.
   - *NA* – Data are not applicable to the CIS. There is no plan to provide this data set in the CIS.
2. **Quality.** This data attribute accounts for the completeness, correctness, and currency aspects of the CIS data.
   - *Green Light* – The CIS users have a high degree of confidence in this set of data. A data quality QA/QC plan is in place to continuously assess and enhance data quality.
   - *Yellow Light* – The CIS users do not have a high degree of confidence in this set of data. A data QA/QC plan with improvement milestones defined is in place to enhance the data quality.
   - *Red Light* – The CIS users do not have a high degree of confidence in this set of data. No plan has been established to improve the quality of this data set.
   - *NA* – This data set is not currently in the CIS.
3. **Security.** This attribute assesses whether adequate security procedures have been implemented to safeguard data content.
   - *Green Light* – The cooperative's current data security procedures allow it to maintain the necessary levels of data security.
   - *Yellow Light* – Security procedures are being developed to allow the cooperative to maintain the necessary levels of data security within 12 months.
   - *Red Light* – No security procedures are currently in place or being developed within 12 months to allow the cooperative to maintain the necessary levels of data security.

E

TABLE E.1: CIS Data Quality Self-Assessment				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
Customer Information				
C1 – Customer Data	**Information in the customer information file is maintained or is associated information from other data fields.**			
	Personal Information: Name			
	Trading as Name			
	Alias Names			
	Driver's License			
	Social Security Number			
	Co-op Member ID			
	Customer's Primary Language			
	Special Conditions			
	Spouse or Significant Other Names, Roommates			
	Spouse or Significant Other Names, Roommates' Contact Information			
	Customer Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code			
	Customer Mailing Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code			
	Deposit Information			
	Theft and Tampering History (diversions)			
	Account(s) in Effect			
	Banking Information			
	Date of Birth			
	Phone Number(s) (cell phone, unlisted phone, etc.)			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
C1 – Customer Data (cont.)	Email Address(es)			
	Fax Number(s)			
	Dangerous Animals/People/Situation			
	Confidentiality Requested			
	History Information by Account(s): Billing History			
	Payment History			
	Consumption History			
	Product/Service History			
	Customer Contact/Calls Information Customer Response to Messages/Inserts/Programs			
	Customer Correspondence			
	Open/Close Accounts			
	Update Account Information			
	General Inquiry			
	Billing Inquiry			
	Complaints			
	Credit Inquiry			
	Trouble Calls			
	Customer Credit Information: Credit Profile			
	Credit Checking			
	Credit References			
	Third Party/Guarantor/Co-signer			
	Collections			
	Notification and Cut-off for Non-payment			
	Returned Checks (a credit perspective)			
	Payment Arrangements			
	Bankruptcy			
	User's Comments			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
Account Information				
A1 – Account	**Information in the account file is maintained or is associated with information from other data files.**			
	Account Name			
	Account Information: Account Number			
	Account Types			
	Account Status			
	Tax and Penalty Status			
	Exemptions			
	Account Collection Status			
	Penalty			
	Payment Arrangements			
	Liens			
	Customer Name/ID			
	County Parcel ID			
	Account Address (standardized components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code			
	Land Parcel Number (GPS coordinate)			
	Special Codes (i.e., life-support)			
	Account Premise ID			
	Customer Account Representative			
	Customer Account Representative Contact Information			
	Co-op Account Representative			
	Federal Business Identification Number			
	DBA (doing business as) Name			
	GIS X, Y Coordinate			
	Account History Information: Payments Information History			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
A1 – Account (cont.)	Consumption History			
	Product/Services History			
	Service Order History (including turn-off)			
	Account Call/ Contacts: Trouble Calls			
	Open/Close Accounts			
	Update Account Information			
	General Inquiry			
	Billing Inquiry			
	Credit Inquiry			
	Account Response to Messages/Inserts/Programs			
	User's Comments			
Service Address and Service Point Information				
P1 – Premise	**Service Address Information:** Premise or Location Number			
	Account Name History			
	Keyword or Phrase/Name or Title (e.g., First Bank Building)			
	Address (standard components): • Street Name • Street Type or Suffix (Road, Avenue, Street, etc.) • Direction • Space Number (apt, suite, bldg) • City • State • Zip Code			
	Intersecting Roads			
	Meter/Equipment Number			
	Map Book Number Reference			
	Geographical/GPA Location (X, Y Coordinates)			
	Legal Parcel Number			
	Geopolitical Area (e.g., voting district, special tax district, census tract)			
	Read Route Number for Specific Services.			
	Subdivision Name, Apartment Name, etc.			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)

Data Grouping	Data Description	Quality Assessment		
		Availability	Quality	Security
P1 – Premise (cont.)	Date of Service for the Address			
	Date First Meter Set			
	Past and Present Classifications Regardless of Meter Status by Service			
	Multiple Contact Information (third party) related to the service address. The owner, manager, management company, etc. may be contacted to provide access to the premise, verification of tenant move in/out dates, handling of returned mail, etc.			
	Co-op Defined Premise Information			
	Areas of the Premise Where Damage Claims Have Been Filed			
	Service Address History: Meters/Equipment Located at a Premise/Account			
	Previous and Present Accounts at a Premise/Account			
	Usage History (monthly and peak)			
	Consumption and Billing/Payment			
	Service Point (Premise) Information: Service Address/Premise ID			
	Non-metered Service Points at the Service Address: 1) Each service point's characteristics include GIS coordinates 2) Each service point's connectivity to distribution transformer			
	Metered Service Points at the Service Address: 1) Each service point's characteristics include GIS coordinates 2) Unique meter ID(s) for each meter 3) Each meter's connectivity to distribution transformer			
	Master Meters at a Service Address: 1) Each service point's characteristics include GIS coordinates 2) Unique meter ID(s) for each meter 3) Sub-meter connected – Unique ID			
	Service Address Classifications at the Service Point			
	Past and Present Classifications of the Premise for the Service Point			
	Rate(s) at the Service Point			
	Co-op Order History for the Service Point			
	Consumption History at a Service Point (by meters and/or non-metered connection)			
	User's Comments			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
Usage Information				
R1 – Rates & Billing	**Consumption/usage information, including time-of-use data by metered and non-metered service. Information entered by means of:** Manual Data Entry			
	Hand-held Meter Data Collection Devices Data Entry via Computer Interface			
	Automated Meter Reading Data Entry via Computer Interface			
	Outsourced Meter Data Entry			
	User's Comments			
Meter Information				
E1 – Equipment	**Meter Information** Unique Meter ID			
	Meter Type			
	Meter Size			
	Meter Manufacturer			
	Meter Manufacturer Model			
	Meter Cost			
	Purchase Order Number			
	Delivery Date			
	Warranty Information			
	Test History			
	Tested By			
	Installation/Turn-on Date			
	Installed By			
	Remove Date			
	Removed By			
	Register Id Number (AMR)			
	Register Type (AMR/Direct Read)			
	Meter Transceiver/Telemetering Interfaces			
	Meter Constant/Stationary Dial			
	Meter Status: • Inventoried			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
E1 – Equipment (cont.)	• Received into Inventory • Deleted from Inventory • Service (active) • Service (inactive) • In Shop (meter shop) • Meter Stolen/Missing • Damaged • On Truck • Retired/Junked			
	Other Co-op Defined Status			
	Premise or Service Address			
	User's Comments			
Metering Equipment Information				
E1 – Equipment	**Equipment Information:** Unique Equipment Identification			
	Premise or Location			
	Equipment Type			
	Equipment Manufacturer			
	Equipment Manufacturer Model			
	Equipment Cost			
	Purchase Order Number			
	Delivery Date			
	Warranty Information			
	Test History			
	Tested By			
	Installation/Turn-on Date			
	Installed By			
	Remove Date			
	Removed By			
	Equipment Status: • Inventoried • Received into Inventory • Deleted from Inventory • Service (active) • Service (inactive) • In Shop • Equipment Stolen/Missing			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
E1 – Equipment (cont.)	• Damaged • On Truck • Retired/Junked			
	• Other Co-op Defined Status			
	Premise or Service Address			
	User's Comments			
Portfolio Information				
S1 – Services	**Service Offerings Information:** Services Available for Each Class of Customer: Residential Customers			
	Industry/Commercial Customers			
	Multi-family Customer			
	Industrial Customers			
	Local Government and School Districts			
	Federal Government			
	Irrigation Customer			
	Other Co-op Defined Classes of Customer			
	Program Offerings Information: Programs Available for Each Class of Customer: Residential Customers			
	Industry/Commercial Customers			
	Multi-family Customer			
	Industrial Customers			
	Local Government and School Districts			
	Federal Government			
	Irrigation Customer			
	Other Co-op Defined Classes of Customer			
	User's Comments			
Order Information				
S1 – Services	**Information about the customer order for a predetermined retention period for each active and non-active account:** Service Orders			
	Meter Orders			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
S1 – Services (cont.)	Equipment Orders			
	Collection Orders			
	Energy Audit Orders			
	Trouble/No Lights Orders			
	Special Assistance			
	Other (co-op defined)			
	User's Comments			
Rates and Charges				
R1 – Rates & Billing	**Rate classes, usage volumes, number of dwelling units, rate schedules, etc. for the following classes of customers:** Residential Customers			
	Commercial Customers			
	Multi-family Customer			
	Industrial Customers			
	Wholesale Customers			
	Local Government and School Districts			
	Federal Government			
	Irrigation Customer			
	Other Customer Classes Defined by the Co-op			
	Service charges, program charges, etc. for the following classes of customers: Residential Customers			
	Commercial Customers			
	Multi-family Customer			
	Industrial Customers			
	Wholesale Customers			
	Local Government and School Districts			
	Federal Government			
	Irrigation Customer			
	Other Customer Classes Defined by the Co-op			
	Fees, Charges, Taxes, Surcharges Information: Interest Rate on Past Due Amounts			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
R1 – Rates & Billing (cont.)	Late Payment Charges (Penalties)			
	Security Deposit			
	Returned Check Fees			
	Reconnect Fees			
	Permitting Fees			
	Taxes			
	After-hours Fees			
	Meter Tampering or Diversion Penalties or Fees			
	Other Co-op Defined Categories			
	User's Comments			
Billing Information				
R1 – Rates & Billing	**Billing Category:** • Time-based Billing • Volume-based Billing • Other Co-op Categories			
	Billing and Billing Option Policies: Time-based Billing Cycle			
	Volume-based Billing Determinants			
	Rebill an Adjusted Bill			
	Final Bill			
	Billing Due to Late and Early Reading			
	Special Billings			
	Cancel/Rebills for Consumption Corrections			
	Other Co-op Determined Billing Options			
	Payment Program Information: Prepayment			
	Deferred Payment			
	Landlord/Owner/Third Party			
	Low-income Assistance			
	Senior/Disabled Discount			
	Bank Drafting or Credit Card Drafting and All Electronic Payments			
	Other Co-op Defined Programs			

Continued

TABLE E.1: CIS Data Quality Self-Assessment (cont.)				
Data Grouping	**Data Description**	**Quality Assessment**		
		Availability	**Quality**	**Security**
R1 – Rates & Billing (cont.)	**Conditions for Non-Turn-off of Service:** Pre-determined Days (holidays, winter, summer, etc.)			
	Weather (very cold – very hot)			
	Payment Arrangements (automatic)			
	Bankruptcy Proceedings – Pre-petition Account			
	Fire-line Service (automatic)			
	Life Support (automatic)			
	High Bill Investigation/Bill Disputes			
	Re-read Order Pending			
	Other Conditions as Defined by the Co-op			
	User's Comments			

F CMMS Data Quality Self-Assessment Template

This section provides the cooperative with a template to assess the state of its CMMS data in the areas of availability, quality, and security. This template is intended to be used as a data load guide for the initial implementation of the CMMS, as well as for the assessment for data quality in an existing system for continuous data quality improvement. Green, Yellow, and Red light conditions are defined to enable the cooperative to quickly identify data quality in a measure relative to other co-ops.

Please note that the asset quality assessment template is intended for assessment of each asset class the co-op decides to include in the CMMS. That is, if the co-op is managing maintenance of all substation equipment, the data quality assessment has to be conducted separately for each of the assets managed, including transformers, circuit breakers, regulators, switches, etc.

1. **Availability.** This attribute assesses the availability aspect of the CMMS data.
   - *Green Light* – This data set is included in the GIS and is available to the CMMS users.
   - *Yellow Light* – Current plan is underway to make these data available to CMMS users within the next scheduled inspection and maintenance cycle for this asset type.
   - *Red Light* – The data set will not be available within the next scheduled inspection and maintenance cycle for this asset type.
   - *NA* – Data are not applicable to a co-op's CMMS. There is no plan to provide this data set in the CMMS.
2. **Quality.** This data attribute accounts for the completeness, correctness, and currency aspects of the CMMS data.
   - *Green Light* – The CMMS users have a high degree of confidence in this set of data. A data quality QA/QC plan is in place to continuously assess and enhance data quality.
   - *Yellow Light* – The CMMS users do not have a high degree of confidence in this set of data. A data QA/QC plan with improvement milestones defined is in place to enhance the data quality.
   - *Red Light* – The GIS users do not have a high degree of confidence in this set of data. No plan has been established to improve the quality of this data set.
   - *NA* – This data set currently is not in the CMMS.
3. **Security.** This attribute assesses whether adequate security procedures have been implemented to safeguard data content.
   - *Green Light* – Current data security procedures allow the co-op to maintain the necessary levels of data security.
   - *Yellow Light* – Security procedures are being developed to allow the co-op to maintain the necessary levels of data security within 12 months.
   - *Red Light* – No security procedures are currently in place or being developed within 12 months to allow the co-op to maintain the necessary levels of data security.

F

TABLE F.1: CMMS Data Quality Self-Assessment				
Data Grouping	**Data Description**	**Asset Quality Assessment**		
		Availability	**Quality**	**Security**
CMMS Stage: _____ **Asset Type: _____**				
1 – Asset Technical Data	1. Asset Type			
	2. Asset ID			
	3. Purchase Order ID			
	4. Environmental-related Information			
	5. Utility Standard (page and ID)			
	6. Manufacturer Identification (make, model)			
	7. Manufacturer Catalog Number and Serial Number			
	8. Rating with Operating Parameters (utility and manufacturer)			
	9. Manufacture Data			
	10. Utility Acceptance/Received Date			
	11. Manufacturer Warranty			
	12. Operational Instructions			
	13. Maintenance Instructions			
	14. Parts List (material, design, assemblies)			
	15. Construction Unit (CU)			
H1 – Asset Historic Data	1. Current and Historical Work or Functional Location (date, WO, etc.)			
	2. Delivery Date and Receiving Location			
	3. Settings			
	4. Maintenance Program			
	5. Inspection Results/History (date, WO, etc.)			
	6. Maintenance Result/History (date, WO, etc.)			
	7. Operations Counters			
	8. Failure (including specific failed component)			
	9. Defect (including specific defective component)			

G OMS Data Quality Self-Assessment Template

This section provides the co-op a template to assess the state of its OMS data in the areas of availability, timeliness, accuracy, and security. This template is intended to be used as a data load guide for the initial implementation of the OMS, as well as for the assessment for data quality in an existing system for continuous data quality improvement. Green, Yellow, and Red light conditions are defined to enable the cooperative to quickly identify data quality in a measure relative to other co-ops.

1. **Availability.** This attribute assesses the availability aspect of the OMS data.
   - *Green Light* – This data set is included in the OMS and is available to the OMS users.
   - *Yellow Light* – Current plan is underway to make these data available to OMS users within the next scheduled inspection and maintenance cycle for this asset type.
   - *Red Light* – The data set will not be available within the next scheduled inspection and maintenance cycle for this asset type.
   - *NA* – Data are not applicable to a co-op's OMS. There is no plan to provide this data set in the CMMS.
2. **Timeliness.** This data attribute accounts for the timeliness with which data is made available to OMS.
   - *Green Light* – Information is made available to the OMS on a timely basis to adequately support all OMS functionality.
   - *Yellow Light* – Information is currently not made available to the OMS in a timely enough manner to adequately support all OMS functionality. Programs have been established to improve data timeliness.
   - *Red Light* – Information is currently not made available to the OMS in a timely enough manner to adequately support all OMS functionality. No plan has been established to improve the timeliness of this data set.
   - *NA* – This data set currently is not in the OMS.
3. **Accuracy.** This data attribute accounts for the completeness, correctness, and accuracy aspects of the OMS data.
   - *Green Light* – The OMS users have a high degree of confidence in this set of data. The OMS is functioning at a high degree of accuracy. Data refresh is conducted regularly as planned.
   - *Yellow Light* – The OMS users do not have an acceptable degree of confidence in this set of data. The OMS is functioning at an acceptable degree of accuracy. Although data refresh is not conducted regularly as planned, improvement programs have been established to improve data refresh frequency.
   - *Red Light* – The OMS users do not have a high degree of confidence in this set of data. No plan has been established to improve the quality of this data set.

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- *NA* – This data set currently is not in the OMS.

4. **Security.** This attribute assesses whether adequate security procedures have been implemented to safeguard data content.
   - *Green Light* – The co-op's current data security procedures allow it to maintain the necessary levels of data security.
   - *Yellow Light* – Security procedures are being developed to allow the co-op to maintain the necessary levels of data security within 12 months.
   - *Red Light* – No security procedures currently are in place or being developed within 12 months to allow the co-op to maintain the necessary levels of data security.

TABLE G.1: OMS Data Quality Self-Assessment

Data Grouping	Data Description	Quality Assessment			
		Availability	Timeliness	Accuracy	Security
Facility Information from GIS					
T1 – Asset Technical Data	1. Poles				
	2. Cables				
	3. Conductors				
	4. Substructures (ductbanks/manholes, vaults, handholes, terminators/pedestals, etc). Note: underground structures to have a concept of connectivity.				
	5. Line Equipment (OH and UG) – transformers				
	6. Line Equipment (OH and UG) – capacitors and regulators, etc.				
	7. Switching Equipment (OH and UG) – switches (all types)				
	8. Protection Equipment (OH and UG) – fuses/reclosers/network protectors, etc.				
	9. Revenue Meter (self contained and CT type) Information to Include Service Location and Connectivity to Service (distribution) Transformer				
Connectivity Information from GIS					
N1 – Network System Data	Configurations, Connectivity, and Parameters: • As designed				
	Configurations, Connectivity, and Parameters: • As operated (temporary) if available in GIS				
Customer Information from CIS					
C1 – Customer Data	1. Service Addresses (geographic reference) 2. Service Facilities (transformer, meter, service drop, etc.)				
	Service Turn-off (nonpayment, change of account, etc.)				
	Outage Call Taking				

Continued

TABLE G.1: OMS Data Quality Self-Assessment (cont.)					
Data Grouping	**Data Description**	**Quality Assessment**			
		Availability	**Timeliness**	**Accuracy**	**Security**
Spatial Information from GIS					
L1 – Landbase Data	• Topography w/Contours • GPS Control Points • Streets • Parks (federal, state, city/county) • Federal Land • Communities/Municipalities • Reference Maps (lots, legal monuments) • Quarter-section Grid • Indian Reserves • Easements • Leases • Photographic Images • Transportation • Governmental and Federal Boundaries • License Areas • Franchise Area • Operating Districts • Flood Lines • Catchment Basins • Resource Areas • Hydro • Geotechnical • Non-electrical Utility Infrastructure • Ecological • Meteorological • Property and Land Use				
Customer Information from IVR					
C1 – Customer Data	Automated Outage Call Taking				
Network Information from SCADA					
N1 – Network System Data	Switch Status (on/off and tagging)				
	Substation Circuit Break Status (on/off and tagging)				
	SCADA Controlled Line Protection Devices (circuit switchers, reclosers, etc.) Status (on/off and tagging)				
Administrative Information					
A1 – Administrative Data	Operations and Safety Policies				
	Crew Schedule and Crew Personnel Information				

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