BIOGRAPHICAL INFORMATION

Glen A. Reitmeier
Manager, Engineering Systems
Manitoba Hydro

Specific Responsibilities

Glen Reitmeier manages an Application Systems Department for providing Engineering Systems solutions in partnership with the three operating and engineering business units of Manitoba Hydro: Transmission and Distribution, Customer Service and Marketing, and Power Supply. Glen's group is responsible for providing the technology vision to assist the business realize their strategic goals.

Past Experience

Glen has held a variety of IT positions in over 25 years with Manitoba Hydro. This experience includes: major technology projects; managing day-to-day infrastructure including network, storage, and desktop; and architecture and planning. Glen has played an active role in the technology integration of recent corporate acquisitions, including Centra Gas Manitoba and Winnipeg Hydro. Having held leadership roles in all areas of technology development and operations, Glen is regarded as a thought leader within Manitoba Hydro and the industry.

Educational Information

B.Sc. – Computer Science, University of Manitoba

Professional Memberships

Canadian Information Processing Society

BIOGRAPHICAL INFORMATION

Robert J. Sarfi
Partner
Boreas Group LLC

Specific Responsibilities

Robert Sarfi provides business vision and technology solutions to electric utilities around the world. Sarfi is currently partner in a consulting firm, Boreas Group LLC.

Past Experience

Prior to Boreas Group, Sarfi was Director, Utility Practice at E X L Consulting, a utility focused consulting firm. Prior to E X L, Sarfi was Director, Business Transformation Practice at Convergent Group. In this capacity, he directed a team of consultants that performed front-end studies and ensured that integration projects preserved the intent of the initial business vision. Previous to this, Sarfi was a Program Manager at Convergent Group. As a program manager, he directed full life-cycle custom application development and system integration projects for electric utilities. Prior to joining Convergent Group, Sarfi worked for ABB, Distribution Information System Division. At ABB, Sarfi was the technical lead for projects integrating outage management systems with legacy systems. Sarfi began his career at Hatch Associates in Toronto.

Educational Information

B.Eng. - Electrical & Computer Engineering, Royal Military College of Canada
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Professional Memberships

Association of Professional Engineers, Ontario
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DEVELOPING A T&D APPLICATION EVOLUTION PLAN: HOW DO WE KNOW WHAT TO DO NEXT

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ABSTRACT

Manitoba Hydro recently developed a system evolution strategy based on an integrated suite of commercial applications. This strategy involves the cradle-to-grave mapping of all T&D business processes, identification of the data and data exchanges associated with the processes, and then mapping them to the suite of commercial applications commonly used within the T&D space. This T&D Application Architecture is built around a robust GIS platform. The T&D Application Architecture includes: GIS, work management, graphical design, outage management, computerized maintenance management, engineering analysis, and mobile workforce management. The success of this implementation relies on the GIS as the central repository for spatially enabled data. The system evolution strategy is based on the definition of a Common Data Model. The Common Data Model is a conceptual data model that identifies where data should reside within the framework of the commercial application suite. Based on the knowledge of where data should reside, Manitoba Hydro can identify how the T&D Application Architecture evolves. The goal of Manitoba Hydro is to use the Common Data Model to identify how a new business requirement will be addressed by a component of the T&D Application Architecture.

1. INTRODUCTION

Manitoba Hydro embarked on a project called the Common Data Model Initiative in 2000. The scope of the initial Common Data Model initiative quickly expanded with the acquisition of Centra Gas as there was considerable application functionality overlap between the gas and electric business units. The growth of the Manitoba Hydro T&D suite over a relatively large number of years created considerable data redundancies and led to islands of information. Islands of information create process inefficiencies.

With the purchase of the integrated GIS and graphical design software from GE-Smallworld, Manitoba Hydro entered into a paradigm where major applications are purchased as opposed to built. Now Manitoba Hydro can focus its development efforts on integration and continue to build minor applications, when applicable. The Common Data Model initiative evolved from the definition of a single physical data model to represent all of T&D's data needs into a conceptual system representation that relies on geospatial data contained within the GIS.

The Common Data Model presented in this document is based on the assumption that Manitoba Hydro will, over time, procure and install a suite of applications that is similar to those implemented at other T&D utilities throughout the world. Consequently, it was important to understand how the Manitoba Hydro legacy systems will fit into this context so that growth and system evolution can be performed in a controlled manner. Understanding how data should be organized will help Manitoba Hydro determine who should own the data, where the data should be captured and kept, and who needs to view the data. Use of this strategy at

Manitoba Hydro will lend itself favorably to the integration of another recent acquisition, Winnipeg Hydro, from both a technology and process perspectives.

When developing the Common Data Model to support the suite of commercial applications, identification of the data ownership by type and system is of greater importance than building a data model at a very low level of detail. Now, the concept of a master data repository or system of record will be introduced. This is to say that a specific system, and consequently a particular user group, will own every component of data. Introducing a data repository will resolve many of the issues associated with duplicate data entry and data redundancy. Manitoba Hydro currently experiences the negative impacts of these duplicated efforts. Each database of the commercial application (COTS – Commercial off the shelf software) of the Manitoba Hydro T&D Application Architecture may become a master data repository for specific data.

The first steps of the development of the Common Data Model involved a review of the high level Manitoba Hydro T&D and customer service and marketing (CS&M) processes as well as assessing the existing systems and data redundancies in place at Manitoba Hydro. An alignment of Manitoba Hydro processes and technology with the typical COTS application suite currently prevalent in the industry is then necessary to gain support for the idea that Manitoba Hydro processes can be supported by commercial applications: this is an important organizational change activity. This alignment results in the production of the Common Data Model.

This presentation consists of six sections: Introduction, Process Overview, The Model, Target Systems, Data Redundancies, and Conclusions.

2. PROCESS OVERVIEW

A high-level process review was conducted with a cross-section of the business areas of T&D at Manitoba Hydro. This review was necessary to validate that the processes supported by the typical T&D COTS applications are applicable, with minor modification, at Manitoba Hydro. This means that the operating practices and nature of the electric and gas systems at Manitoba Hydro have data requirements similar to the typical North American utility. The process review was necessary to gain buy-in from all levels of business and technology resources at Manitoba Hydro. The following processes were reviewed:

- Customer contact
- Planning
- Design
- Construction
- Commissioning
- Distribution outage response
- Station outage response
- Power quality
- Distribution network maintenance
- Station maintenance
- Vegetation management

Based on this process review, the consensus was that Manitoba Hydro uses the following terminology to describe its T&D work:

- Project

- Program
- Unplanned

The principal systems included in this study include:

- Computerized maintenance management (Plant, distribution, and transmission)
- Customer information system (Electric and Gas)
- Engineering Analysis – electric distribution, electric transmission, and gas
- Enterprise resource planning application (including AP, GL, materials management, project systems, and human resources)
- Design estimating application
- Outage Management (OMS)
- Laboratory test management (electronic test sheets, test inventory systems)
- Maintenance management (power plant, station, and distribution systems)
- Mobile workforce management (MWM)
- Joint use management
- GIS – Gas and electric
- Service facilities management system
- Transmission asset management system
- Work Order Tracking/Work management (WMS)

Project work includes all aspects of a project, for example all phases involved in building a new substation, from planning through commissioning and maintenance. Program work refers to work that is performed by the frequency of operation or some other form of event trigger, for example, routine maintenance. Unplanned work includes all work performed outside the scope of project and program work and is necessary to maintain the reliability, safety, and security of the electric and gas systems.

Within the Common Data Model, an assumption is made that all the data are in place to support the eventual implementation of a “Customer-Focused” layer at Manitoba Hydro. A “Customer-Focused” layer will allow Manitoba Hydro resources to track all interaction and impacts to a customer from within a single application layer. Many utilities have attempted to tie together all customer interaction through the implementation of a Customer Relationship Management (CRM) application. The Common Data Model presented within this report includes all the enabling technologies and data to support the eventual implementation of a CRM application at Manitoba Hydro.

3. THE MODEL

In order to support the generic processes, an integrated suite of T&D applications can be built with the relationships described in Figure 2: the target Common Data Model of this report will be in alignment with Figure 2. This figure is not comprehensive but rather includes the touch points within the T&D Application Architecture itself. The integration of these applications will be selected and implemented to ensure commonality for both the electric and gas lines of business at Manitoba Hydro.

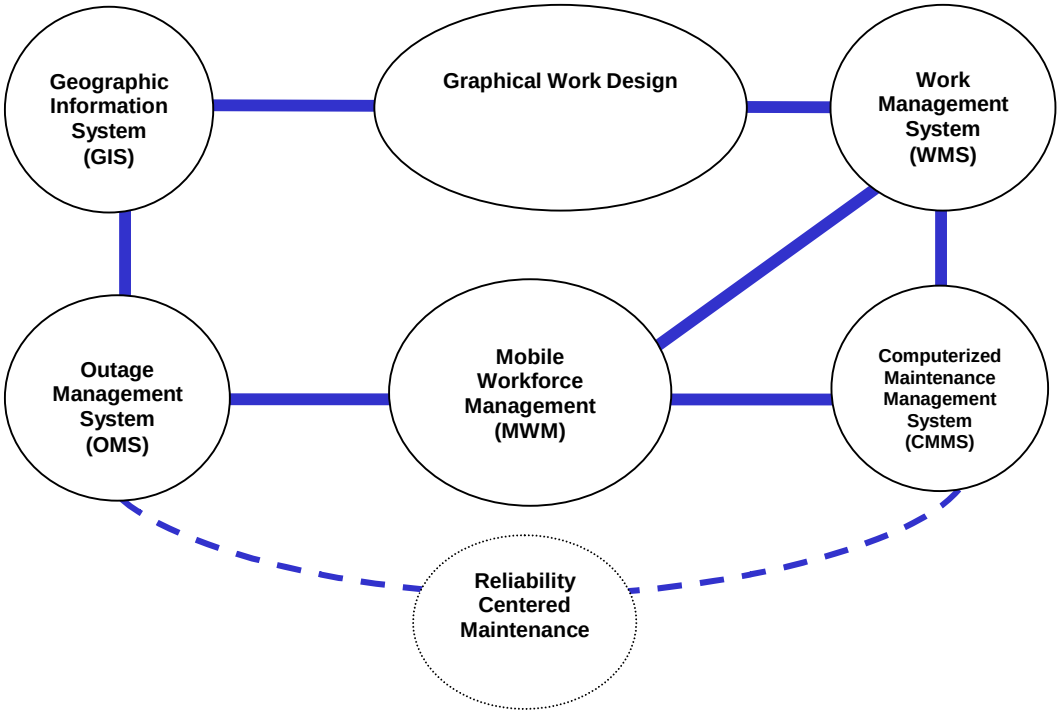

Figure 1: Target Integrated T&D Application Architecture

If one performs a review of the functionality and the data associated with the commercial applications described in Figure 1, one will remark that there is considerable functionality and data overlap. This overlap concerned Manitoba Hydro. If one takes the case of a WMS and MWM, traditionally the WMS addressed predominantly project work and the MWM short duration work. At present, WMS and MWM provide increased functionality in areas previously limited to the other's domain. Manitoba Hydro built a set of rules that identify where the data will reside, i.e. all crew related activity will be maintained within the MWM, even if it is outage related.

The model itself was divided into the following classes:

- Information related to the electric, gas, and civil networks or infrastructure.
- Program, planned and unplanned work activities.
- Rights and accesses
- Customers
- Landbase
- Administrative
- System and user related parameters

This conceptual representation, Figure 2, of all Manitoba Hydro electric and gas assets should be considered inclusive at this level of detail. Once Manitoba Hydro data was identified, the data was mapped to specific commercial applications as a target. The commercial applications are consequently used for the physical implementation of the Common Data Model. Development of the next level of detail of the Common Data Model will not bring substantial gain to Manitoba Hydro since the COTS applications to be procured contain their own representation of the data within their spheres of influence. Through the Common Data

Model, any Manitoba Hydro resource can identify which system becomes the owner of the data.

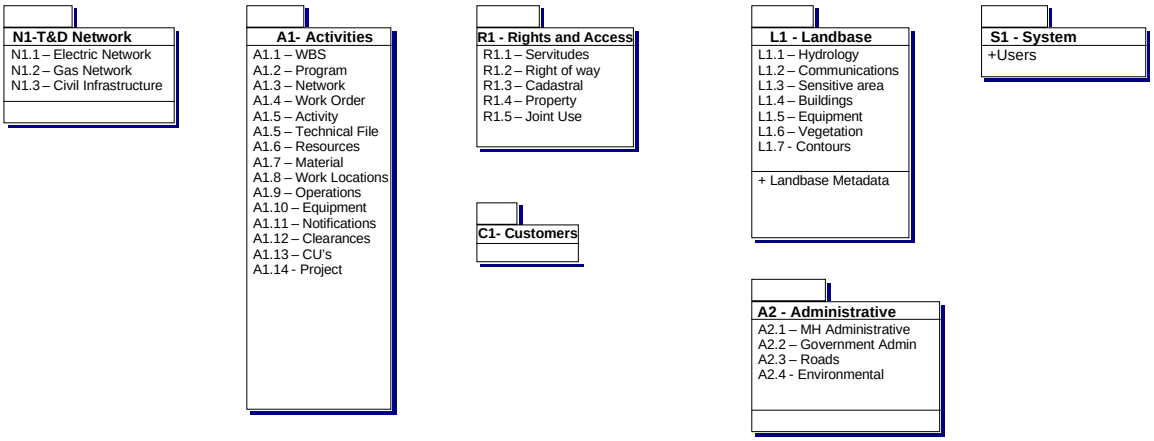

Figure 2: Organization of Common Data Model

A summary of the data ownership, as identified by Manitoba Hydro is provided:

- Asset history, including maintenance and inspection information – CMMS
- Customer information, including account and consumption – CIS
- Crew assignment, including crews, resources, and equipment – MWM
- Project tracking and reporting, including design and as-built information - WMS
- Materials and inventory – MM
- Operational distribution system model, including temporary states and outage information but excluding crew information – OMS
- Geospatial context for all assets - GIS

4. TARGET APPLICATIONS

The core components of the Common Data Model solution architecture are the GIS, outage management (OMS), customer information system (CIS), work management (WMS), mobile workforce management (MWM) and maintenance management (CMMS) enterprise systems. These technologies have been introduced to support business processes more efficiently, to replace older technologies that have become a liability, and to achieve consistent process implementation across the enterprise. While some utilities have implemented individual systems without a GIS, it is the belief of Manitoba Hydro that the addition of the spatial reference provided by the GIS maximizes benefits. With such a large service territory, maintaining the concept of location is critical.

3.1 Geographic Information System

In conjunction with other key systems, such as the CMMS, the GIS is an integral part of the foundation of the Manitoba Hydro asset registry. It will provide links to integrated design, compliance, maintenance and inspection, and system planning applications. Coupled with increased spatial query capability and thematic mapping tools, the GIS will provide many options for analyzing Manitoba Hydro electric and gas data. In addition, the new GIS will support web-based access and distributed environment deployment.

The T&D Application Architecture includes a mobile GIS component to support field view-only of GIS data. The mobile GIS solution will provide viewing and navigational functionality of data. A future goal may include full design functionality within the mobile unit.

The graphical work design application enables graphic design and placement of facilities within the GIS environment. Within the proposed Manitoba Hydro solution architecture, the graphical work design application will provide GIS design capability and serve to integrate WMS and GIS. The Manitoba Hydro solution will use a vendor provided data model to support integration between the CU-based designs in WMS and the graphical placement environment within GIS. The design integration is achieved by mapping CU type, make, and kind attributes to corresponding mapped GIS objects. The graphical work design application integration provides a transfer for designs and as-builts between the two major components of the Manitoba Hydro solution, WMS and GIS. The graphical work design application also provides the user with methods for configuring job design palettes, enforcing the entry of required completion data and other design tools. At the present time, the graphical work design application is targeted solely to the distribution business area.

3.2 Work Management System

Manitoba Hydro currently has no true process-driven WMS installed. Manitoba Hydro uses various in-house applications, such as a Lotus Notes Work Order Tracking, estimating tool, and various maintenance management applications to support parts of the customer- or developer-driven work. A modern WMS will cover all aspects of the workflow associated with initiation, design/estimate, approval, schedule, construct, as-built/complete, and close. Using a single WMS will expand the concept of design using CUs and standard job types. A WMS supports the creation of job packets for internal Manitoba Hydro crews and job or bid packages for contractors.

By using a WMS, Manitoba Hydro will drive consistent processes, materials, and job completion metrics throughout distribution operations. Manitoba Hydro can use WMS data to compare estimates to actuals, monitor job progress, manage budgets, and perform various other business activities not currently supported by existing Manitoba Hydro systems.

WMS will allow Manitoba Hydro to constantly improve on design and estimates. Also, through interface tables provided with most WMS products, integration with the Manitoba Hydro SAP suite can be achieved. Integration with SAP will automate many of the manual entries currently made into the SAP MM and Projects Systems. Through configuration and integration, WMS will become an integral part of the Manitoba Hydro operations systems, providing data ties and links to many facets of the business.

3.3 Customer Information System

CIS encompasses the existing Manitoba Hydro systems and databases that will provide customer information, including premise ID, service addresses, type of service, and consumption, to the new suite of applications, primarily to GIS.

3.4 Outage Management System

Recent industry trends concerning improved reliability and accountability for reliability reporting has placed the implementation of an OMS at the forefront of most utility T&D IT strategies. However, an effective implementation of an OMS relies heavily on accurate data from CIS and GIS systems as well as timely updates from the graphical design application. Typical functionality that can be expected from an OMS includes:

- Trouble call grouping, sorting, and prioritization
- Emergency crew management
- Electronic wallboard/tools to track system operational state

- Switch order generation
- Rudimentary outage statistics generation
- Automated SCADA interface

While the other systems described in this document can provide similar functionality to both electric and gas lines of business, OMS application functionality is not common to electric and gas at the present time.

Gas outage management can be achieved using the tools within the GIS, provided that customer information is retained within the GIS. GIS functionality can be created to include lists for customers affected and relight lists. Gas outage management is different from electric in that a large volume of calls are customer related, and consequently, multi-customer outages involve a higher level of severity due to safety constraints.

3.5 Computerized Maintenance Management System (CMMS)

While the use of maintenance management functionality is more familiar at the station level, a CMMS should be considered a key to implementing a successful distribution asset management program. A CMMS should be employed by a utility to perform the following:

- Perform maintenance analysis in accordance to corporate maintenance philosophy (i.e. RCM)
- Develop and maintain maintenance plan from equipment family to individual equipment level
- Track and monitor maintenance programs
- Trigger creation of maintenance work orders
- Associate supporting Manitoba Hydro and factory test results with equipment

3.6 Mobile Workforce Management (MWM)

Manitoba Hydro is currently using a mobile workforce management application (MWM) within the core business application suite in the gas business unit. The Common Data Model solution architecture proposes augmenting the current type of work being scheduled, assigned, and dispatched through MWM with inspections and Manitoba Hydro field crew tasks. Expanding MWM to handle inspection work orders initiated by the CMMS will enable Manitoba Hydro to more efficiently balance work and route field service crews to cover more tasks in the same locations.

By using MWM as the single point of order scheduling and dispatch of work, Manitoba Hydro can better manage its daily work plans and crew schedules. MWM will also provide the opportunity for all Manitoba Hydro crews to be wireless in the future.

3.7 Enterprise Resource Planning (ERP) – SAP

SAP will serve as the financial and accounting hub for the applications within the Common Data Model. All of the required project IDs and associated budgets and financial accounts will be sourced from SAP. As work progresses to completion in WMS, SAP modules will be the recipients of project completion data covering the as-built asset spectrum. This includes automating asset ID entries to the property books based on CU type, make, kind, usage, and action attributes. Data mapping will be required between SAP and WMS to achieve the proper configuration needed to support the integration. The Common Data Model will not impact SAP. SAP is a major enabling application for the Common Data Model.

The data feeds to and from WMS will need to conform to the Manitoba Hydro SAP configuration. All integration should be done using SAP-provided integration points to minimize and perhaps eliminate the need for custom builds. SAP will remain Manitoba Hydro's plant and property accounting data repository. This Common Data Model will augment the data by providing more details surrounding individual facilities, work orders, and maintenance history.

SAP Materials Management modules at Manitoba Hydro will serve as key links for materials for the Common Data Model. Because all of the Manitoba Hydro material items in the CU catalog will be sourced from MM, mapping and aligning materials in SAP MM with those in WMS and design tools play an integral part of building and maintaining CUs, which are the cornerstone of the WMS and design tools.

The SAP Human Resources (HR) modules at Manitoba Hydro will serve as the source of employee data. The data needed by WMS includes skills and rates for all of the classifications of Manitoba Hydro workforce. Once the skill class and rate data is loaded into WMS, the values remain static for longer periods of time. In addition to employee data, the architecture depicts a future consideration for time reports being fed from WMS to HR.

5. DATA REDUNDANCIES

Within the scope of the Common Data Model, several significant areas of data redundancies were identified. This redundancy introduces data corruption and operational inefficiencies to all processes with data dependencies. The long term-goal of Manitoba Hydro is to eliminate data redundancies.

An analysis of the current architecture at Manitoba Hydro identifies that a number of applications exist which, due to their data requirements, inherently fit within the scope of the T&D Application Architecture described in Figure 2. Due to data availability and departmental constraints that existed when these applications were created, many of these applications represent a minor database with data maintenance, and query and reporting tools. The data contained within these applications is in several cases already captured within other systems at Manitoba Hydro. This application overlap is common in many utilities with a legacy of building point technology solutions to satisfy department needs.

In order to support the full cycle of asset management, it is necessary that Manitoba Hydro eliminate data redundancies. Data redundancies exist primarily where application redundancies exist.

Figure 3 demonstrates that the major T&D application functional redundancy at Manitoba Hydro is specifically in the areas of maintenance management and project management. Resolution of the functionality overlap and the inclusion of tight integration within the T&D Application Architecture will reduce many of the duplicate data entry associated issues currently witnessed within Manitoba Hydro. This situation is common in many utilities where work groups developed their own maintenance and work tracking applications: the shortcoming of this approach is that a common view of resource utilization or work across the enterprise is not possible

Within the area of maintenance management, Manitoba Hydro is striving to consolidate functionality into a single CMMS. The Common Data Model suggests using the CMMS to track all data related to the following:

- Maintenance history
- Test history
- Inspection history
- Generation of maintenance work orders

The other area of application overlap is project work support. Manitoba Hydro has developed a relatively large number of department applications to create, capture, and track work order information. While short-term elimination of duplicate work order tracking systems may be unrealistic, Manitoba Hydro will pursue a long term-strategy of procuring a WMS that includes the ability to perform short-term or template work scheduling as well as long-term scheduling. Consolidation of work order tracking will provide Manitoba Hydro with an enterprise view of work at any given time.

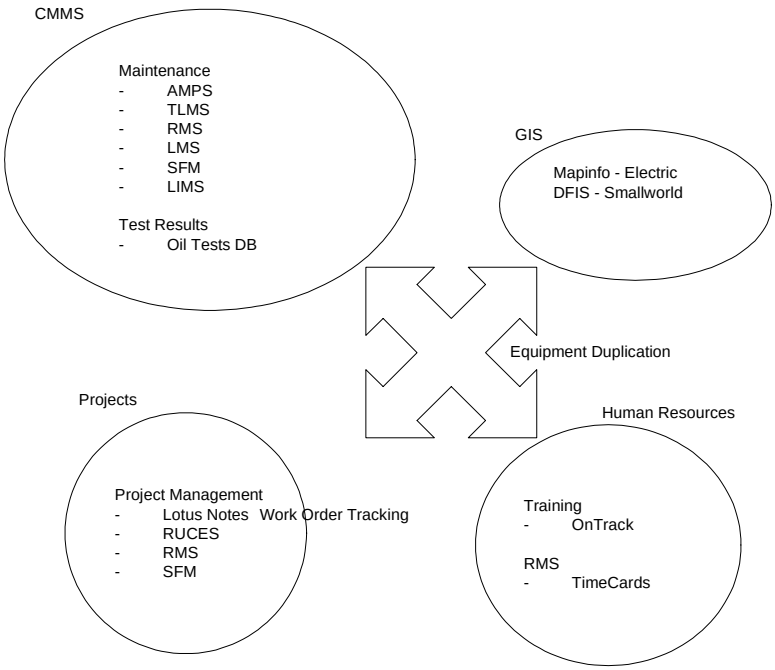

Figure 3: Current Application Functionality Overlap

6. CONCLUSION

A Common Data Model to represent the Manitoba Hydro T&D electric and gas lines of business is presented. This Common Data Model is based on the assumption that Manitoba Hydro will pursue a strategy of procuring a suite of commercial applications as opposed to building a custom suite of applications. Development of a Common Data Model in the framework of procurement and integration of a commercial application suite represents a different philosophy than that the steps necessary to build a Common Data Model to support a custom-built applications suite. A Common Data Model that supports a commercial application suite requires the identification of data ownership by type and system. This is of paramount importance.

The Common Data Model presented in this document will ensure that growth and system evolution can be performed in a controlled manner. This understanding of the data should help Manitoba Hydro determine who should own the data, where the data should be captured and kept, and who needs to view the data. Integration within the Common Data Model

enables applications to function together by sharing data based on events. The principal COTS applications of the Manitoba Hydro solution is a fully integrated geographic information system (GIS), graphical design, outage management system (OMS), customer information system (CIS), computerized maintenance management system, mobile workforce management (MWM), and work management system (WMS) that behaves as a single application to the end user. System integration involves a blend of data, triggers, timing, and applications assembled in a manner that enables the systems to work together seamlessly.

It is the expectation of Manitoba Hydro that the Common Data Model will evolve over time based on business and technology drivers. A Common Data Model Steering Committee and Maintenance Organization has been established to assist both technologists and business area resources to understand how to use the model as well as to own the growth of the model. Manitoba Hydro recognizes that when the Common Data Model stagnates its use will cease. The System Development Methodology at Manitoba Hydro will be changed to incorporate the CDM for all future system enhancements.

It is the belief of Manitoba Hydro that integration of the core applications within the Common Data Model will offer both tangible and intangible benefits. Through implementation of the Common Data Model, Manitoba Hydro will strive to:

- Improve cash flow
- Reduce operating costs
- Provide information to those who need it
- Improve business process performance
- Optimize capital
- Reduce cycle times
- Improve decision support effectiveness
- Grow revenues
- Integrate technology with business processes
- Enhance competitiveness
- Support performance-based rates
- Support deregulation.

To summarize, the Common Data Model provides Manitoba Hydro with the means to identify where they are and where they should be. The Common Data Model does not tell you how to get there (there may be interim steps) and does not tell you when. The how and when is determined by need and available resources.