Challenges in Metadata Integration:
*BMO Financial Group Case Study*

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Information Resource Management Association (IRMAC)

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Executive Summary:

Challenges in Metadata Integration: BMO Financial Group Case Study

BMO Financial Group metadata journey is now heading to a new challenge. It is necessary to create an metadata integration strategy and standard to ensure different types of sources are brought together to provide a holistic business and technical value to the enterprise where the total is expected to be greater than the sum of the parts.

◆ What is metadata integration?
◆ How BMO strategize the integration?
◆ Where we are having success and where the challenges persist?
◆ Who is getting benefits from this?
◆ Why this strategy sounds good?
Agenda

- Introduction to Bank of Montreal Financial Group (BMO)
- Metadata @ BMO
- Data Quality @ BMO
- Data Governance @ BMO
- Lessons Learned & Next Steps
Bank of Montreal Financial Group - Overview

- Founded in 1817 as Bank of Montreal, Canada’s first bank

Now, a highly diversified financial services organization providing a broad range of retail banking, wealth management and investment banking products and solutions:

**Canada:**
- Retail: BMO Bank of Montreal
- Wealth management: BMO Nesbitt Burns, BMO InvestorLine, BMO Harris Private Banking

**United States:**
- Chicago-based Harris and Harris Private Bank

**North America & International:**
- Investment & corporate banking: BMO Capital Markets

- Total assets of $416 billion as at October 31, 2008
- More than 37,000 employees
Information Management Origin: Metadata and IM Policy

- We first brought in metadata technology in 2001, and began using it to support inventorying the data warehouse and supporting our business steward start-up.

- Information was declared a strategic asset by the Board of Directors in May 2004, through ratification of our Corporate Information Management policy.

- We have been working since then to implement information accountabilities, through delivery standards, guidelines and best practices to support BMO Financial Group.

- Over the last 2 years, the Office of the Superintendent of Financial Institutions (OFSI) published *Data Maintenance Principles* to assure proper controls for Basel II data.

- OSFI supplied a regulatory requirement reinforcing our need for IM for Basel information. Thus, Basel II has become a key driver for the IM program at BMO.

- Integration of metadata and data governance topics into IT and business practices has been a goal of the Information Governance and Quality team from the beginning.
What is Metadata Integration?

- Metadata is not viewed as a narrow, technical specialty
- Metadata is used to develop a big-picture view of information and systems
- Metadata repository provides a single view of the truth
- Metadata repository is the enterprise view of metadata
- Metadata is viewed by technical and business users as key information asset
- Metadata management best practices integrated into requirements management, development and operations processes
- Metadata is part of your life
Metadata Integration Strategy

- Working with business and technical partners to develop current and future requirements
- Building new enterprise metadata repository to increase functionality and enhance user experience
- Have established close ties with Enterprise Data Architecture group
- Working on high-profile business projects to demonstrate the value of metadata
First Focus – Business Metadata

We capture business (and technical) metadata in the Enterprise metadata repository

- What it is (subject area, business concepts/terms, definitions, models)
- Where it is (system name, report/table/file column/field)
- Who is accountable for it (and what is the policy for it)
- How it got there (ETL mappings)

Our existing metadata practices were based first on a simple value proposition: people, like our stewards, need metadata to do their jobs. Now, they also provide much of the basis for our demonstrating compliance to IM related regulatory directives.

“Metadata provides a pedigree to our information: what the information is, where it came from and how it got there, what systems use it, its relationship to other information.”
BMO recently adopted a common reference vocabulary for describing data - it is used by IT to develop data models, XML schemas. With the vocabulary, we have adopted metadata tooling that manages integration between business and technology levels.

It forms the core starting language we use for:

- Data Rationalization - reviewing data attributes in existing systems and assigning common business meaning to the many existing data elements
- Data Modeling – developing new solutions more quickly
- Business Standards - identifying and harvesting business terms

Because the vocabulary is specific to the industry but not complete and customized for our Bank, it requires a governance process to manage changes.

The common vocabulary provides integration between business views and our architecture.
The previously very difficult integration between logical models and enterprise vocabulary occurs within the data modeling tool, and new concepts can be identified both top-down, and bottom-up.

Entity-Relationship Models can be generated from FSDM Scopings.
Metadata integration – Business to Technical view

Common vocabulary

Arrangement
- Product Arrangement
  - Account Arrangement
    - Finance Service Arrangement
      - Loan Arrangement
- Finance Service Arrangement
- Loan Arrangement

The language used in new data models is derived and linked to the common vocabulary.

Existing systems that were not designed using the framework architecture are rationalized to the reference vocabulary – (corresponds to building the metadata mappings from business to technology).

Metadata Mappings between vocabulary and data models are managed in the data modeling tool.

Enterprise Data Warehouse

New Operational System Model

Legacy System Model

Metadata integration – Business to Technical view

Metadata @ BMO: IRMAC – January 21, 2009
Metadata Product & Services

- **Ensuring Data Quality and Integration**
  - Metadata Assessments
  - Classification
  - Glossaries
- **Standardizing Business Information**
  - Business Definitions
  - Business Terms

- **Making Data Identifiable and Traceable**
  - ETL
  - Traceability
  - Reports
- **Making Data Readily Available**
  - Databases / Files
  - Data Models

Making Data Identifiable and Traceable
Ensuring Data Quality and Integration
Standardizing Business Information
Making Data Readily Available
Ensuring Data Quality & Integration

Provide data verification and rationalization services to help clients build metadata procedures and processes into their workflows.

Verify
- Verify data correctness.
- Ensure standards are followed and data relationships are defined.

Rationalize
- Identify existing data elements and integrate new data into existing relationships.

Version Control
- Establish versioning for new data and ensure that latest relationships are maintained.

Load
- Store data in the repository and ensure data properties and relationships are maintained.
Integration Successes

- **Examples**
  - Student Loans
  - Air Miles
  - Data Quality
Integration Use Case

- Effective March 2008, BMO complies with the regulatory requirements to provide the Quebec Government with a consolidated monthly Balance Update file containing the required information for all loan classes of Quebec Student loans held by BMO. Back in 2007:
  - We were trying to figure out if the Data Warehouse or the Basel Retail Datamart has certain transactional data on Quebec Student loans
  - Information required was: Loan Balance, Accrued Interest and Capitalized Interest.
  - A search into Enterprise Metadata Repository provided:
    - There is a mapping file with the first two information between the Data Warehouse and Basel Retail Datamart
    - The corresponding source layout details
    - Nothing on Capitalized Interest
  - But did not provide:
    - The identification in the Data Warehouse of which are the QSL among other loans (i.e., QSL loans are branch = 3802)
    - That the ETL between those has not run since Dec 2006.

Business Metadata
- Technical Metadata
- Operational Metadata
Missing Integration Links

Quebec Student loans

Capitalized Interest

Loan Balance

Accrued Interest

mapping file

source layout

identification

Case Study - Québec Student Loan

has not run

Business Metadata

Technical Metadata

Operational Metadata
Metadata Scope

Metadata Types

**Business**
- Business Terms
- Business Definitions
- Data Standards
- Privacy Categories
- Retention
- Information Categorization
- Conceptual Data Models
- Information Steward
- Process Steward
- Information
- Policies and Procedures
- Detail Requirement Specification Data Inventory
- Application Name & Description
- Application Mapping to Business Processes and Information Categories
- Information Framework Workbench (IFW)

**Technical**
- Database Schema/Catalog
- Table and View Definitions
- Stored Procedures (business rules)
- Logical Data Model
- Physical Data Model
- Diagrams
- File Name
- Field Name
- File Description
- File Definition
- Version Control
- Report Design Description
- Reporting Tool Catalog
- Report Definition
- COBOL Copybooks
- Assembler Macros
- PL/I Declares

**Lineage**
- Forward Traceability
- Backward Traceability
- Relationships (between, upstream and downstream)
- Business Rules
- Calculations and Derivation Rules

**Operational**
- Usage Statistics
- Load or Systems Failures
- Change Management Process
- Data Load History
- Load schedules
- Reconciliation

Metadata Quality

- Data Quality Business Commentary (Wiki)
- Code Values (valid values)
- Metadata Profiling
- Skyhooks Analysis
- Unique Identifier Analysis
- Defect Logs

Continuous Improvement Processes
Metadata Scope - Considerations

**Metadata Types**

**Business**
- Business Functions
- Organization Unit Hierarchy
- Reporting Hierarchy
- Business Vision, Goals
- Business Objectives
- Project Deliverables
- Project Sign-offs
- Artefacts Responsibilities

**Technical**
- Releases
- Transformation Specifications
- Architecture Diagrams
- Requirements Specifications
- Screen Designs
- Technology Reference Model
- Database Index, Table Spaces
- Java, C++, C#
- XML Schema
- SOA Registries
- Network Nodes & Topology
- Addresses
- Network Resources
- Permissions
- Security Groups
- Resources
- Service Standard

**Lineage**

**Operational**

**Metadata Quality**

**Continuous Improvement Processes**
Data Governance supports information accountabilities

We have established these objectives of information accountabilities:

◆ Ensure that information assets are identified, well defined, and catalogued
  ▪ Accomplished via a common enterprise vocabulary linked to business perspectives
  ▪ We have processes for adding new terms, for standardizing data

◆ Ensure that the business and legal/regulatory requirements for managing information assets are established, implemented and maintained
  ▪ Data is classified

◆ Ensure that information is provided with the quality expected by the business and its information consumers
  ▪ Monitoring via data profiling (just starting)

◆ Increase business value by optimizing the creation, management and use of information assets
  ▪ Re-use of assets, publication of integrated metadata
Governance Structure for Data Decisions

Executive Technology Committee

Architecture Review Board

Data Architecture Foundation Team

Data Governance and Quality

Enterprise Data Governance Review

Business Working Group(s)

Project team (data models, data integration, business analysis)
Data Rationalization

“If it weren’t for all that stuff that happened already, life would be simpler”

- Different Legacy systems use local terminology to describe the same thing. Data Rationalization is a generic term for harmonizing the terminology and definitions across systems.
  - Previous to the common enterprise vocabulary data rationalization practices involved nominating business terms via bottom-up analysis of metadata
  - In the presence of a common vocabulary, this activity can more readily include a top-down approach.
  - With metadata integration built-into the modeling tooling it becomes feasible to imbed rationalization into the SDLC, as opposed to an out-of-cycle practice

- A common vocabulary doesn’t imply data rationalization produces simple mappings. Any data item in a legacy system may involve more than one business term in the common taxonomy
Demonstration

◆ Example

**Air Miles**

- To support our marketing initiative, we’d like to get a bank-wide review of all customer Air Miles rewards. What data structures at enterprise level can provide that information?
- Or let’s at look what the marketing group is using today.
Privacy
<table>
<thead>
<tr>
<th>Data Mart</th>
<th>Business Name</th>
<th>Business Description</th>
<th>Accuracy</th>
</tr>
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<tbody>
<tr>
<td>CKBO</td>
<td>Air Miles Awarded Count</td>
<td>Number Of Air Miles Awarded</td>
<td></td>
</tr>
<tr>
<td>CKBO</td>
<td>Air Miles Collector Number</td>
<td>A unique number assigned by the Loyalty Management Group Canada Inc. to an individual or entity for the purpose of collecting Air Miles. This number will be provided by a customer who is either an AIR MILES® or an AIR MILES® for Business subscriber to permit the bank to allocate AIR MILES® to the customer.</td>
<td>Citi Approved</td>
</tr>
<tr>
<td>CKBO</td>
<td>Air Miles Current Month Amount</td>
<td>A total of Air Miles assigned month to date</td>
<td></td>
</tr>
<tr>
<td>CKBO</td>
<td>Air Miles Expense Amount</td>
<td>The sum of the LGM Air miles expense for all accounts belonging to that household.</td>
<td></td>
</tr>
<tr>
<td>CKBO</td>
<td>Air Miles Offer Code</td>
<td>Air Miles FLOC, Mortgage Tier or GIC Offer Indicator. Values: Y, N or Null.</td>
<td></td>
</tr>
<tr>
<td>CKBO</td>
<td>Air Miles Type Code</td>
<td>Type As Per AMT/APRS</td>
<td></td>
</tr>
<tr>
<td>CKBO</td>
<td>Total Air Miles Cost</td>
<td>Bank's cost for air miles point issued and redeem at 95%. Issuance cost = (redemption cost + 75% * miles issued) (based on finance reserve rate)</td>
<td></td>
</tr>
<tr>
<td>CUSTSOL</td>
<td>Air Miles Collector Number</td>
<td>A unique number assigned by the Loyalty Management Group Canada Inc. to an individual or entity for the purpose of collecting Air Miles. This number will be provided by a customer who is either an AIR MILES® or an AIR MILES® for Business subscriber to permit the bank to allocate AIR MILES® to the customer.</td>
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<td>CUSTSOL</td>
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<td>Air Miles Expense Amount</td>
<td>The sum of the LGM Air miles expense for all accounts belonging to that household.</td>
<td></td>
</tr>
<tr>
<td>EVT</td>
<td>Air Miles Awarded Count</td>
<td>Number Of Air Miles Awarded</td>
<td></td>
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<tr>
<td>EVT</td>
<td>Air Miles Collector Number</td>
<td>A unique number assigned by the Loyalty Management Group Canada Inc. to an individual or entity for the purpose of collecting Air Miles. This number will be provided by a customer who is either an AIR MILES® or an AIR MILES® for Business subscriber to permit the bank to allocate AIR MILES® to the customer.</td>
<td>Citi Approved</td>
</tr>
<tr>
<td>CKBD</td>
<td>SRC_MECCRF</td>
<td>AC_AIRMILES_NUMBER</td>
<td>CHAR</td>
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<td>CKBD</td>
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<td>CUSTSOL AC SENSTV_ PRFL_D_CURR</td>
<td>CUSTSOL cdw Респ specific act me YYYYMM.dat</td>
<td>MECH_AM_COLLECTR_ID</td>
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<td>CUSTSOL HANKS_RTL_CUST_F</td>
<td>CUSTSOL MCV RFRL D</td>
<td>CUSTSOL MCV RFRL D_CURR</td>
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<td>CUSTSOL PCDW ME MRKTOUTn</td>
<td>CUSTSOL PMEG NBFM MDB00n MDCBA AMRKTOUT</td>
<td>CVM MCV RFRL D</td>
</tr>
<tr>
<td>CUSTSOL PIPS NBPM COPY CUSTOMER</td>
<td>CUSTSOL PCDW ME MRKTOUTn</td>
<td>CUSTSOL PMEG NBFM MDB00n MDCBA AMRKTOUT</td>
<td>CVM MCV RFRL D</td>
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<td>CVM MCV RFRL D</td>
</tr>
</tbody>
</table>
How we get Metadata?

- A ETL metadata change process has been established involving IMGQ, the Data Warehouse Team, and project managers.
- The same process is applied for the central Warehouse and all data marts.
- A standard format for ETL and REPORT metadata capture has been adopted.
- Metadata is verified by Data Warehouse Quality Assurance. IMGQ produces metrics.

**Diagram:**

```
<table>
<thead>
<tr>
<th>Source</th>
<th>Standard Staging (Warehouse)</th>
<th>Target (Data Mart)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERWIN data model</td>
<td>ETL Mapping</td>
<td>ERWIN data model</td>
</tr>
<tr>
<td>COPYBOOK Or FLAT FILE</td>
<td></td>
<td>ETL Mapping</td>
</tr>
<tr>
<td></td>
<td>Metadata Repository</td>
<td></td>
</tr>
<tr>
<td></td>
<td>REPORT Definition</td>
<td></td>
</tr>
</tbody>
</table>
```

**Legend:**
- ERWIN data model
- ETL Mapping

Metadata @ BMO: IRMAC – January 21, 2009
EIP – an opportunity for Data Governance

- Enterprise Information Provisioning (EIP): our multi-year program that evolves will re-architect our current data mart environment into a new Enterprise Data Warehouse
- Current environment is fragmented and hard to maintain and expand
- Business case is based largely on cost reductions (maintenance, software and hardware)
- However, the underlying need to provide a high quality trusted source of information that the business can use to make better decisions, and a capability to react to new needs more quickly
- Improvements are needed in Metadata, Data Governance and Quality to help EIP succeed

Part of EIP Strategies

- W011 – Retention Control
- W025 - Metadata Management
- W025A - Operational Metadata
- W030 – Data Quality Management
- W037 – Data Profiling
- W039 – Data Quality Measurement
- W047 – Regulatory Compliance
Metadata Integration Challenges

1. Budget
2. Access to knowledgeable staff resources (business & technical)
3. Early access to projects – at the requirements stage
4. Project prioritization
5. Staff knowledge / awareness of metadata matters
6. Establishing a complete picture of the metadata landscape
7. Process gaps – metadata collected and discarded, or not collected for re-use, hence of low quality
Metadata Integration Benefits

1. We target business problems that depend on good quality metadata.
2. We align with programs where we and our business partners mutually observe a value proposition.
3. Support to Information Stewardship: warehousing their metadata, supplying assistance for business standards, data quality, IM assessment and planning
4. Helping BI users find data and assess the ‘fit for use’ to their needs, including sharing standards provided by stewards
5. Supplying data inventory information to development teams such as the Enterprise data warehouse
6. Supporting regulatory initiatives such as Basel II
7. Supplying best practice support to the enterprise
Data Governance Context

- **Information based on line of business**
  - Fragmented and silo’d view of information assets
  - Culture: business operated autonomously; wary of expense of head-office ideas

- **No corporate governance of information**
  - Significant compromises to the core information architecture
  - Tools often selected locally with no thought to enterprise implications
  - Enterprise data integration issues were secondary concerns
  - No common data standards

- **Information management value proposition unclear**
  - Information security and privacy clearly defined but IM was murky
Regulatory and Business Drivers for Governance

- Legislative and Regulatory trends
  - Protection of individual rights: Privacy legislation: PIPEDA (Canada), GLBA (U.S.)
  - Enterprise transparency – ensuring practices are controlled, consistent and visible:
    - SOX; Basel II; End user computing applications
  - Compliance timeframes shrinking:
    - UNST / Anti-Money Laundering: near-real time

- Industry trends
  - Integrated customer info & common reference data
  - Enterprise Business Intelligence CoCs
  - Increased enterprise data governance

- BMO Financial Group Implications
  - Need to know where our data resides and to use it effectively across the bank
  - We need to able to access it quickly
  - We need to be able to trust the data that we find
2004 IM Policy: The Foundation for Governance

Board approved principles – *Information is a strategic asset* to be monitored, reported, and audited.

For business areas, purpose of information is *value creation*.
Organizing Framework

- Board approved policy
- Integrated into bank governance via Operational Risk Framework
- External models, e.g. IBM’s *Data Governance Council*, support BMO’s approach
# Data Governance Framework Components

<table>
<thead>
<tr>
<th>Framework Disciplines</th>
<th>Provides Leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Architecture</td>
<td><strong>Enterprise Data Architecture</strong> provides best practices and architecture standards (e.g., Banking Data Warehouse model).</td>
</tr>
<tr>
<td>Data Quality</td>
<td><strong>Information Governance and Quality</strong> provides leadership and supplies services; collects and publishes metadata; provides guidance on records retention and information stewardship; monitors data quality. Assists in value creation via data management practices.</td>
</tr>
<tr>
<td>Information Lifecycle Management</td>
<td></td>
</tr>
<tr>
<td>Meta Data / Business Glossary</td>
<td></td>
</tr>
<tr>
<td>Stewardship</td>
<td></td>
</tr>
<tr>
<td>Value Creation</td>
<td></td>
</tr>
<tr>
<td>Audit and Reporting</td>
<td><strong>Corporate Support Area</strong> responsible for monitoring and reporting on risks related to their area. E.g., responsible for information risk monitoring Partnership for education and awareness (common training, annual attestation).</td>
</tr>
<tr>
<td>Organizational Structures and awareness</td>
<td></td>
</tr>
<tr>
<td>Risk Management</td>
<td></td>
</tr>
<tr>
<td>Security / Privacy / Compliance</td>
<td></td>
</tr>
</tbody>
</table>
Information, along with financial resources and human resources, is a key resource in managing any business. As such, information needs to be managed as an integrated business resource.

Organizations must plan their future information needs and effectively use and manage information to support their business processes.

“The Bank manages information as an integrated, enterprise asset, in a disciplined and coordinated manner. The outcome optimizes the value of our investment in the information assets and is core to achieving the Bank’s business strategies and goals.”

Source: BMOFG Information Management Policy
Data Governance: Practical Tips

1. Focus efforts on practical business requirements
   - **DO:** Focus on cost containment; revenue generation; risk management; compliance
   - **DO:** Leverage / promote good IM practices already in place, find existing processes rather than make new ones
   - **DO:** Establish accountabilities that work for the organization
   - **DON’T:** Promote information management solely as good business

2. Secure a broad-base of support
   - **DO:** Get an executive sponsor
   - **DO:** Obtain broader executive buy-in for traction
   - **DO:** Develop grassroots & lateral support

3. Embed governance and quality as part of an overall information strategy aligned to business goals
   - **DO:** View IM as integration not administration
Data Governance Integration: Accomplishments

1. Became an integral part of major application development efforts:
   - Customer Information Integrity (retail banking)
   - BASEL II programs (data governance & enterprise metadata)

2. Established close partnerships
   - Privacy, Security, Risk and Enterprise Architecture groups through combined work efforts

3. “Information into action”
   - Key part of overall strategy to gain value from its information assets

4. Increased profile of information management to the Board and management
Data Governance Process Integration

◆ Transparency vs. Opacity
◆ Embedded into existing processes
◆ Leverage:
  ▪ Broad organizational impact
  ▪ High impact process change
  ▪ Low cost, minimal additional investment
Process Integration: Records Management

Records Management

- Ensures we meet regulatory requirements
- Reduces lifecycle costs (storage of information)
- **Records Classes** identify groupings of information, associated retention schedule, and legislative requirement
Process Integration: Accomplishments

1. Risk Control Self Assessments; Business Continuity Plans
2. Accountabilities & annual employee attestation
3. Development requirements management process
4. Governance
5. Monitoring and Reporting: Key Risk Indicators
Process Integration: Education & Awareness

1. Integrated IM training program for all employees
   - Information Management, Information Security & Privacy
2. Information sessions (seminars, professional forums)
3. Consulting support model
4. Integration into existing Communities of Practice
5. Integrated website for IM, Security & Privacy topics
What’s Next? – Evolving Role

We have established a foundation of practices based on our Enterprise IM Strategy. Additional focus areas for 2008 include:

**Foundational**
- Metadata Management
- Policy and Standards development
- Information Classification
- Information Accountabilities & Stewardship Business Model

**Key focus areas:**
- Monitoring and Reporting
- Communications & Awareness
- Data Architecture & Quality
- Enterprise Records Retention
- Business-managed Applications
- IM risk identification
- Data leakage
- Policy & Standards review
Lessons Learned - Summary

● **Compliance ≠ Governance**
  - Achieving regulatory compliance is not the same as adopting best information management practices and embracing IM principles

● **Organizational Info Management Maturity will be uneven**
  - Some areas will be early adopters, others will require more effort
  - Executive sponsorship and effective change management practices are vital for success

● **Not all information is equal**
  - Not all information has the same value or the same risk
  - An effective governance framework needs to be flexible

● **Information can be governed**
  - The experience of BMO and others are testimony to the success that can be achieved
Questions?

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