Embracing Change

Financial Informatics and Risk Analytics

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The views expressed are those of the author and do not necessarily reflect official positions of the Federal Housing Finance Board or the U.S. Department of the Treasury.
Federal Home Loan Banking System

- 12 regional Federal Home Loan Banks (FHLBs)
  - Owned by members (8000 banks and thrifts)
  - ca. $1,000,000,000,000 in aggregate assets
  - ca. 100,000 complex financial contracts
  - ca. 4.50% capital
Managing Risk

• Analysis requires data and models
• Unstable metadata, due to:
  • financial innovation
  • model risk
  • strategic policy evolution
• Flexibility is the central requirement
Model Risk

Data input risk
- Market data
- Position data

Estimation risk
- Method #1
- Method #j

Model selection risk
- Model #1
- Model #k

Implementation risk
- Analytics #1
- Analytics #n
Scalability of Metadata

**Stovepipe topology**

Source systems       Analytics systems

\[ s_1 \]
\[ s_2 \]
\[ s_3 \]

\[ a_1 \]
\[ a_2 \]
\[ a_3 \]
\[ a_4 \]

**Cost** = \((m + n)k_{spec} + (mn)k_{map}\)

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**Numeraire topology**

Source systems       Analytics systems

\[ s_1 \]
\[ s_2 \]
\[ s_3 \]

\[ N \]
\[ a_1 \]
\[ a_2 \]
\[ a_3 \]
\[ a_4 \]

**Cost** = \(k_N + (m + n)k_{spec} + (m + n)k_{map}\)
Scalability of Metadata

Stovepipe topology

Numeraire topology
Implementing a Solution

• Requirements:
  • Flexible
    Auto-generate all significant outputs from metadata
  • Scalable
    Use the numeraire architecture
  • Practical
    Use production-quality tools available today
  • Portable
    Design is self contained and independent of platform
Implementing the Numeraire

**Numeraire topology**

- Source systems: $s_1, s_2, s_3$
- Analytics systems: $a_1, a_2, a_3, a_4$

**Numeraire component design**

- Market data: Market 1, Market 2, ...
- Position data: Portfolio 1, Portfolio 2, ...
- Data integration
- Analysis: Analytics 1, Analytics 2, ...

$N$
Implementing the Numeraire

Data Integration:
- Ontology editor
- Metadata Manager
- Data Mapping Manager
- Version control repository
- Database

GUI

Market Data:
- Vendor data 1
- Vendor data 2
- Vendor data 3 (etc...)
- Market data (preliminary)

Position Data:
- Portfolio system 1
- Portfolio system 2
- Portfolio system 3 (etc...)
- Position data (preliminary)

Analysis:
- Analytics package 1
- Analytics package 2
- Analytics package 3 (etc...)

LEGEND:
- Bespoke (user-maintained) system components
- Licensed (third-party) system components
- Data
Ontology for Flexible Metadata

User-maintained with an ontology editor

Generated SQL-DDL, XSD, etc.

Financial data

Ontological structure

Ontology instance

Metadata

Data

Four-layer metamodel architecture

Description logics

Frame-based knowledge representation

Meta-metamodel

TBox

Classes

Metamodel

ABox

Instances

Model

Information
Implementing Flexible Metadata

Metadata Manager

<< infrastructure >>

Ontology editor << application >>

Client GUI << application >>

Version control repository << datastore >>

XSLT processor
<< infrastructure >>

Ontological structure

numeraire

source spec.

1..*

1..*

target spec.

spec2artifact.xslt

ontology

ontological instance

config

artifacts

numeraire

source spec.

target spec.

input

output

style

1..*

1..*

store
Really implementing it
Thank you.