Software Engineering
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Session 6 - Sub-Topic 2
Sample Enterprise Application Design

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Best Practices in Technical Architectures for Fixed Income Market Participants

Dr. Jean-Claude Franchitti
Presentation Agenda

- Observations of a Former Trader
- Fixed Income Technical Architectures
  - Architecture Development Methodology
  - Fixed Income Business Process Maps
  - Fixed Income Solution Capabilities Matrix
  - Deriving a Conceptual Technology Vision
  - From the Conceptual Technology Vision to a Logical Infrastructure
  - From the Logical Infrastructure to a Physical Solution
  - Physical Solution Implementation Steps
- Conclusion

Observations of a Former Trader
### Trading Environment Characteristics

<table>
<thead>
<tr>
<th>Anonymity</th>
<th>Liquidity</th>
<th>Transparency</th>
</tr>
</thead>
</table>

### Brokers' Broker

**Were They Efficient?**

- Human factor
- Limited network of contacts
- Largest firms control the inventory
- Regional broker/dealers not well serviced
- Difficult to unwind odd-lot positions
- Phantom trades
- Buy-side firms are not a part of the equation
Where Are We Now?
Automated Trading Systems (ATS)

- Eliminates the Human Factor
- Buy-side is involved
- More regional bank and foreign institution participation
- Internet – A border-less enterprise

All of which creates better Liquidity and more Transparency in an Anonymous environment.

Six Drivers for Change

- Institutional and Retail customers
- Brick and mortar sell-side institutions
- Traditional buy-side firms
- Broker’s brokers
- Regulatory
- Entrepreneurs
Challenges

- Existing legacy systems and newer ATS's will need to handle anticipated increases in trade volume implied by the development of STP.
- Fixed Income securities can have complex structures. Trading systems will need to incorporate proper analytics to calculate various essential data.
- There are many types of Fixed Income securities which trade in different ways. Standardized trading methodologies will need to be applied.
- Security information repositories will need to be large enough to hold data on millions of securities.
- Present front-end interfaces are no more than client/server versions of legacy systems.
- Back-office systems are antiquated. It may not be feasible to integrate them if they cannot support the new economy business.
- The new Fixed Income market of tomorrow may require an Application Program Interface (API) to a single Fixed Income exchange.
- T+1 must be incorporated into new technology.

Architecture Development Methodology
Mapping Vision to Solution
Fulfilling the Objectives to Support the Vision

**WORK STREAMS**

- **Customer facing**
  - Interviews
  - Demographic research

- **IT analysis and design**
  - Current IT state assessment
  - Architecture design/collaboration

- **Business processes**
  - Current business process assessment
  - Operating model design/collaboration

- **Competitive analysis**
  - Regional competitive analysis (including Web site evaluation)
  - Demographic research

- **Regulatory analysis**
  - Deal structure assessment
  - Regional regulatory analysis for operating model

- **Accounting and fiscal analysis**
  - Tax assessment
  - Global analysis of tax implications for operating model

- **Business case**
  - Documentation of revenue and cost driver
  - Financial model development

- **JV and partnership analysis**
  - Document findings from due diligence conversations
  - Develop general terms and conditions of JV/partnership

- **Go-to-market strategy**
  - Document integration plan for all work streams
  - Strategic plan

**OUTPUT**

- Preliminary Future State Model
  - Preliminary IT Architecture Design

- Preliminary Business Process Design

- Final Future State Model
  - Future State IT Architecture Design
  - Future State Business Process Design

**FUTURE STATE REALIZATION PROCESS**

- Extraction of Capabilities

- Refinements

- Constraints

- Validation
Right to Left Thinking...

Architecture Development Map

As information is collected, work effort, estimates and solution becomes concrete

Architecture Design Approach

Object-Oriented Analysis and Design

- UML models and diagrams

Design Assumptions

- Architectural capabilities are based on a limited set of business and technical requirements
- Simplicity, elegance, intelligibility, well-defined levels of abstraction, and clear separation between interface and implementation at all levels

Architecture Object Model

- Application architecture model
- Application infrastructure
  - Application Framework
- Technology infrastructure model
  - Physical architecture instance(s)
“4+1” Architecture View Model

Describes the Architectural Vision
Model helps represent the various constraints on the architecture
Provides multiple perspectives to represent the system
  • Logical view
    – Static and dynamic aspects
  • Implementation view
    – Organization of modules within the development environment
  • Process view
    – Decomposition in terms of execution flows, and flow synchronization
  • Deployment view
    – Describes hardware resources and associated software deployment
  • Use case view
    – Motivates and justifies the architectural choices (i.e., “the glue”)
**Application Architecture Overview**

Enterprise Application Suite

- Channels
  - Web Portal
    - Web Interface
      - Web View
      - Web Controller
  - Application Enterprise Services
    - Business Controller
      - Client Interface
      - Client Handler
      - Component Manager
  - Business Object Model
  - Infrastructure
    - Services
    - Common Facilities
    - Domain Specific Facilities

**Architecture Design Summary**

Driving Forces:

- Functional Requirements document
- Internal design guidelines
- Technology Preferences
- Software Architecture = Elements + Patterns + Motivations
- ‘4 + 1’ View Model
- Model View Controller (MVC) Concept
**Resulting Solution**

Fixed Income Trading Process Map

- Client logs in "Personalized" Web Page
- Submits Order
- Validate Order
  - Yes: Electronic trading available
  - No: Manual Review Needed
- Is the product in your inventory or available on ECN?
  - Yes: Electronic submission, execution
  - No: Non-Automated Execution
- Monitor Execution
- E-mail Confirmation
- Confirm Execution (price Qty, Etc..)
- Update customer account

- Is it Domestic?
  - Yes: Trigger FX, Electronic Execution?
  - No: FX Process

- Client Calls in Order
- Record by Sales Desk
- Contacts Client

**Typical Fixed Income Legacy Systems**

<table>
<thead>
<tr>
<th>Order Process</th>
<th>System</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rossi (OPICS)</td>
<td>S.A.M.</td>
<td>Used for accounting purposes</td>
</tr>
<tr>
<td>SIOPEL</td>
<td>CRYL</td>
<td>Order routing system</td>
</tr>
<tr>
<td>EUROCLEAR</td>
<td>CEDEL</td>
<td>System that shows the market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The central clearing system for Argentina fixed income products</td>
</tr>
<tr>
<td>Custody</td>
<td>Rossi</td>
<td>Performs Custody role for retail fixed income products</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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<tbody>
<tr>
<td>OPICS</td>
<td></td>
<td>Order routing system</td>
</tr>
<tr>
<td>INDEVAL</td>
<td>OPICS</td>
<td>The central clearing system for Mexican Securities</td>
</tr>
<tr>
<td>Custody</td>
<td></td>
<td>Performs Custody role for retail fixed income products</td>
</tr>
</tbody>
</table>
## Fixed Income Solution Capabilities Matrix

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### Preliminary Capabilities Matrix

<table>
<thead>
<tr>
<th>Drivers</th>
<th>Technical</th>
<th>Competitive</th>
<th>Customer</th>
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</thead>
<tbody>
<tr>
<td>Customization / Personalization</td>
<td></td>
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<tr>
<td>Customer Relationship Management</td>
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<tr>
<td>Efficient cross- and inter-enterprise communication</td>
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<tr>
<td>True integration</td>
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<tr>
<td>Continuously available hardware platform (24 x 7)</td>
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<tr>
<td>Flexibility</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Global portal (multi brand, multi channel)</td>
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<td></td>
<td></td>
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<tr>
<td>Localization</td>
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<td></td>
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<tr>
<td>Open, extensible, flexible architecture</td>
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<tr>
<td>Global eTrading business application support</td>
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<tr>
<td>Best-of-breed global e-trading solution</td>
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<td></td>
</tr>
<tr>
<td>• Secure transactions</td>
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<tr>
<td>• Collaboration (online chat)</td>
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<tr>
<td>• Real-time quotes, financial news, research</td>
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<tr>
<td>• Online help and training</td>
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<td></td>
</tr>
<tr>
<td>• Alerts</td>
<td></td>
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<tr>
<td>• Analytics (&quot;what if&quot; scenarios)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>• Online operation (order status, billing &amp; pricing, accounting, portfolio management, etc.)</td>
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</tr>
</tbody>
</table>
## Deriving a Conceptual Technology Vision

### Security
- Personalization
- Community
- Content Management
- Catalogs
- Commerce
- Information Access

### Enterprise Application Frameworks /Servers

### Other Application Frameworks /Servers

### Hardware/Operating Software
- Systems Management
- Hosting Services

### Using an Architecture Framework
Operations & Technology Support Vision

Technology support should support a vision that will guarantee a unique experience for e-Trading customers anywhere in the world.

Sample Trading Process

Message Broker

Order Confirmation

Order Placement

Order Routing

Main Office Staff

Local Office Staff

Retail Client

Internet

Technology

Order gets routed locally

Local Office Staff

Main Office Staff

Local Office Staff

Internet

Legend:
Central Office
Country Offices
E-Trading Customers
Integrated Value Chain Support System
Local Back-Office Systems
3rd Party Systems

Data Repositories

Integrated

Data Warehouse

Local Databases

3rd Party Services

3rd Party E-Brokers

Exchanges

Data Providers, etc.

CEO

Operations / Technology Support Vision

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Legend:
Central Office
Country Offices
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Integrated Value Chain Support System
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3rd Party Systems

Data Repositories

Integrated

Data Warehouse

Local Databases

3rd Party Services

3rd Party E-Brokers

Exchanges

Data Providers, etc.
From a Conceptual Technology Vision to a Logical Infrastructure
Architecture Enabled Capabilities

Architecture Scalability Features

- "Statelessness"
- Subject-based distributed queues (EAI)
- Load distribution
- Fault-tolerance
  - Notification: Primary/Secondary failover
  - Recovery
  - Verification against state signature
  - True Hot Standby
### Architecture Support for Fixed Income Market Inventory

- Role-based market views
- Pre and post-trade workflow supported
- All Fixed Income instruments supported

### Architecture Support for Client Access

- Local, specialized user interfaces
- API's
- Internet access
- Legacy order streams
Architecture Security Features

- Encryption standards: 128 bit RSA: RVDS
- X.509 compliant certificates: TIBCA
- Level 5 firewall architecture

Architecture Support for Legacy Order Stream

- Legacy messaging interfaces seen as a user of the system
- Interoperates with existing users
- Can act as a bridge between deployed hubs
### Considering Mainstream Tools

<table>
<thead>
<tr>
<th>Categories</th>
<th>Applications</th>
<th>Frameworks/Platforms</th>
<th>Systems Management</th>
<th>Hardware/Software</th>
<th>Hosting</th>
</tr>
</thead>
</table>
### Evaluating Alternatives

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>(1) Web Enabled Legacy</th>
<th>(2) Combined Vendor Packages</th>
<th>(3) Component Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed to Business</td>
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<tr>
<td>Long-Term Viability</td>
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<tr>
<td>Cost of Ownership</td>
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<tr>
<td>Alignment with Vision</td>
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<tr>
<td>Business Risk</td>
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<tr>
<td>Simplicity/Ease of Use</td>
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<tr>
<td>Overall Rating</td>
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</tbody>
</table>

- Worst
- Good
- Best

### Physical Architecture (Example 1)

![Physical Architecture Diagram](image-url)
Physical Architecture (Example 2)

Technology Infrastructure
Physical Solution Implementation Steps

Development Methodology

<table>
<thead>
<tr>
<th>Practice Areas</th>
<th>Stages</th>
<th>Discover</th>
<th>Design</th>
<th>Develop</th>
<th>Deploy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business System Development</td>
<td>Business Modeling</td>
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<td></td>
<td>User Experience</td>
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<td></td>
<td>Content Development</td>
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<tr>
<td></td>
<td>Application Architecture and Development</td>
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<tr>
<td></td>
<td>Technical Architecture and Development</td>
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<tr>
<td>Management and Quality</td>
<td>Testing</td>
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<td></td>
<td>Performance Engineering</td>
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<td></td>
<td>Program/Project Management</td>
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<tr>
<td></td>
<td>Configuration Management</td>
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</tbody>
</table>
Identifying Domains of Change

- Location
- Data
- Technology
- Organization
- Business Process
- Application

- • Implementation team
- • Training team
- • Projects creation and update
- • Projects approval
- • KPI creation
- • Project information retrieval
- • System administration
- • Data conversion
- • Supplied volume data
- • Hardware
- • Standard system software
- • Reporting software
- • Ad-hoc spreadsheet functions
- • Security and performance
- • Site navigation design
- • Site content design
- • Reusable components
- • Security workflow
- • Help
- • Office hosting development

Adding Iterations

Development is an iterative process, where for each subset of requirements, components must be analyzed, designed, developed and deployed.

Proposed Project Lifecycle

- Discover
- Design
- Develop
- Deploy
- Release 1
- Release 2
- Release 3...

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Conclusion

Feature Summary

• Ubiquitous Client Access
• Pushes Status in Real-time
• Framework Inter-Operates with Legacy
• Support for Current and Emerging Standards
• Scales in Capacity and Function
• Optimization of Integrated Services
• Secure, Mission-Critical Infrastructure
Addressing the Challenges

- Existing legacy systems and newer ATS’s will still need to handle anticipated increases in trade volume implied by the development of STP.
- Fixed Income securities can have complex structures. Trading systems can plug and play analytics to calculate various essential data.
- There are many types of Fixed Income securities which trade in different ways. Standardized trading methodologies will need to be applied.
- Security information repositories will need to be large enough to hold data on millions of securities.
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