Research Statement

Alan Megargel
School of Information Systems, Singapore Management University
Tel: (65) 6808-5276; Email: alanmegargel@smu.edu.sg
29th Jan 2015

Background

During my years working in the banking industry, I came to realize the importance of Enterprise Architecture (EA) and its role in implementing a bank’s business strategy while minimizing the overall IT cost for the bank. As a natural consequence of a growing bank, organizations tend to become “silo-ed”, with each business unit having its own dedicated tech & ops functions. While this organizational model is meant to be more agile in terms of time-to-market, the down-side effect is that bank-wide technology and platform standards are harder to enforce, resulting in higher overall IT costs for the bank. EA frameworks, platforms, and best practices are meant to address this problem.

SMU has embarked on a multiyear programme entitled “SMU Bank for Financial Services Education”, referred to as “SMU Teaching Bank” (or “SMU tBank”). Starting from a clean sheet, we are building a “teaching bank” from the ground up, using today’s architecture best practices.

I am the lead architect of SMU tBank, and my academic research is anchored around the EA best practices demonstrated in SMU tBank’s implementation.

Mission Statement

“The mission of SMU tBank is to become a world class ‘teaching bank’, generating an on-going supply of undergrad and postgrad student projects whereby classroom learning outcomes can be put into practice, leveraging industry leading banking software and enterprise platforms.”

Guiding Principles

1. SMU tBank shall exist for academic purposes only, to support banking related coursework, labs, and student projects.

2. SMU tBank shall align to, and inform, SMU’s Unified Banking Process Framework.

3. SMU tBank shall be assembled using a mixture of vendor products, in order to demonstrate real world large-scale change scenarios, for example:
4. SMU tBank shall be a platform for collaboration with banks and product vendors, for incubating new innovations.

**Conceptual Model**
SMU has acquired several off-the-shelf banking products over the years from leading software vendors, in order to support hands-on labs for both post-grad and undergrad courses. SMU also uses leading middleware products to support some of its undergrad core technology courses. SMU tBank is then assembled leveraging this mix of vendor software into a flexible service-oriented-architecture, and student projects then develop banking applications that consume reusable services.

**Engagement Model**
- SMU’s Unified Banking Process Framework (UBPF) guides all Financial Services programmes.
- UBPF banking use cases inform the post-grade coursework.
- Post-grade capstone projects specify the solution architecture for banking channels.
- Undergrad projects deliver banking channel prototypes, based on the solution architecture specified by post-grade capstone projects.
- Banking channel prototypes developed by undergrad projects are integrated into the SMU tBank architecture, and are in turn used to support hands-on labs for both undergrad and post-grade courses.

Reference Architecture
The solution architecture for each component of SMU tBank shall align to and “refer” back to a common reference architecture. The Enterprise Platform layer of the architecture is key to enabling the on-going flexibility of SMU tBank as it evolves. Briefly the components of the Enterprise Platform layer are described as follows:

- **Enterprise Service Bus (ESB)** decouples systems within an industry best practice **Service Oriented Architecture**. Exposes functionality of banking systems as reuse-able services. Data abstraction is guided by the Banking Industry Architecture Network (BIAN) Service Definitions.

- **Channel Integration Layer** enables a 360° view of and by customers across multiple banking channels. Supports long running state-full business processes, eg; for multi-channel account origination, enabling origination to start on one channel and complete on another.

- **Payment Services Hub** orchestrates end-to-end payment processing, and interbank clearing & settlements. Provides full payment life cycle
support including; payment instruction validation, repair, credit check, FX, liquidity management, advice/statement, etc..

- **Master Data Management (MDM)** cross references customers to accounts across multiple banking systems. Contains customer master data, eg; the CIF record. Contains reference data for: Product codes, Account codes, Branch codes, etc..

- **Business Rules Management System (BRMS)** provides centrally managed business rules "externalized" from the processing logic within channel applications, for; credit decisioning, collections/NPL handling, product pricing (interest, fees), etc..

- **Content Management System (CMS)** provides centrally managed content delivered to customers across various channels, eg; product marketing content delivered via Internet Banking, Mobile Banking, email, post, etc..

- **Operational Data Store (ODS)** holds frequently accessed data within an in-memory data grid, for fast access, eg; customer profile, payment transactions, core banking system cache. Supports real-time analytics, eg; customer next best offer triggered by a customer interaction.

*Figure 3 – Reference Architecture*
Deployment
One of the goals is to make SMU tBank available to other universities for the purposes of classroom teaching as well as collaborative development. To enable this, the architecture supports multiple instances of SMU tBank, such that each instance may have its own; base currency, reserve ratio, SWIFT routing number, interest rates, fees and charges, etc..

The multi-instance version of SMU tBank is deployed to Amazon Web Services (AWS), and is used in the classroom to teach enterprise architecture and banking concepts.

As of Oct 2014, SMU tBank is licensed by Ngee Ann Polytechnic for use in their Financial Informatics Diploma course.

Interbank Payments
Deployment of SMU tBank to the AWS cloud adds a whole new level of possible extensions, and is currently under development.

- **Automated Clearing House (ACH)** to orchestrate interbank payments between instances of SMU tBank. The ACH will; execute both real-time as well as batch instructions, perform sorting and routing of payment instructions between participating banks, perform netting on a schedule sending settlement instructions to the Central Bank (another instance of SMU tBank). Other feature include; multicurrency, liquidity management, transaction volume and revenue reporting.

- **Corporate Internet Banking** featuring; Cash Management (Account Sweeping), and Payments; Credit Transfer and Direct Debit (GIRO). Possible use cases are, a) manufacturing company (eg; Seagate Technology) sends payment invoices to its suppliers, b) billing organization (eg; SingTel) invokes monthly billing of its customers.

- **Trade Finance** featuring a number of financial instruments related to international trade, such as; Letter of Credit, Bill of Exchange, Bill of Lading, Bank Guarantee, Documentary Collection, Open Account, Export Factoring. Another deliverable will be an end-to-end trade simulator that can be used in the classroom to illustrate the movement of goods and trade documents across the relevant parties, eg; Importer, Exporter, Freight Forwarder, Issuing Bank, Advising Bank.

- **General Ledger & Financial Reporting** featuring; Chart of Accounts setup and maintenance, GL posting rules management, Balance Sheet and Income Statement reporting. For interbank payments, dual-entry accounting will be ensured in both sending and receiving bank ledgers.
Figure 4 – Interbank Payments Involving Multiple Instances of SMU tBank

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Settlement</th>
<th>Function</th>
<th>Sender</th>
<th>Receiver</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Realtime</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Realtime</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Realtime</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Batch</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Batch</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Batch</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Batch</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Future</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>Future</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Future</td>
<td>Credit Transfer</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*Cheque truncation: Sender captures image, sender's bank scans image & processes payment

Figure 5 – Interbank Payments; Supported Payment Modes
Benefits

Benefits of **Building** SMU tBank

- SMU tBank uses banking software that is developed by students. Students that develop the SMU tBank gain a deep technical understanding of how a bank works. As well as gaining banking domain knowledge, students will benefit from implementing industry best practices in enterprise architecture. Note: We believe that we are the only University in the world that is going to the extent of actually building a bank, for teaching purposes.

Benefits of **Using** SMU tBank

In the classroom, the labs are useful under 3 main contexts.

- **IS419 Retail Banking** – Students use SMU tBank to learn banking processes such as; account opening, credit evaluation, loan repayments, fund transfers, foreign exchange, standing instructions, GIRO, mobile payments, Two-Factor-Authentication, ATM network management, real-time customer specific promotion offers. Lab questions assess the students understanding of both bank processes as well as financial accounting.

- **IS430 ePayments** – Students use SMU tBank to understand how interbank payments works through an Automated Clearing House (ACH), from different perspectives, a) corporate and retail customers, b) participating banks, and c) central bank. Lab exercises will include; payment initiation from corporate customers for both credit transfer and direct debit (GIRO), and bank liquidity management demonstrating scenarios whereby a participating bank has insufficient funds during net settlement with the central bank.

- **IS301 Enterprise Integration** – Students use SMU tBank to learn integration technologies such as; Message-Oriented-Middleware, and Service-Oriented-Architecture. Labs exercises include; building integration components that allow different applications in the bank to communicate, and drill-down visualizations of what is actually happen in the integration layer when a fund transfer is executed, for example.

- **IS303 Architectural Analysis** – Students will use a “lite” version of SMU tBank which is deployed on their laptops, to demonstrate their understanding of 3 main architecture principles; “resiliency” (ability to failover to a standby system), “concurrency” (handling large number of users), and “performance” (response time of the application).
Research Areas

Anchored around the implementation of SMU tBank, I have in mind to spin off a few areas of research, described briefly as follows:


2. “In-Memory Data Grid Use Cases in Banking” – Covers performance improvements of data caching, eg; characterization of response times with and without a data cache in front of the core banking system, and the resulting impact on customer satisfaction. Also covers the economics of caching data in front of the core banking system, eg; the cost saving in MIPS incurred on mainframe systems. Covers how massive-scale in-memory data grid technology is used to enable real-time cross-sell to banking customers, eg; next best offers pending in memory, triggered on the next customer interaction. Covers real-time fraud detection.

3. “Core Banking System Replacement” – Covers the scenario where a core banking system is replaced, eg; Oracle Flexcube is replaced with Infosys Finacle. The transition from one system to the other can be done with minimum impact to banking channel applications, by using a flexible service oriented architecture. Using SMU tBank as a test bed, specific scenarios can be trialed in conjunction with actual banks in Singapore that want to participate in the study.

4. “Bank Mergers: Technology Migration or Coexistence” – Covers the scenario whereby one bank acquires another, and the combined bank needs to make decisions about which technology to keep or discard, and which technologies can coexist. The coexistence of different technologies across the two banks can be achieved with minimal impact to banking channels, by using a flexible enterprise platforms such as; SOA, BPM, BRMS, and MDM. Using SMU tBank as a test bed, specific scenarios can be trialed in conjunction with actual banks in Singapore that want to participate in the study.

5. “Banking Industry Information Model” – Covers the adoption of the Banking Industry Architecture Network (BIAN) Service Landscape as the enterprise data model for SMU tBank. The study will demonstrate, in actual practice, how an industry model can inform and optimize the decomposition of banking processes into reusable services.
Selected Publications and Outputs

1. Chapter Title: Enterprise Integration: Architectural Approaches (co-authored with Venky Shankararaman). The chapter traces the evolution of Enterprise Integration Architectures and will be of great value to anyone working in the area of integration. We also intend to use this content in the Enterprise Integration course. The chapter is part of an edited book entitled: Service-driven Approaches to Architecture and Enterprise Integration/Raja Ramanathan. Published by: IGI Global (2013)