

# **SMU Teaching Bank:**

## **Case Study of a Multiyear Development Project Utilizing Student Resources**

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# Agenda



- Overview of SMU tBank: How we teach banking and FinTech
- Multiyear Project Milestones
- Types of Student Resources, drawn from 3 Levels of Education
- Ecosystem of Interdependent Student Resources
- SMU tBank as an Anchor for Teaching and Research
- Lessons learned

# SMU Teaching Bank



- SMU as 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.

*“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.”*

- SMU tBank exists for academic purposes only, to support banking related coursework, labs, and student projects.

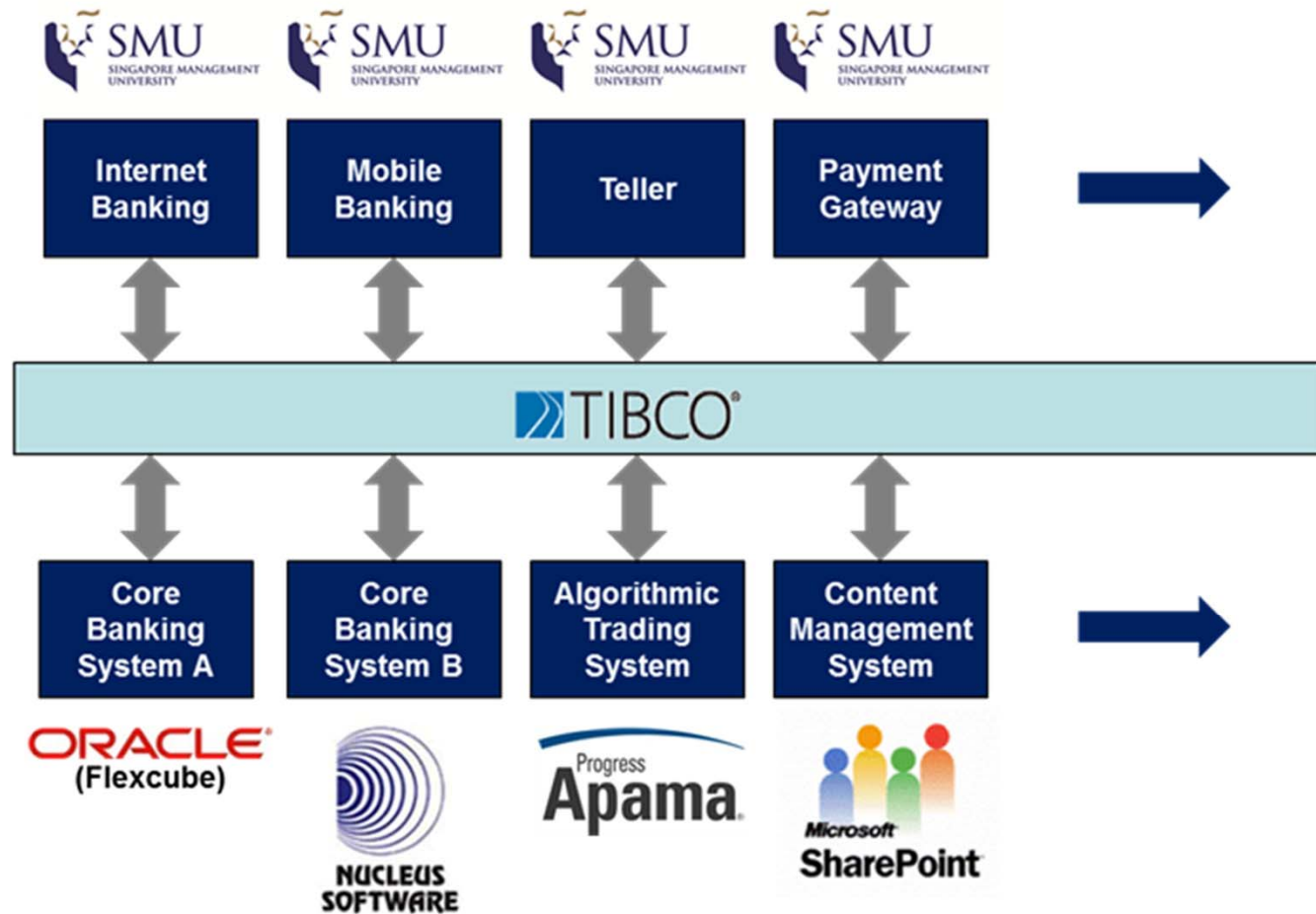
# SMU tBank: Conceptual View

(March, 2012)

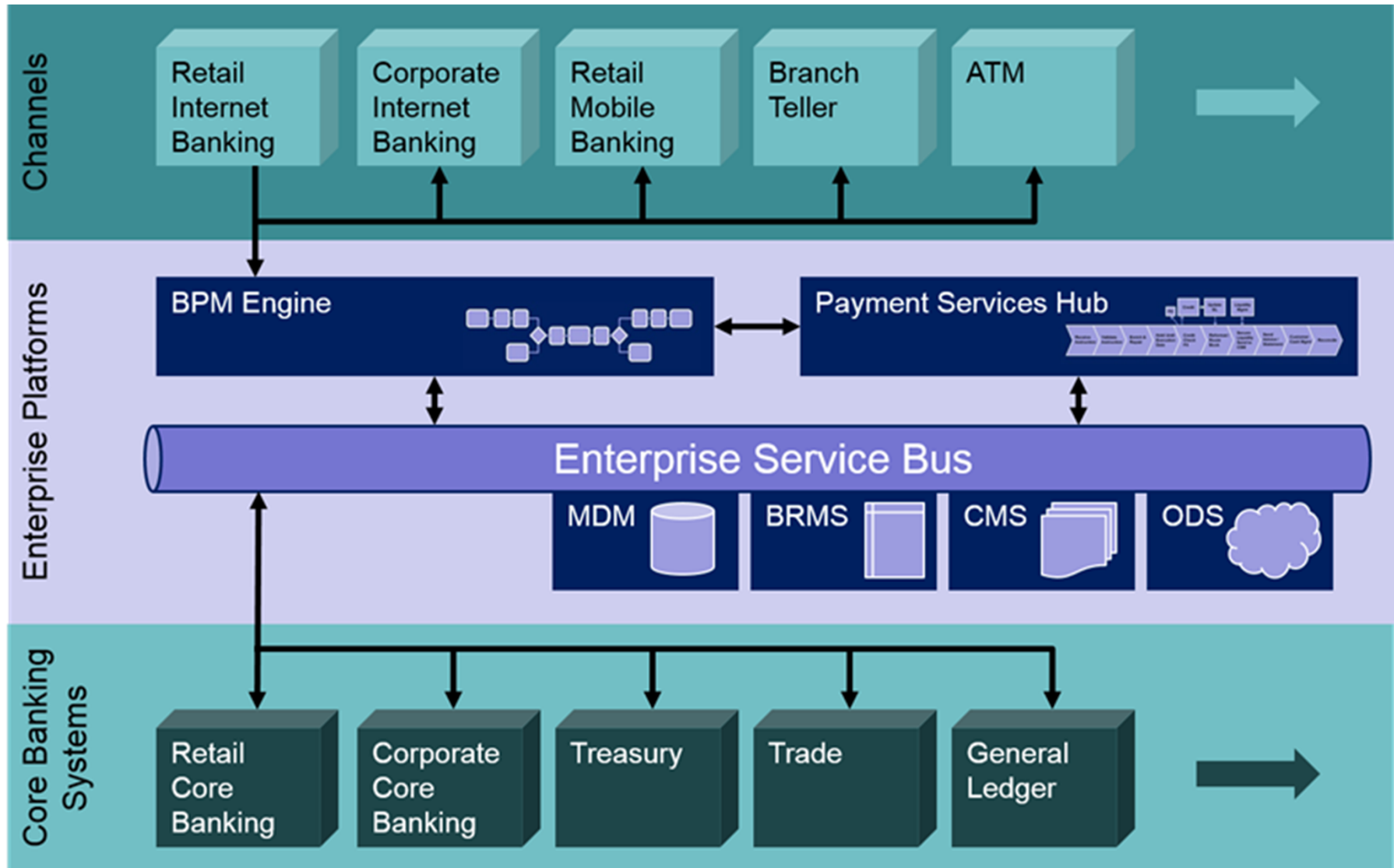


Banking apps to be developed through student projects

Existing platforms available at SMU can be integrated into a teaching bank



# SMU tBank: SOA Layered Architecture





# SMU tBank: Retail Channels (example)

- **Flexible SOA** enables rapid development of new solutions
- **Developed 4 channels concurrently in 6 months**

Branch Teller	Retail Internet Banking	Retail Mobile Banking	ATM
<p><u>Customer</u></p> <ul style="list-style-type: none"> <li>✓ Account Opening</li> <li>✓ PIN Creation</li> <li>✓ Credit Evaluation</li> </ul> <p><u>Accounts</u></p> <ul style="list-style-type: none"> <li>✓ CASA</li> <li>✓ Term Deposit</li> <li>✓ Home Loan</li> <li>✓ Auto Loan</li> <li>✓ Education Loan</li> </ul> <p>(16 products total)</p> <p><u>Transactions</u></p> <ul style="list-style-type: none"> <li>✓ Deposit/Withdrawal</li> <li>✓ Bill Payment</li> <li>✓ Loan Repayment</li> <li>✓ GIRO / Direct Debit</li> <li>✓ Transaction History</li> </ul>	<p><u>Account Maintenance</u></p> <ul style="list-style-type: none"> <li>✓ Update Personal Details</li> <li>✓ Setup Preferences</li> <li>✓ Setup Alerts</li> <li>✓ Setup Likes/Interests</li> <li>✓ Apply for Loan</li> <li>✓ Apply for GIRO</li> <li>✓ Account Statement</li> </ul> <p><u>Transactions</u></p> <ul style="list-style-type: none"> <li>✓ Setup Beneficiaries</li> <li>✓ Fund Transfer</li> <li>✓ Standing Instruction</li> <li>✓ Bill Payment</li> <li>✓ Transaction History</li> </ul> <p><u>Real-time Offers</u></p> <ul style="list-style-type: none"> <li>✓ Merchant Discounts</li> <li>✓ Bank Products</li> </ul>	<p><u>Platforms Supported</u></p> <ul style="list-style-type: none"> <li>✓ iOS</li> <li>✓ Android</li> </ul> <p><u>Transactions</u></p> <p>Same as Internet Banking plus the following:</p> <ul style="list-style-type: none"> <li>✓ QuikPay</li> </ul> <p>Person to Person Fund Transfer using Near-Field-Communication</p> <p><u>Real-time Offers</u></p> <p>Same as Internet Banking</p>	<p><u>Transactions</u></p> <ul style="list-style-type: none"> <li>✓ Cash Withdrawal</li> <li>✓ Fund Transfer</li> <li>✓ Bill Payment</li> </ul> <p><u>Account Maintenance</u></p> <ul style="list-style-type: none"> <li>✓ Update Mobile Number</li> </ul> <hr/> <p><u>ATM Network Mgmt</u></p> <ul style="list-style-type: none"> <li>✓ Setup New ATM</li> <li>✓ Monitor ATM Network Utilization &amp; Uptime</li> <li>✓ Cash Inventory Management</li> <li>✓ Cash Top-up Forecasting</li> <li>✓ ATM Location Optimization</li> </ul>

# SMU tBank Applications



## Applications Used by Bank Staff

tBank Administrator

General Ledger

Branch Teller

Payment Services Hub

Automated Clearing House (simulation)

Business Rules Management System

ATM Network Management

Trade Finance Operations

Design and Runtime Governance Tools

## Applications Used by Customers

Retail Internet Banking

Retail Mobile Banking

ATM (simulation)

Merchant Point of Sales Terminal

Corporate Internet Banking

Trade Finance Blockchain

Conversational Banking

## Applications Used by External FinTechs

Marketplace Lending Platform

Personal Finance

KYC-as-a-Service Blockchain

All Developed by Students

# SMU tBank Use in the Classroom



## Retail Banking Courses

- **Students learn banking processes** such as; account opening, credit evaluation, loan repayments, fund transfers, foreign exchange, standing instructions, 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**.

## Corporate Banking Courses

- **Students learn financial instruments related to international trade**, such as; Letter of Credit, Bill of Exchange, Bill of Lading, Documentary Collection, Trust Receipt, and Export Factoring.
- Students manage the **end-to-end trade process** to understand the flow of documents and payments across the relevant parties, e.g.; Importer, Exporter, Freight Forwarder, Issuing Bank, Advising Bank.



# SMU tBank Use in the Classroom



## Payments Courses

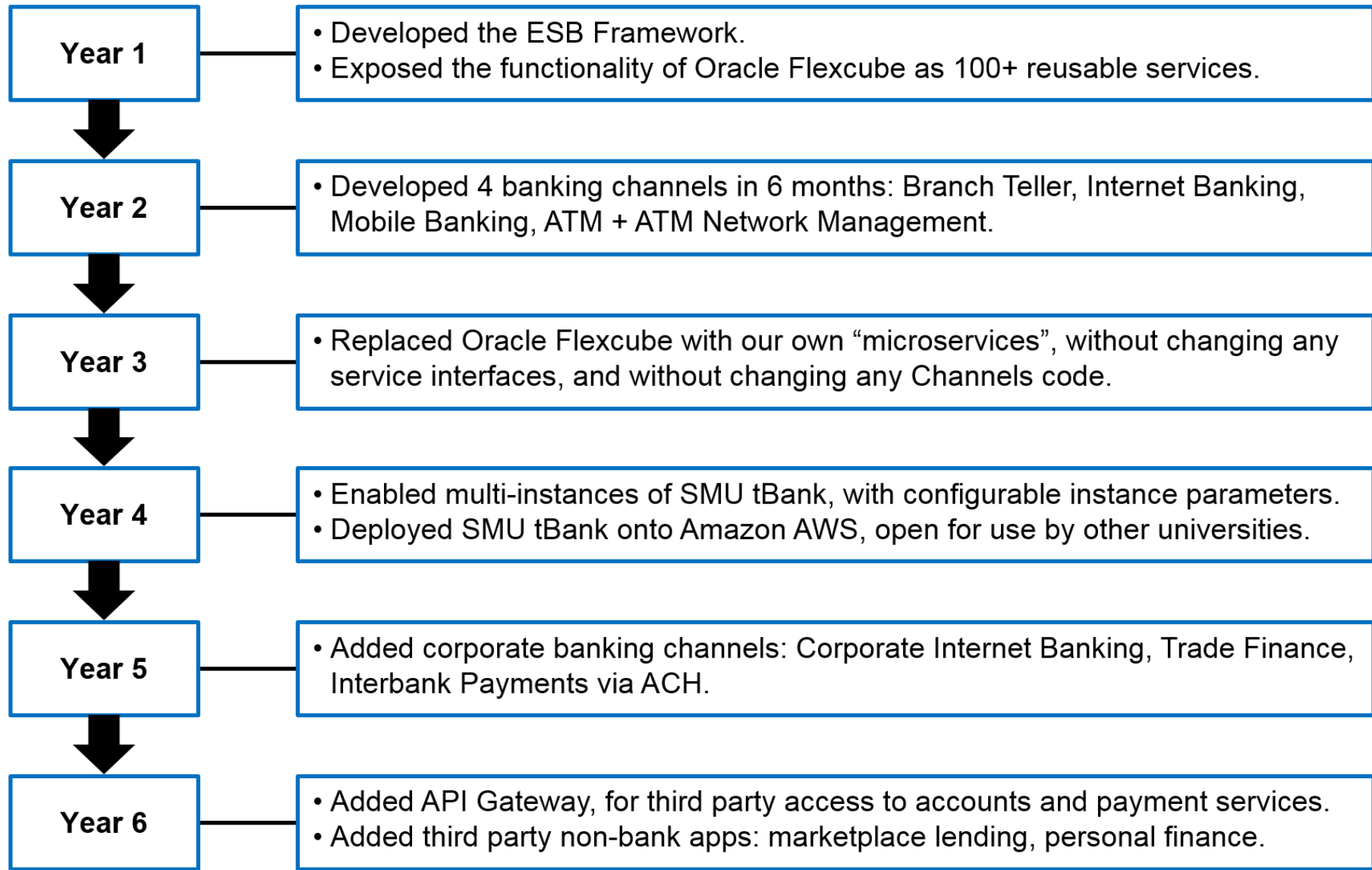
- **Students learn how interbank payments works** through an Automated Clearing House (ACH), from different perspectives, a) corporate and retail customers, b) participating banks, and c) central bank.
- Lab exercises include; payment initiation from corporate customers for both credit transfer and direct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

## Architecture Courses

- **Students learn application integration technologies** such as message-oriented middleware and web services within an SOA layered architecture.
- Labs exercises include; developing services which can be assembled to fulfil complex business logic, and drill-down visualizations of what is actually happening in the services layer when a fund transfer is executed, for example.
- For their term project, **students use the SMU tBank API to assemble their own financial services solutions** such as a marketplace lending platform.

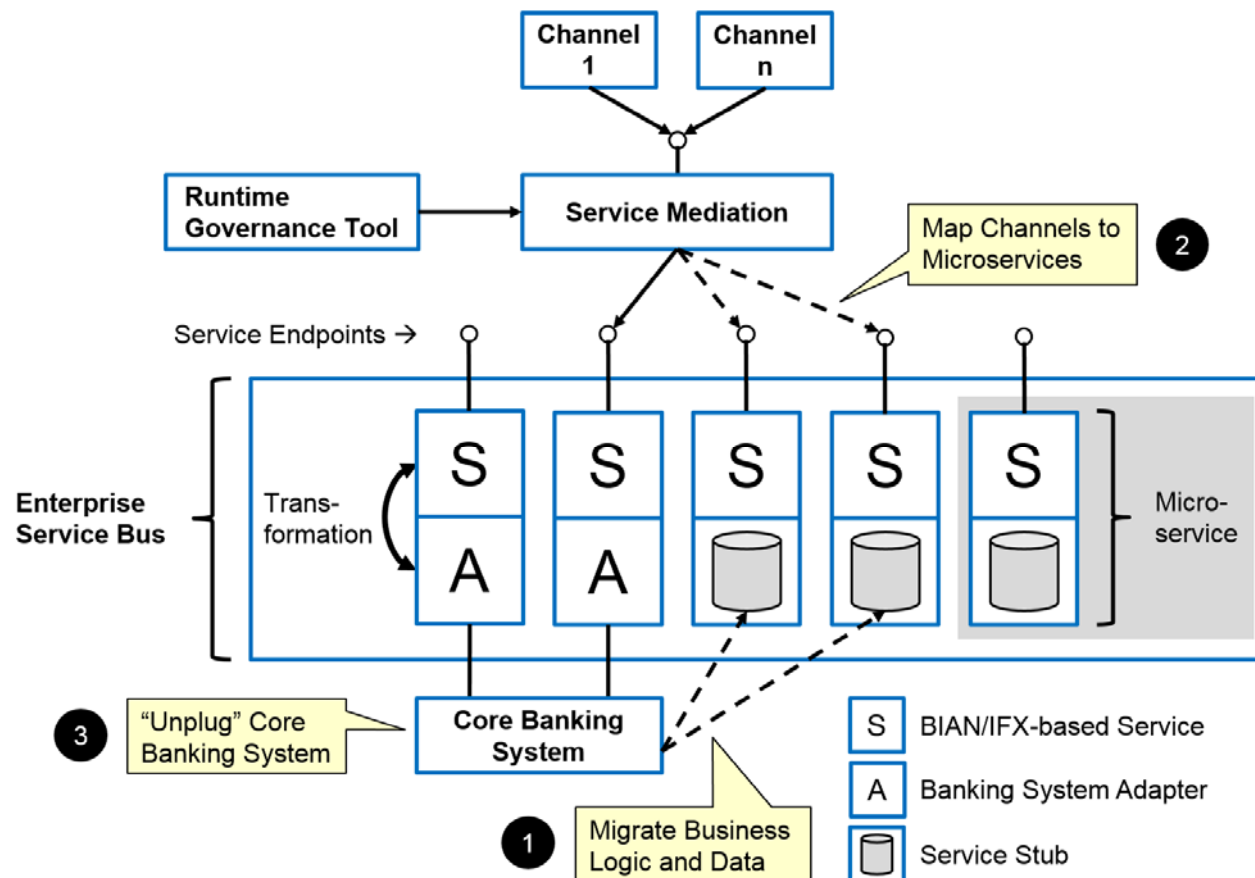


# SMU tBank: Multiyear Project Milestones



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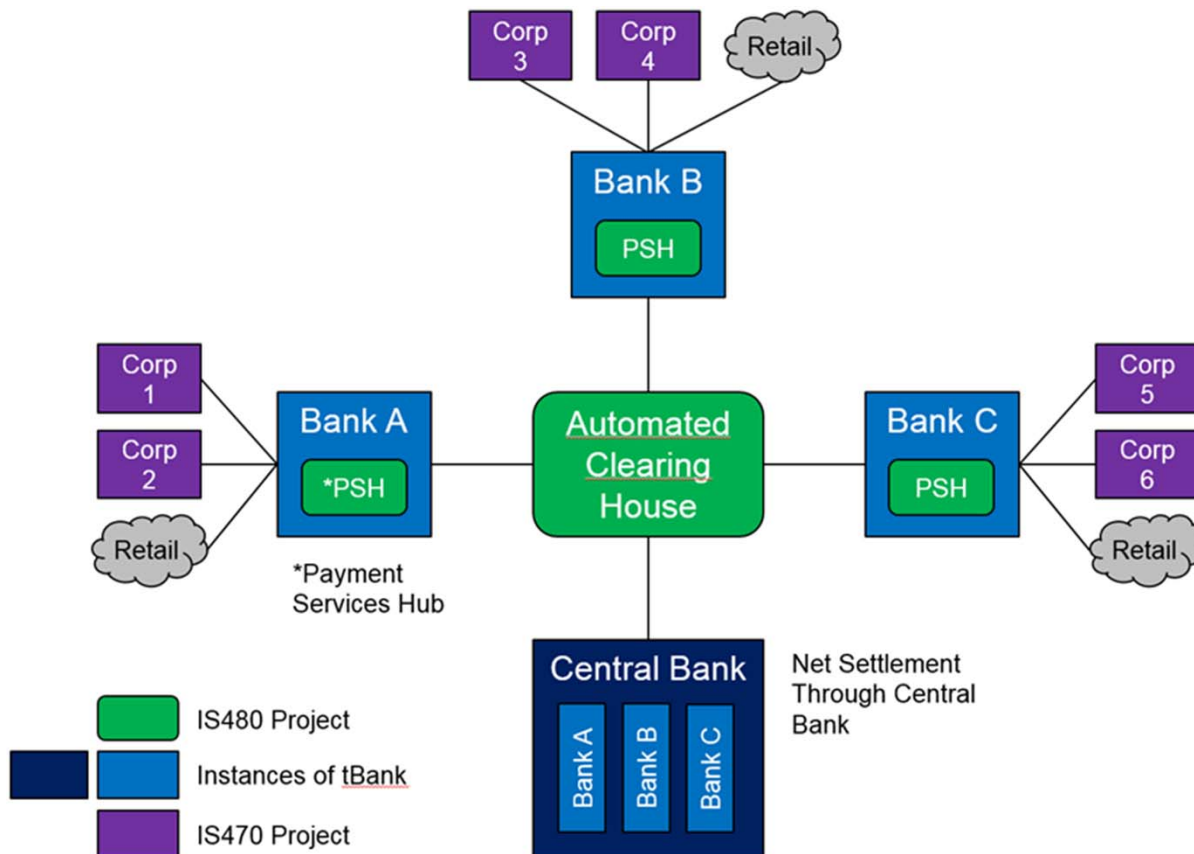
- Year 3
  - Replaced the **Oracle Flexcube** core banking system **with our own microservices**, without changing any service interfaces or any channels code.
  - This was also the moment in time when we **realized** that the components we had built so far **could be** packaged and **commercialized** as a “starter kit” for banks.



# SMU tBank: Multiyear Project Milestones



- Year 5
  - Logically segregated SMU tBank into a **multi-instance bank**.
  - Deployed SMU tBank onto **AWS**, open for use by other schools (Ngee Ann Poly).
  - Developed Corporate Internet Banking including a **Payment Services Hub**.
  - Developed an **Automated Clearing House** (ACH) for interbank payments



## ACH administration includes:

- Registering a bank (SWIFT/BIC code) onto the network.
- Setting up a bank's preferred payment message format; SWIFT MT or ISO20022.
- Setting up a bank's settlement account with the central bank.
- Setting up the settlement schedule with central bank.
- Managing a bank's rules for handling liquidity shortfalls at settlement time, e.g.; prioritize payments by value, prioritize payments by time, overdraft with central bank.



# Payments Lab (example)



- You will be using 5 tBank applications:
  - ACH – Automated Clearing House
  - GL – General Ledger
  - CIB – Corporate Internet Banking
  - RIB – Retail Internet Banking
  - Teller
- We have setup:
  - 14 Banks (one for each lab group), you will send payments to each other's banks
  - 7 Currencies (2 banks for each currency)
  - 2 Payment Messaging Standards (7 banks on SWIFT MT, 7 banks on ISO20022)
  - 56 Corporate Customers, including:
    - 14 Manufacturers
    - 28 Suppliers
    - 14 Billing Organizations
  - 28 Retail Customers
- Lab Scenarios
  - Manufacturers send Credit Transfer to 2 Suppliers each (1 in diff currency)
  - Billing Organizations send Direct Debit to 2 Retail Customers each (1 in diff currency)
  - View the ACH reports, the GL reports for each bank, and Customer account balances

# Types of Student Resources Utilized To Develop SMU tBank



- Over 6 years, there were **5 different types of student resources** utilized to develop SMU tBank, **drawn from 3 different levels of education**.
- All student resources contributed for **academic credit only**, except for the SMU tBank “Core Team”.
- Student resources were **not funded by external grants**.
- The Core Team was funded by an internal Work Study Grant.
- **Challenge: Maintaining continuity**, and knowledge, as project teams roll off and Core Team members graduate and need to be replaced.

Level	Resource/Project Type	Description
Postgrad	Capstone Project	Individual Project – 6 months
Undergrad	IS Project Experience	Group Project – 6 months
Undergrad	Guided Research	Individual Project – 4 months
Pre-University	Internship	Group/Individual Project – 5 months
Undergrad	SMU tBank Core Team	Funded via Work Study Grant – 2 years assignment

# Types of Student Resources Utilized



## Capstone Project: Postgrad Students Developing Solution Architecture

- Postgrad students may deliver a detailed **solution architecture** for one new application to be incorporated into SMU tBank.
- The solution architecture is then handed down to an undergrad team, which then develops the new application as their project deliverable.
- Examples solution architectures include; Internet/Mobile Banking, Trade Finance, General Ledger, Automated Clearing House, Business Rules Engine.

## IS Project Experience: Undergrad Student Teams Developing Applications

- Undergrad students may select an SMU tBank related project to deliver for an internal faculty sponsor, guided by a solution architecture (see above)
- The project timeframe is limited to just over one semester (around 6 months), whereby project teams are expected to deliver and deploy fully featured **software applications** to be incorporated into SMU tBank.

# Types of Student Resources Utilized



## Guided Research: Individual Students Developing Advanced Prototypes

- Students may select an SMU tBank related research project.
- Projects have two parts; 1) an **academic style research paper**, and 2) an **advanced prototype** software application which demonstrates the core subject of the paper.
- Examples projects include; Microservices Architecture Implementation in Banking, and Digital Identity Management Blockchain Customer Onboarding.

## Internship: Pre-University Student Teams Doing Testing and Documentation

- Polytechnic Interns are assigned projects which they can handle, given their limited training at the polytechnic level.
- Typical internship projects include; **documenting the SMU tBank API**, **developing demo applications** which utilize the SMU tBank API, and writing up **classroom lab guides**. Interns with more coding experience are assigned small application development projects.



# Types of Student Resources Utilized



## SMU tBank Core Team: Funded via Work Study Grant

- The Core Team is made up of **3 undergrad students in their 3<sup>rd</sup> and 4<sup>th</sup> year**.
- They are hired under a Work Study Grant (WSG) where they can work up to **200 hours per semester**, and must commit to a 2 years assignment.
- Every 2 years, a core team **graduates**, and a new core team is hired to take their place.
- These students handle all of the **ongoing bug fixes and enhancements** needed for all of the SMU tBank software applications delivered by IS Project Experience teams since inception of the programme.
- At present, there are a **total of 19 software applications** that require ongoing maintenance.

# Types of Student Resources Utilized



## SMU tBank Core Team: Funded via Work Study Grant

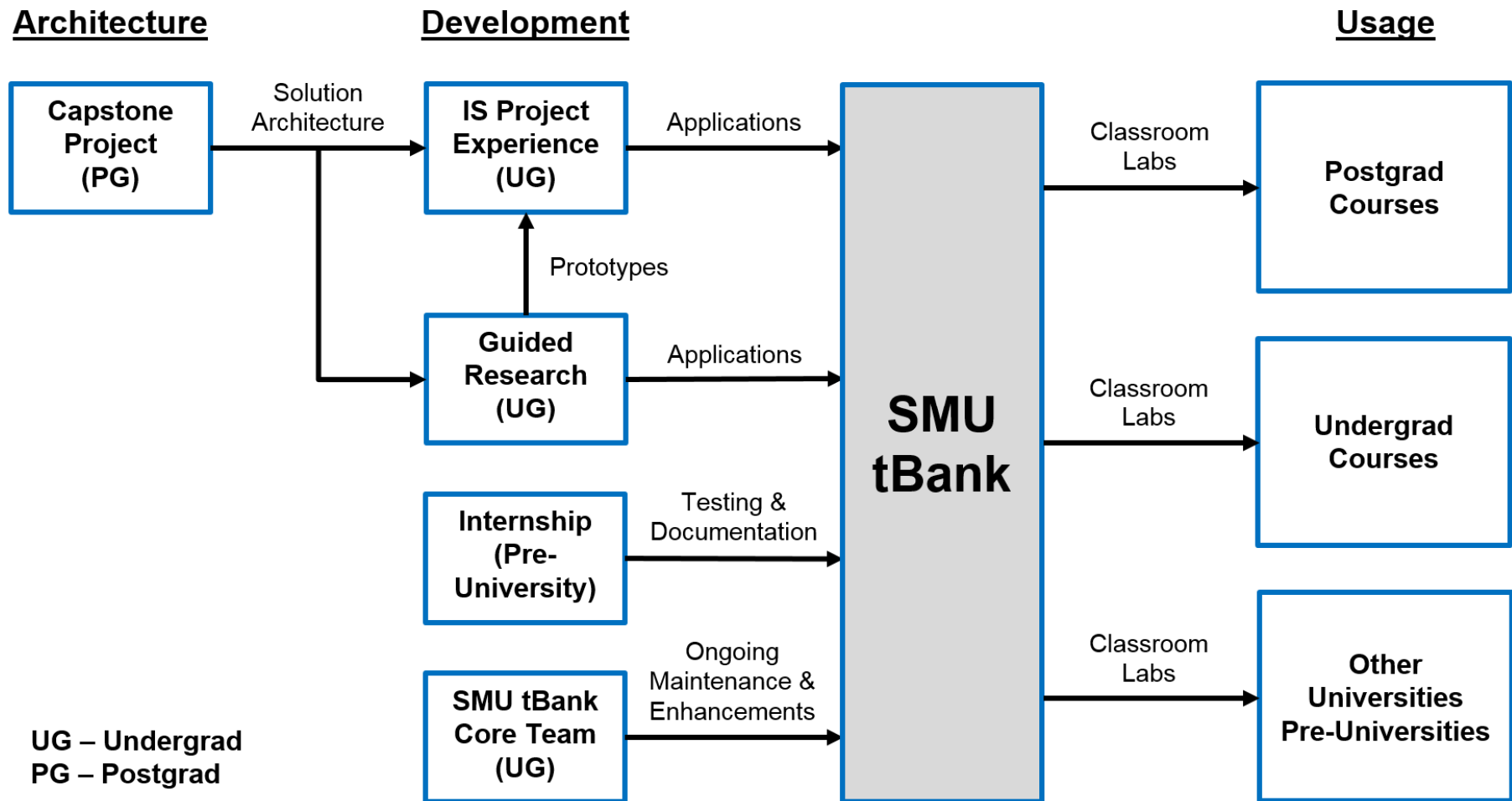
### Challenges utilizing WSG students

- **Hiring** – New core team members are hired based on two main criteria; a) they must be **strong in javascript coding**, and b) they must be qualified for WSG, i.e.; they must already be **under a student loan or other financial aid programme**. It is difficult to identify students with strong javascript skills who are also on financial aid.
- **Legacy** – The core team **needs to maintain all of the older SMU tBank software** applications which were originally developed using javascript frameworks which are now out of fashion. It is difficult for students to **support multiple legacy frameworks**.
- **Continuity** – As each core team graduates and is replaced by a new core team, every 2 years, it is **difficult to manage the handover from one team to the next**, all of the code and implementation details and domain knowledge.
- **Commitment** – While the WSG students are technically employees, **their first priority is always their own school work**. If some code needs work, it will always take second priority. It is not reasonable to expect a high level of commitment from these students.



# Ecosystem of Student Resources

- Students Drawn from 3 Levels of Education



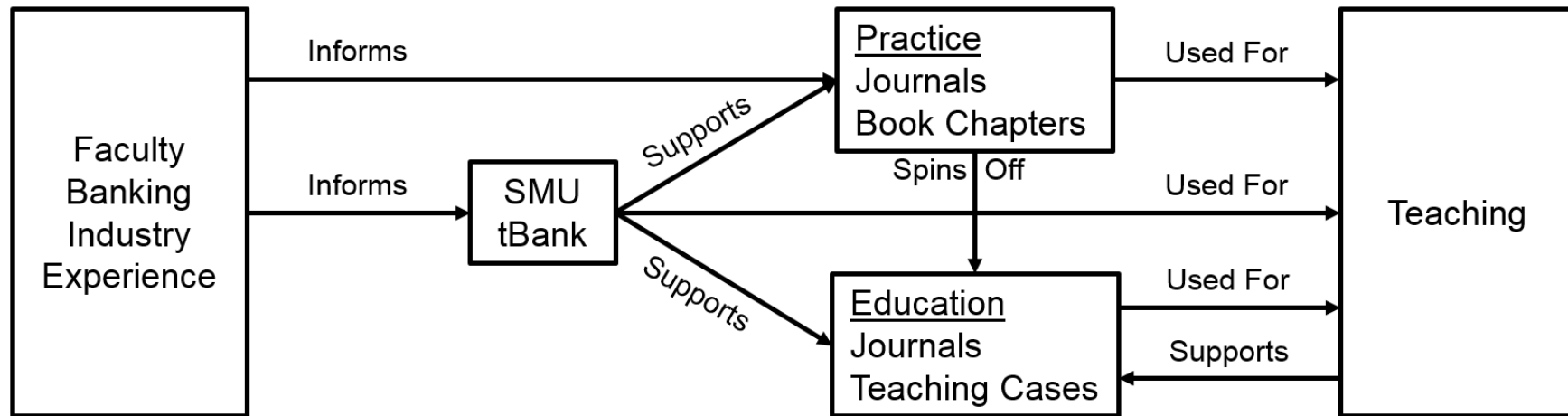
# Students Benefiting from SMU tBank



- Completed development projects
  - Postgrad capstone projects – 13
  - Undergrad final year projects – 10
  - Undergrad guided research projects – 6
  - Polytechnic internship projects – 4
  
- Estimated number of students since 2012

	<b>Development of SMU tBank</b>	<b>Classroom Usage</b>
Postgrad	13	480
Undergrad	78	640
Polytechnic	12	800
<b>Total</b>	<b>103</b>	<b>1920</b>

# SMU tBank as an Anchor for Teaching and Research



- SMU tBank is a **shared platform** for our practice track faculty.
- We leverage our **industry experience** and focus on **practice-based applied research** in the areas of Digital Banking Architecture and FinTech.
  - We use our research outputs to **support classroom teaching** of related topics.
  - We spin off practiced-based research outputs into separate **teaching cases**.
- Our Research, Teaching, and the SMU tBank project are **interrelated**.
- **Our research drives our teaching**, much of it anchored around SMU tBank, and all of it informed by our industry experience.



## Lessons Learned

- Leveraging an internal **work study grant programme** to fund student core team members has been **problematic** (e.g.; continuity, commitment)
  - I am **applying for an external grant** to fund 3 fulltime professional developers for 3 years to cover the ongoing software maintenance, and to support the required research outputs associated with the grant.
- The problem with maintaining **legacy javascript frameworks** is unavoidable.
  - Externally funded professional developers would have been better equipped to maintain legacy frameworks.
- Using an **SOA layered architecture** was a good choice.
  - When legacy applications are replaced, only the user interface needs to change, because all of the business logic and data exposed via the underlying microservices are fully reusable.
- **SMU tBank is generally successful**, given that it has sustained for more than 6 years and has benefited more than 2000 students.
  - SMU tBank applications are **available online for other universities to use**.
  - SMU tBank API enables other collaborators to develop their own applications.



# Summary of what we covered

## SMU Teaching Bank (SMU tBank)

- ✓ Overview of SMU tBank: How we teach banking and FinTech
- ✓ Multiyear Project Milestones
- ✓ Types of Student Resources, drawn from 3 Levels of Education
- ✓ Ecosystem of Interdependent Student Resources
- ✓ SMU tBank as an Anchor for Teaching and Research
- ✓ Lessons Learned

# THANK YOU



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