Reference Architecture and Application of Business Process Modelling for FinTech Industries

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In this talk

- Main Motivation for Research into FinTech Industry
- Why Service Driven?
- Evolving a SOA driven reference architecture for financial cloud services?
  - SEF-SCC & BPD-SCC
  - Design Principles
  - Cognitive Architectures (predicting the future of software architecture)
- FinTech Cloud Applications: Domain and Feature Modelling
- Predictive Modelling & Technologies for Financial Cloud: AI, ML, Smart Devices, IoTs, Cloud, Blockchain Technologies
- Conclusion and Questions
Leeds Beckett is the fifth best uni in the country for producing CEOs

**Beckett breeds more business leaders than Oxford, LSE or Leeds Uni**

The data, released by Emolument, studied 26,000 graduates across the UK – and found that Beckett produces 3.1 per cent of the UK’s CEOs, CTOs and Partners.
Research Groups at Leeds Beckett

- **IT and Sustainability**
- Assistive technologies, computer forensics and security
- **AI, Machine Learning, Robotics**
- **Data Science, Software Engineering, SOA, IoT, and Cloud Computing**

Holistic approach to computer science research
Current & Some Previous Projects

• Software Engineering – Reuse Framework, Component Model for Complex Systems, used in various Industries including Philips, Image Systems, Volantis Systems Research, etc., SPI, Testing, Software Product Line Engineering

• **Software Engineering Framework for Service and Cloud Computing**


• Software Security Engineering Research: Vulnerability Techniques, Security Improvement, Design for Software Security
Main Theme

- Digital economy, digital currencies, and advancement in information technology have contributed to tremendous growth in the global economy and financialisation.
- The positive impact of technology on the financial services sector in the United Kingdom is unprecedented globally (The Rt Hon Liam Fox MP, Secretary of State for International Trade and President of the Board of Trade) UK FinTech State of the Nation
- In order to have contributed sustain this growth, a systematic approach is necessary for all aspects of the financial process and applications.
  - Holistic Approach to FinTech in the cloud
  - Requirements Engineering Framework for Cloud Computing
  - Design Approaches to FinTech Applications (Service components with SoaML, Containers, Smart Contract with Blockchain, etc)
  - Machine Learning Approaches to FinTech
    - Refining, Improving & Reusing Service Requirements for Financial Services
    - Bug Prediction Models with Data Science Approach
MOTIVATION FOR THIS TALK: FINTECH
Figure 1. Ci Ren Ge Dan uses Ant Financial’s services to receive and make payments for the tent store he operates at the foot of Mount Everest, 5,200 meters above sea level.

Figure 2. Zhang Yousheng, a herdsman, uses Ant Financial microloans to purchase calves and fodder.
Digital revolution vs. Challenges for Financial Service Sectors: FinTech Claims

- FINANCIAL TECHNOLOGY, ALSO known as fintech, is a fast-evolving field that has reshaped the financial industry.

- Financial service providers face **major challenges** when digitizing service for the future economy: Customers and Businesses vs. Low-cost vs. Fast vs. Risks vs. Trust vs. Intelligent Way of providing business services

- Ant Financial focuses on five technologies: Blockchain, AI, Security, IoT, and Computing (BASIC) or also known as AI, Blockchain, Cloud, Data Analytics (ABCD)

- Ant Financial has redefined digital financial services, specifically mobile payment and microloan services, and Ping An Technology has developed.

- The innovation of QR payment builds a point-of-sale transaction (offline payment) for remote villages in the foot steps of mount Everest. Decisions made instantly for microloans and car accidental damages with customer sent photos

+1600

FinTech firms in the UK, estimates suggest this will more than double by 2030

42%

UK’s FinTech adoption rate. Global average is 33%

82%

of incumbents expect to increase FinTech partnerships in the next three to five years
UK FinTech 2

- UK start-up into a global market leader in FinTech **worth over $35bn**.
- The question now, is how can the UK keep up with the demand for the skills that will support the future success of FinTechs?
- Research from the **World Economic Forum** shows that emerging roles – such as, data analysts, AI and machine learning specialists, designers, and people who work in innovation roles – which currently account for 15% of the financial services workforce globally, are expected to account for **29% of the workforce by 2022**.
- Future of Technology Trends: Blockchain (identify management, Voting, etc), Drones (insurance claim validation in disaster situations), IoT (mobile banking, inventory and materials tracking, real-time asset monitoring (gold reserve, etc.), Robots (hotel and tourism service industry), 3D Printing, VR, AR, and AI.
Main Finding of Fintech

Their main findings

- Blockchain provides a new trust mechanism to transactions
- Deep learning and natural language processing technologies helped intelligent customer service robots achieve higher customer satisfaction rates than live service staffs
- AI Assessment of Claims and Risks for Insurance and Loans Sectors
WHY SERVICE DRIVEN?
Why SOA? Service Computing of Everything: Internet of Everything (IoE) for the Future of Business IT

The Future is here!

Why SOA? Multitude of devices, seamless data, intelligence, multitude of software, systems, services, and platform integration, and predictions. The Future is here!

SOA is a formalised way of integrating applications existing traditional applications and legacy systems) into an enterprise architecture and hence suitability for connecting IoEs.
YESTERDAY: GADGETS ARE EVERYTHING

Cool toys… Too bad they can’t talk to each other…
TODAY: COMMUNICATION IS EVERYTHING

Configuration? Too much work...

Sync. Download. Done.
Tomorrow: Service is Everything: they communicate, compose new services, and self recover themselves.
Connecting Services is Here with 5G
Cybersecurity Risks with 5G

- 5G and 6G is great for connecting services with Cloud, Big Data Analytics with AI/ML/DL, Robotics, Blockchain, IoT Technologies

- However, if the application services are not engineered (design for security/Build-In Security (BSI)), we will have sever consequences similar to what we have seen in movies

- It could destroy power grid, transportation, financial services, simply every seconds of day-to-day life (Dr Ian Levy, Technical Director of the National Cyber Security Centre, BBC Click Interview, May 2019 (the future of cyberwarfare)

- 5G Click Interview

- Therefore, it is paramount to use Cybersecurity Improvement Framework
Why BPM (Business Process Management = BPMN+CMMN+DMN) for Financial Services and Financial Cloud Based Applications?

Evolving a Reference Architecture for FinTech
Service-Driven IT is the Future: SOA Paradigm

The main focus and purpose is customer driven methods, processes (applicable to both traditional as well as Agile based), and technologies.
Basic Principle of 3-tier Architecture Model

The top layer is called role-based Web access layer, which provides convenient, safe, barrier-free information access portal for all participants in the collaboration. Its specific functions include information browse, search, subscriptions. The middle layer is called application logic layer that reflects the interact logic among person, activities and information. Its specific functions include collaborative process management, information sharing and reuse, integration with existing systems. The bottom layer is data storage layer, whose main role is to change product data into knowledge wealth. Its specific functions include information capture, storage, sorting, enriching, structuring and summary.

What is BPMN?


Service Requirements with BPMN
- Initial process models: Actors/roles/Workflows
- Detailed workflows
- Service Task modelling
- UI prototyping
- Process Simulation:
  - Configure Resources need for tasks
  - Load profiles in sec/min/days/no.of instances
  - Start the Process Simulation as a Service (PSSaaS)

SOA Requirements with use case modelling, story cards, (Agile), Story Boards, CRC Cards, Feature-Oriented modelling

SOA Design with Service Component Models (Design Techniques using UML component model & SoaML)

SOA Implementation with SOAP/RESTful

SOA Test & Deliver

Method, Process, Framework, Architecture, Design Principles

Methods and Design Principles

Process: Business Process Driven Service Development Lifecycle (BPD-SDL)

Reference Architecture

Tools


Adoption Models

Evaluation & Applications
Design Principles

- Reuse of Financial Services with ML
- High Level Abstractions: Lightweight vs. Heavyweight abstractions: Service Components, Microservices, and Containers
- Privacy and Security: BPMN and SoaML Driven Validation before Implementation with Business Process Driven Service Development Lifecycle
- Smart Contract with Blockchain Technology
- Comparative Design Strategies
  - The Sherwood Applied Business Security Architecture (SABSA) is a framework for developing risk-driven enterprise information security and assurance architectures. It defines attributes such as reputation, operational efficiency, business continuity and brand perception. These attributes, and others, need to be protected through security controls.
  - https://www.youtube.com/watch?v=qbFTg85I4eE
Design Abstractions

- Objects
- Components
- Service components (SoaML)
- Microservice components
- Packaging
- Virtual Machine
- Containers
- Serverless Programming abstractions
- Resource-oriented abstraction

Increasing Level of abstractions

Smart Contracts based on Blockchain Concept
Concept of a generic SOA Based Reference Architecture: Aspect of Layering Abstraction

Design Principle on web services granularity: An Example of outsourcing parts shipping / delivering process

If the granularity is too small, the service may be too specific to be useful. If the granularity is too large, it leads to a general application-specific service which cannot be reused. Then, the service should be broken into smaller parts.  

XIAO Jie; CAI Fang; WU Dan; DU Jie. Study of SOA-based CRM System Architecture, Microcomputer Information [J], 2009.12, PP:46-48
FAaaS (Financial Applications as a Service) Component Model
Financial Accuracy & Predictive Mathematical Models & Algorithms

• Models behind FAaaS are essential for the calculation, processing and presentation of financial computation in the Cloud.

• 1. Heston Model
• 2. Wiener Process
• 3. CIR (Cox, Ingersoll and Ross) Model
• 4. Runge–Kutta method (RKM)

• The use of all the models for FSaaS can match accuracy and optimize the performance.
SEF-CC Reference Architecture for Service Computing

Orchestration & Co-ordination Services

Business Services
- Focus on new service composition for new business creation & choreography
- Focus on user-centric business services such as secure access, etc
- Business Utility and Co-ordination Services (task-oriented, entity-oriented & enterprise-oriented services)

Infrastructure Services
- Core Infrastructure services
- Infrastructure utility Services
- Infrastructure co-ordination services

Enterprise Service Bus
As an Architect, you will need to categorise services therefore you will be able to place them in the appropriate architecture layers on the right.
Reference Architecture for Financial Cloud

Business Layer
- Registration, Authentication & Security Control

Orchestration Layer
- Multi-channel service requests

Secure Enterprise Service Bus

Consumer Banking Applications
- Consumer Banking
- Investment Banking
- Predictive Modelling for Financial Services with Machine Learning & Deep Learning

Business Regulations with Smart Contract (AI and Blockchain Services)

Financial Services Algoirthms for Decision Making
- Financial Services Layer
- Mobile, Cloud, IoT
- Sensors, Social Media, Email, QR code, vouchers, Drones, etc

Current Account Services
- Savings & Deposit Services

Loan Services
- Cryptocurrencies

Governance Services (FCA Regulations) with Smart Contract

Insurance Services

Financial Analytics Layer

Infrastructure Layer
- Financial Services Layer
- Mobile, Cloud, IoT
- Sensors, Social Media, Email, QR code, vouchers, Drones, etc

Current Account Services
- Savings & Deposit Services

Loan Services
- Cryptocurrencies

Governance Services (FCA Regulations) with Smart Contract

Insurance Services

Financial Analytics Layer

Infrastructure Layer
COGNITIVE ARCHITECTURES
The TrueNorth architecture, a network of neurosynaptic cores. The crossbars, neuron properties, and point-to-point connections are all configurable.
FINANCIAL CLOUD APPLICATIONS & TECHNOLOGIES
Improving the use of Current Technologies for FinTech Growth (Digital Transformation)

- It was inevitable that technology would meet finance and spawn fintech.
- The use of technologies like algorithmic machine learning, collecting massive amounts of data and interpreting them for decision-making or “crystal-ball” predictions (predictive analytics), and distributed ledgers (blockchain) in financial industry will give rise to innovative business models with increased levels of efficiency, productivity, cost-effectiveness while also improving on customer-centricity.
- The most important thing and also a great challenge for both fintech platforms and financial institutions is to adopt and implement a very pertinent, practical, and transparent strategy for digital transformation within the organization as well as in external engagements.
FinTech Growth
Current Applications

- Crowdfunding
- Peer-to-Peer (P2P) Finances: Lending & Loan
- E-Banking
- E-Insurance
- E-Investments
- E & M-Commerce
FinTech

- **2005**
  - Launch of P2P Platform for transactions

- **2005-11**
  - NFC chip enabled phone launched

- **2011**
  - NFC

- **2012**
  - Over 1 Billion transactions
  - Internet Banking
  - Mobile Banking

- **2014**
  - Peer to peer global Lending worth >= $40 Billion

- **2015**
  - Smartphones overtake laptops in terms of internet usage

Disruption in Cloud Usage
Technologies

- E-Commerce
- Machine Learning and AI
- Big Data Analytics
- Predictive Analytics for Decision-Making (Crystal-bal)
- Blockchain
- IoT
- Cryptocurrencies (Bitcoin vs Ethereum (ETH))
Integrated Financial Cloud Services
Financial Cloud Services
Simulation View of the Financial Cloud Services
MACHINE LEARNING TECHNIQUES TO REQUIREMENTS EVALUATION AND SOFTWARE DEFECT MANAGEMENT WITH REUSE AND KNOWLEDGE DISCOVERY
QoS Metrics to Measure for FinTech

- Availability
- Scalability & composability
- Performance
- Computational Accuracy
- Portability
- Security
- Response Time
- Usability
- Throughput

Financial QoS
Event Logs Data of Loan Application Process for a Dutch Financial Institution between 2012-17 as part of BPI Challenge, https://tinyurl.com/bpic2017
Machine Learning for Process Mining: Improving Efficiency of the Business Processes

- Existing Process Logs (Data)
- Open source data
- Company’s own data

- Process (Data) Transformation and Cleaning
  - Adopting automated techniques for data transformation
  - Identify knowledge patterns for reuse

- Machine Learning Techniques
  - Azure ML

- Knowledge Discovery with Azure/ML (Cloud Driven ML)

- Add/amend existing service requirements
- Add/amend existing business processes

- Requirements Elicitation with Reuse of Process Mining

Process Mining
Machine Learning to Improve Requirements Engineering Process

- Azure Machine Learning
- Predictive analytics
- Improved RE Process
- Performance and Process Accuracy
- BPMN
New Business Process Discovery
Key points

- FinTech is emerging and needs to adopt new technologies quickly.
- Decisions making is a huge challenge for financial applications and services where AI, ML, Deep Learning can help making decisions and predictions faster.
- Smart contract with Blockchain Technology can help building trust with application of BPM and business risk framework.
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