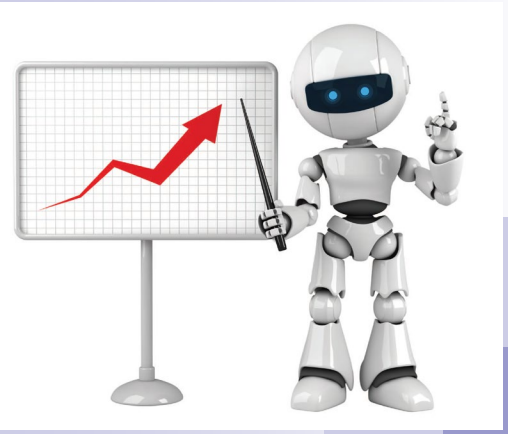

Reference Architecture and Application of Business Process Modelling for FinTech Industries

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Leeds Beckett University
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In this talk

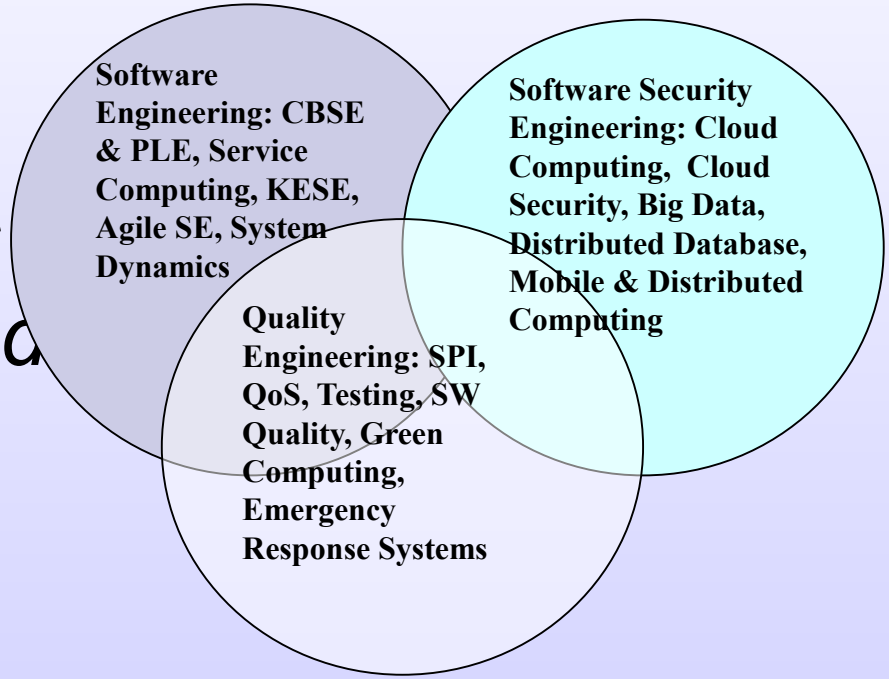
- Main Motivation for Research into FinTech Industry
- Why Service Driven?
- Evolving a SOA driven reference architecture for financial cloud services?
  - SEF-SCC & BPD-SCC
  - Design Principles
  - Cognitive Architectures (predicting the future of software architecture)
- FinTech Cloud Applications: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

Leeds Beckett University

- **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

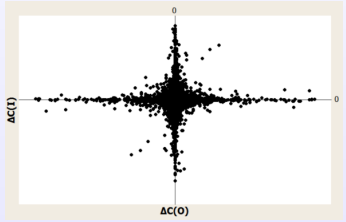
- *IT and Sustainability*
- *Assistive technologies computer forensics and security*
- *AI, Machine Learning, Robotics*
- *Data Science, Software Engineering, SOA, IoT, and Cloud Computing*



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
- Cloud Computing and Big Data – Cloud Computing Adaption Framework (CCAF, IEEE SC 2016), Dynamic Service Component Model, Big Data and Resiliency Framework (FGCS 2015)
- Software Security Engineering Research: Vulnerability Techniques, Security Improvement, Design for Software Security



Example of a complex code analytics

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
  - Software Engineering Framework for Service and Cloud Computing (SEF-SCC): Application to FinTech Cloud
  - Business Process Driven Approach to Service and Cloud Computing (BPD4SCC): Our Model
  - 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

Fintech: Ant Financial Services, China

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.

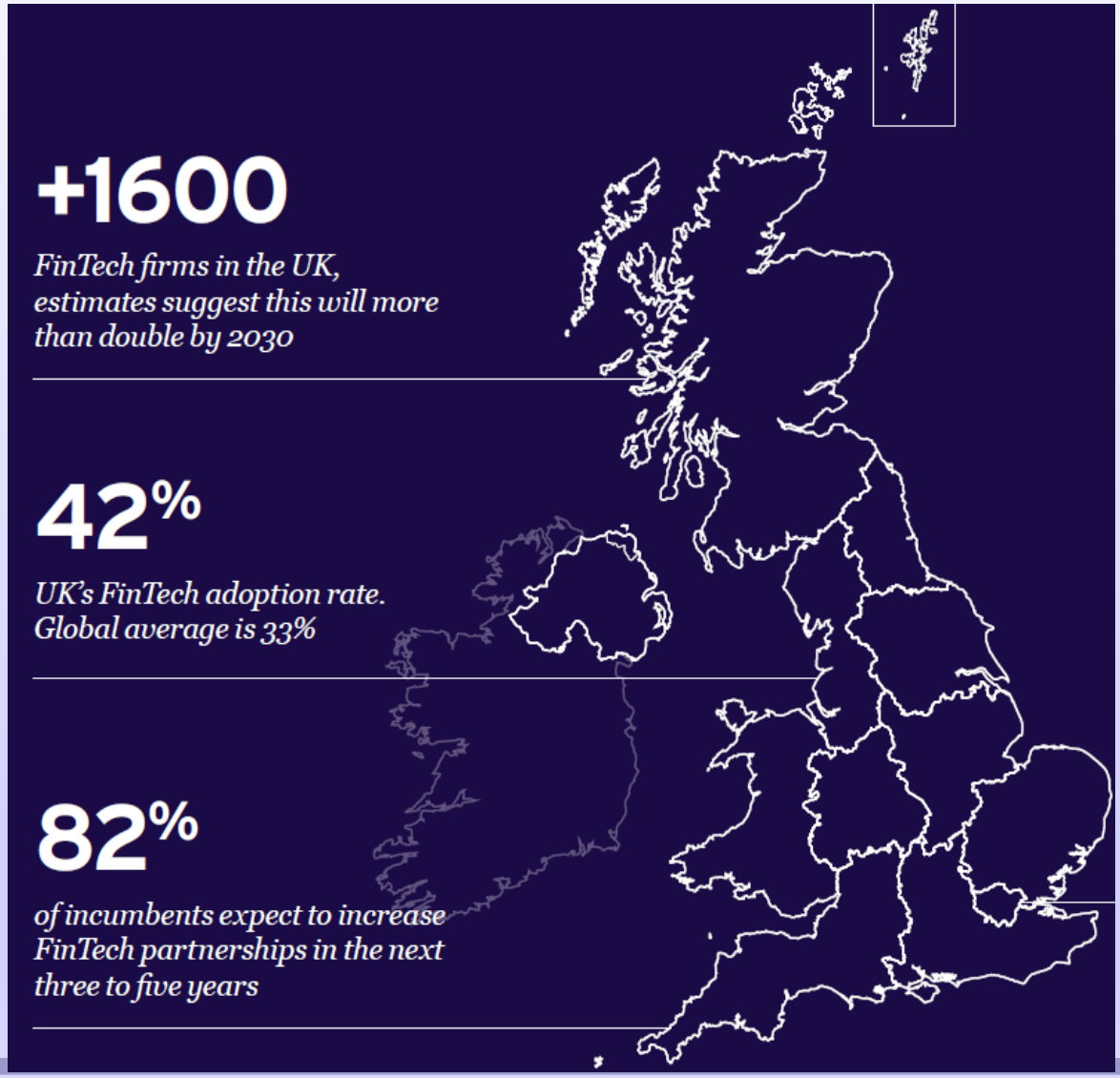
Figure 2. Zhang Yousheng, a herdsman, uses Ant Financial microloans to purchase calves and fodder.

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

UK FinTech 1

UK FinTech (2019) State of the Nation, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801277/UK-fintech-state-of-the-nation.pdf



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

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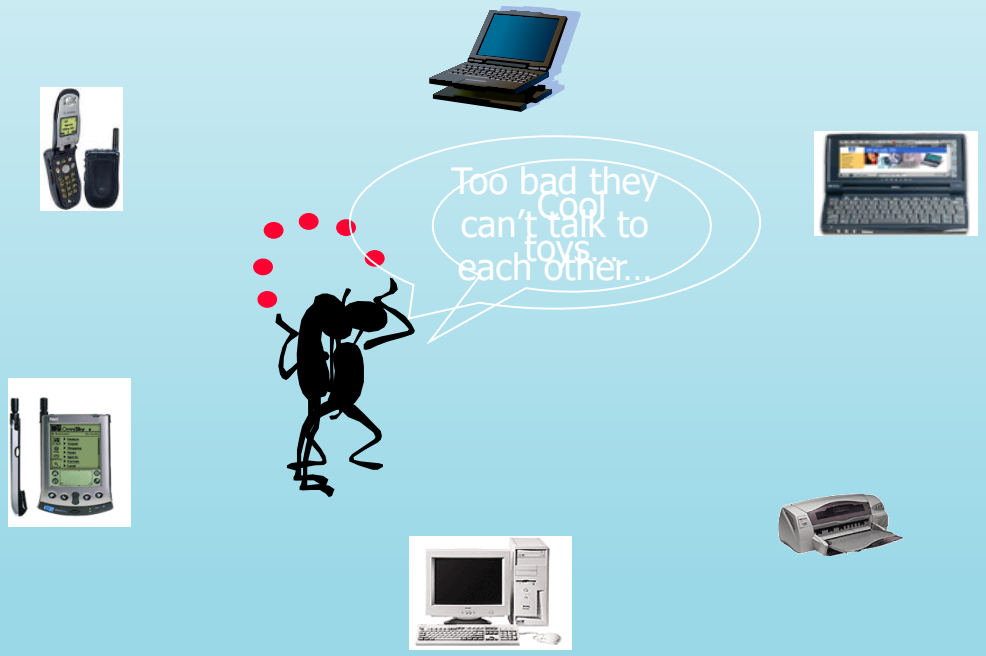
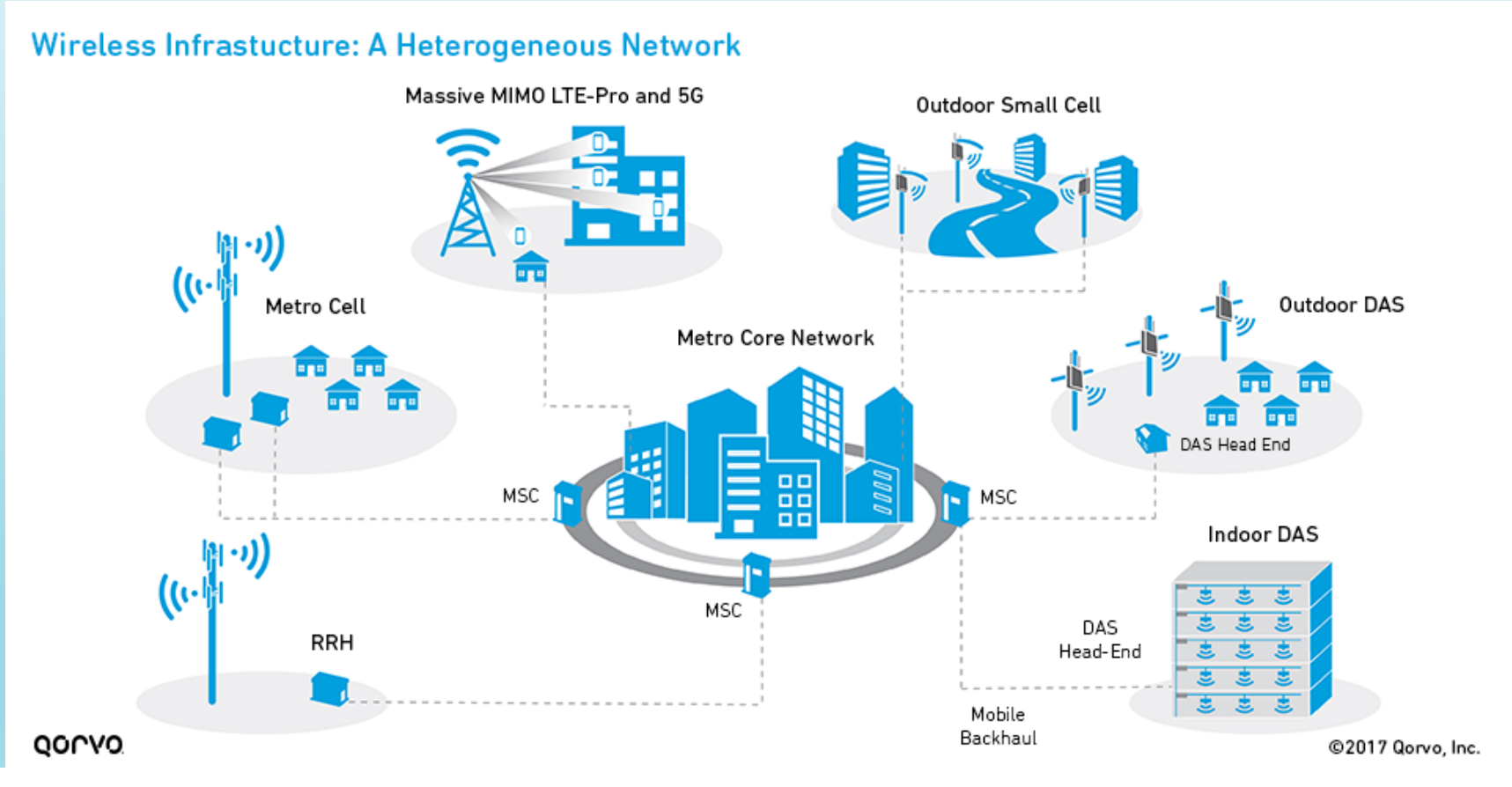
YESTERDAY: GADGETS ARE EVERYTHING



TODAY: COMMUNICATION IS EVERYTHING

Tomorrow: Service is Everything: they communicate, compose new services, and self recover themselves

Connecting Services is Here with 5G



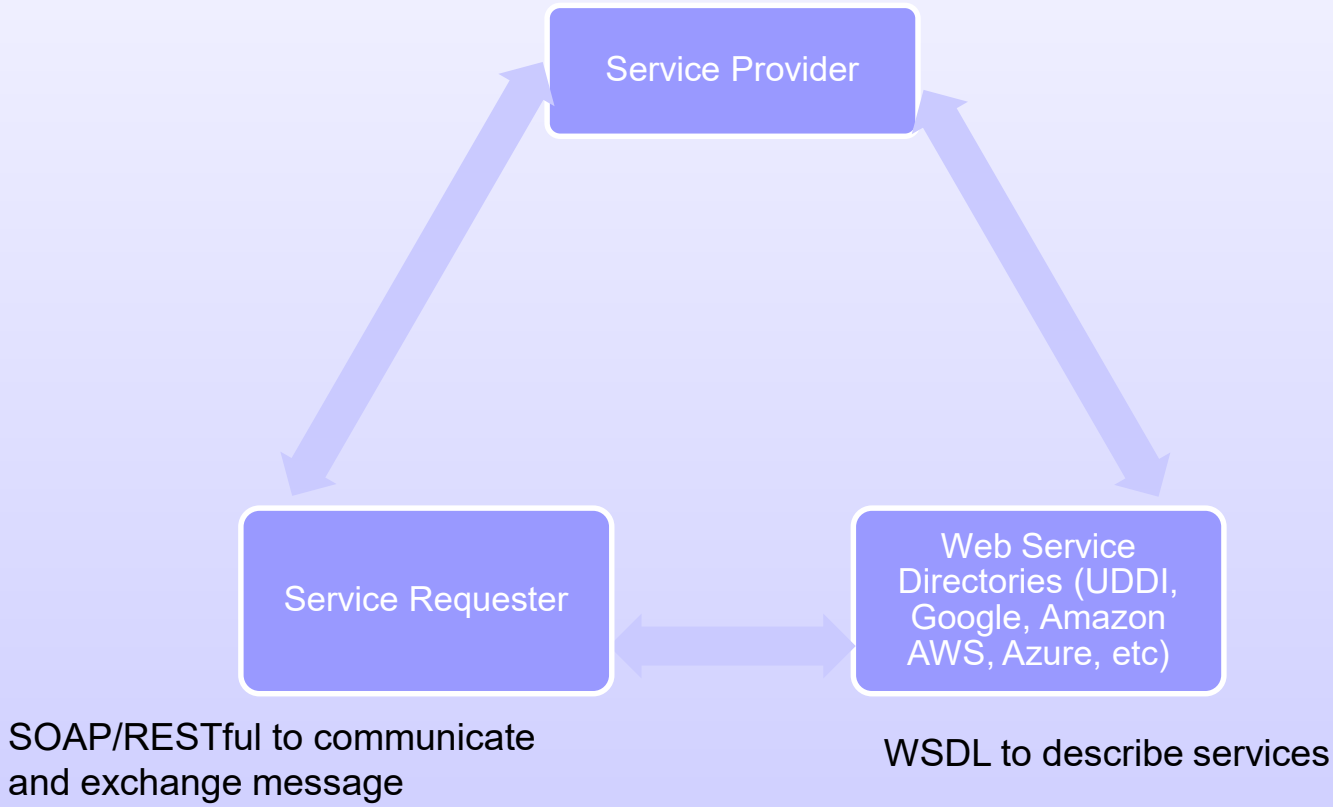
Cybersecurity Risks with 5G

- 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



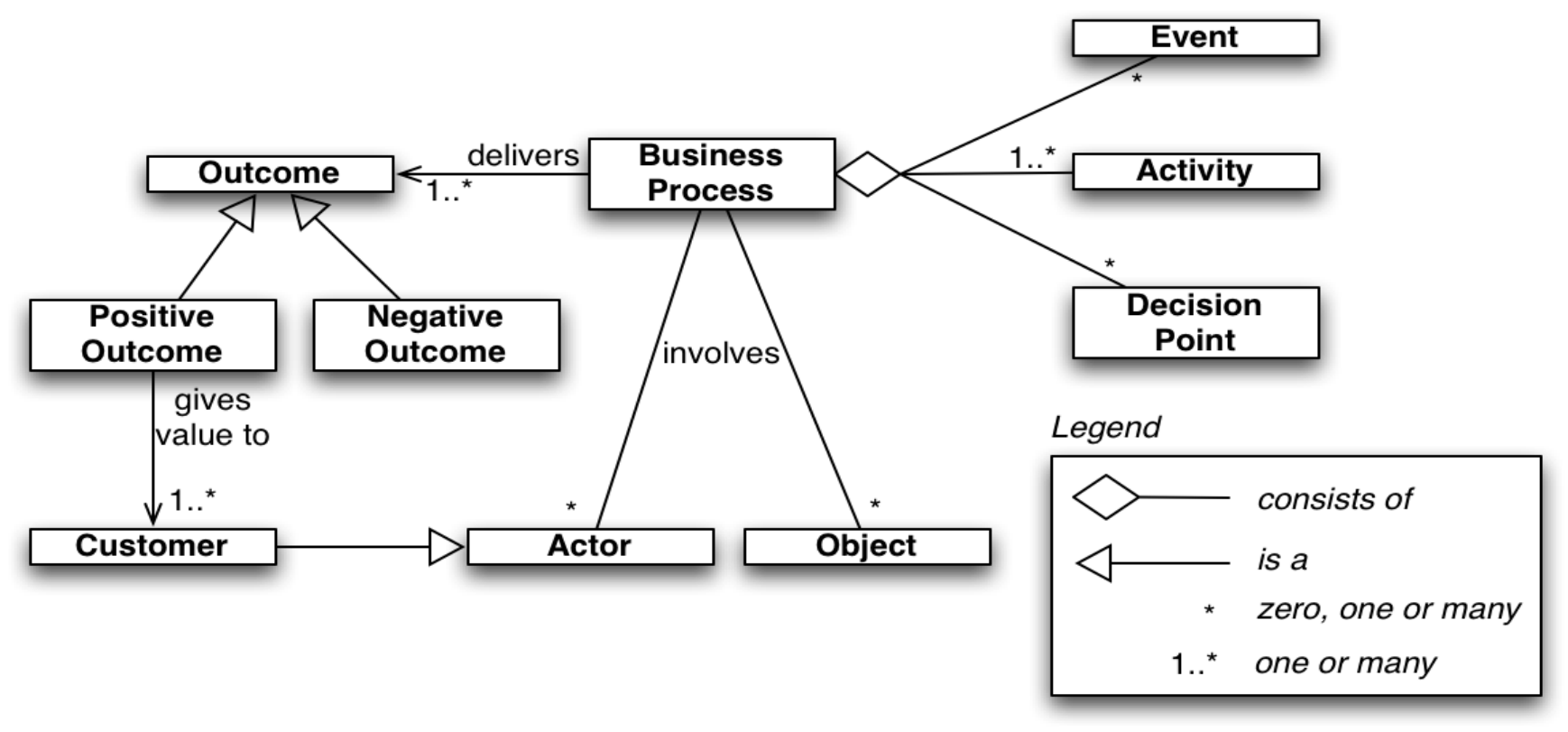
The main focus and purpose is customer driven methods, processes (applicable to both traditional as well as Agile based), and technologies

Basic Principle of 3-tier Architecture Model

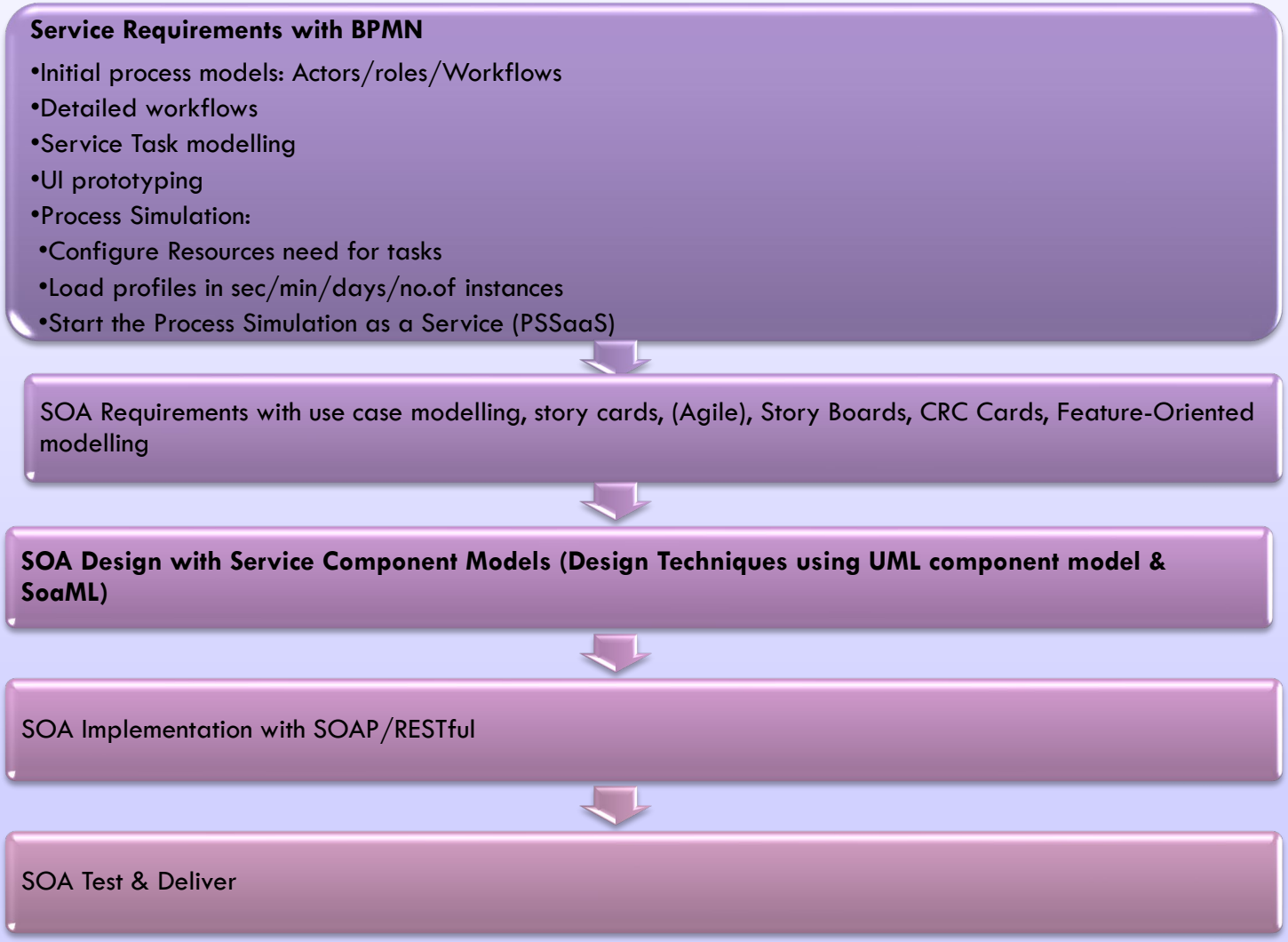
The top layer is called role-based Web access layer, which provides convenient, safe, barrier-free information access portal for all participants in the collaboration. Its specific functions include information browse, search, subscriptions. The middle layer is called application logic layer that reflects 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.

Jiang, J., Zhao, F., and Qiu,, N (2012) SOA-based Architecture of Collaborative Product Commerce, 2012 IEEE Symposium on Robotics and Applications(ISRA)

What is BPMN?


Event
*
Outcome
delivers
1..*
Business Process
1..*
Activity
*
Decision Point
Positive Outcome
Negative Outcome
involves
gives value to
1..*
Customer
*
Actor
*
Object
Legend
consists of
is a
* zero, one or many
1..* one or many

Business Process Driven Approach to Service and Cloud Computing (BPD4SCC): Our Model



Software Engineering Framework for Service and Cloud Computing (SEF-SCC): Application to FinTech Cloud

Method, Process, Framework, Architecture, Design Principles


Methods and Design Principles


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


Reference Architecture


Tools


SE-SCC Services: Software Engineering as a Service (SEaaS): SPMaaS, SPIaaS, SSREMaaES, CCAFaaS, SE for BD, SE for IoT, SE for Cyber-Physical Systems

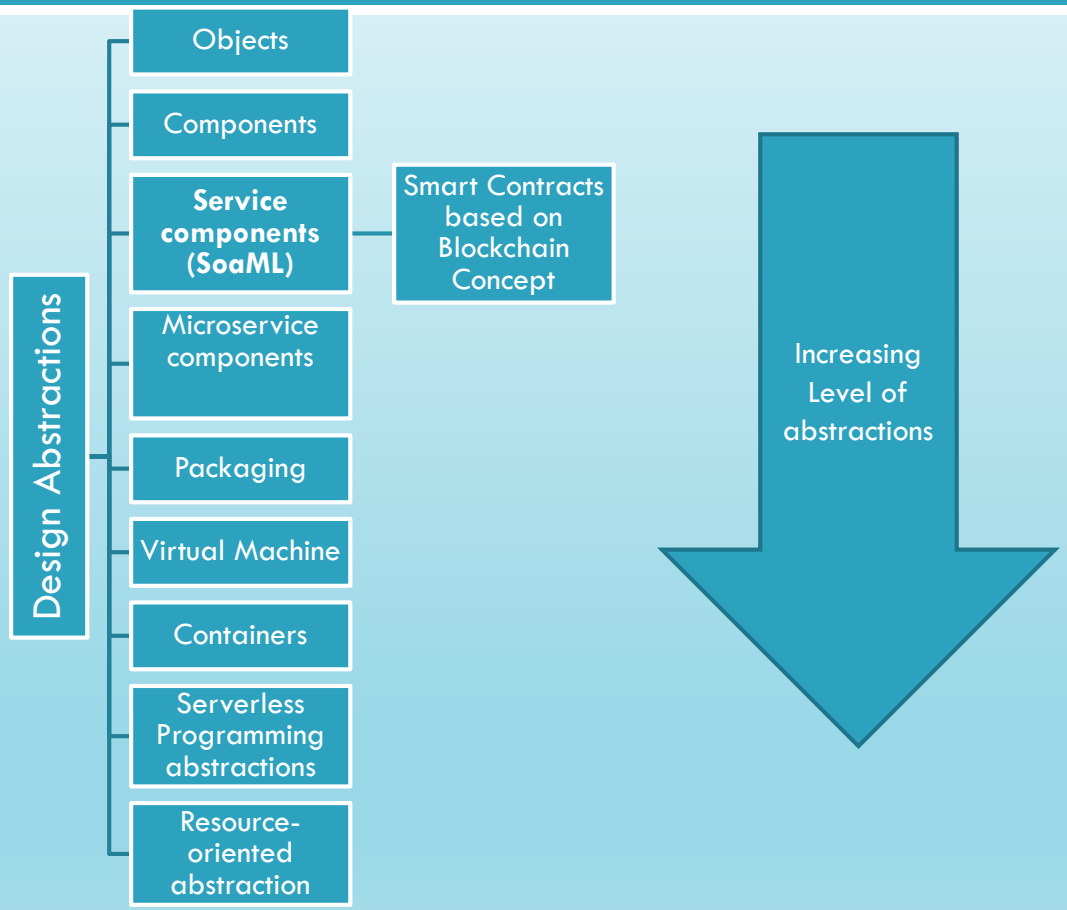

Adoption Models


Evaluation & Applications

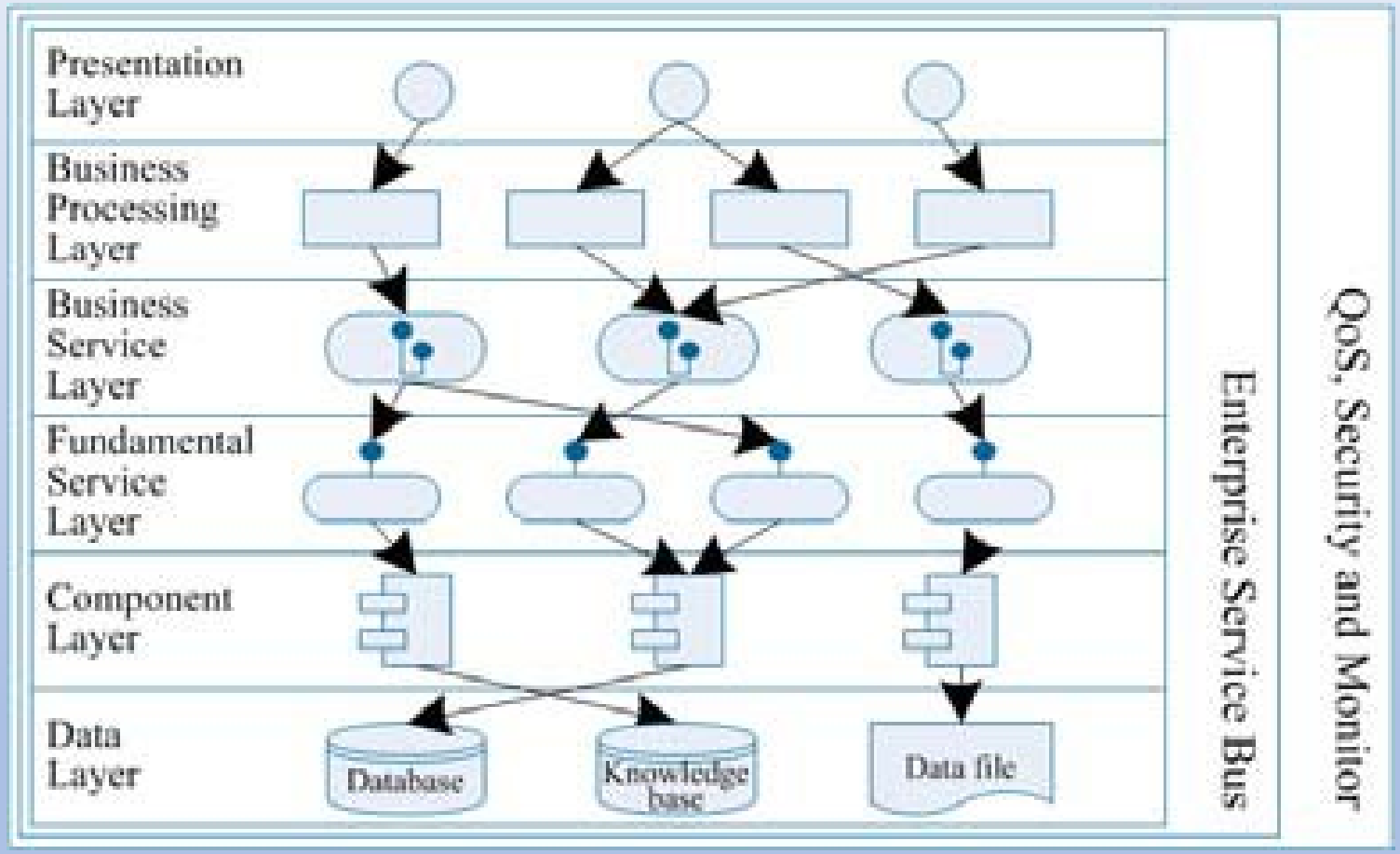
Design Principles

- 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

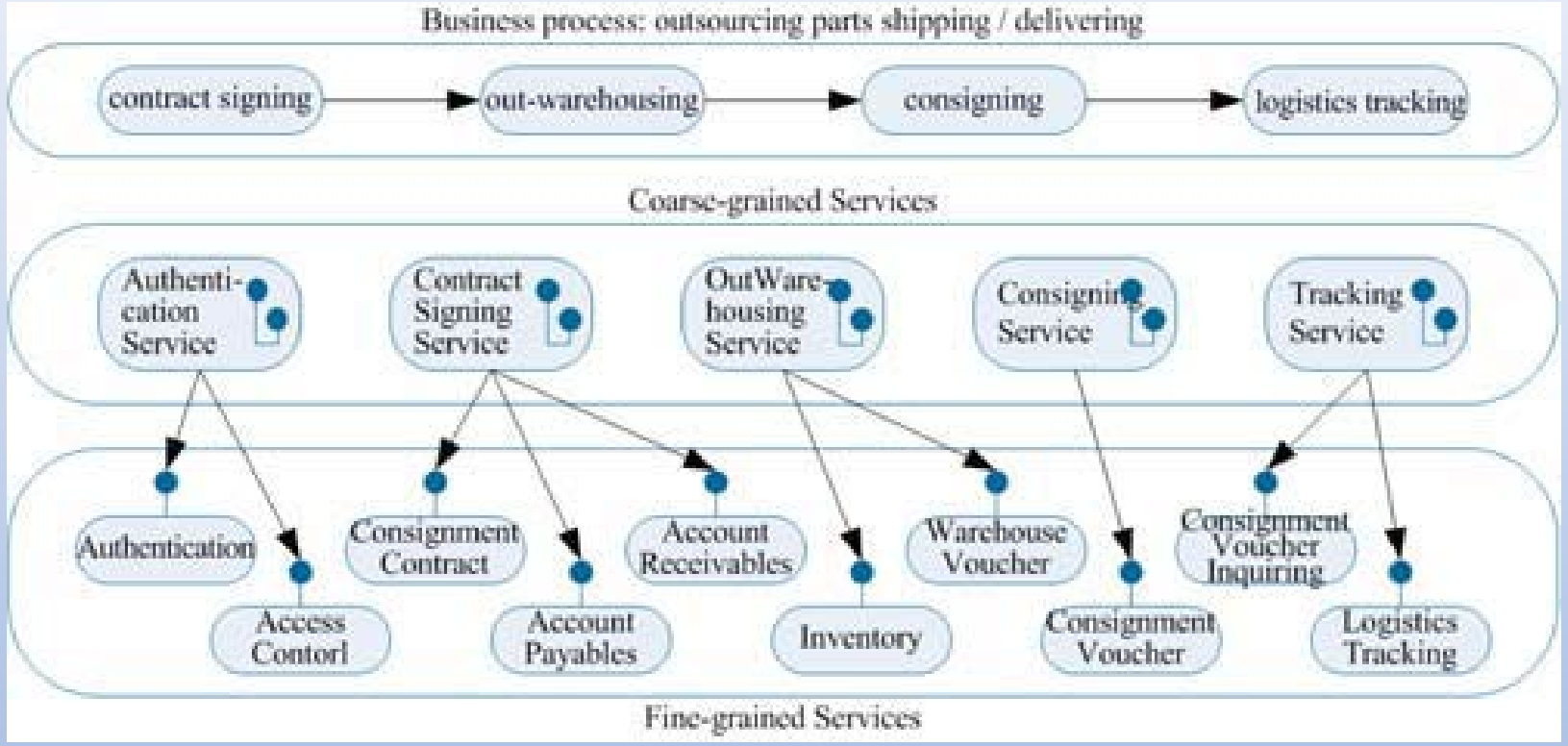


Concept of a generic SOA Based Reference Architecture: Aspect of Layering Abstraction



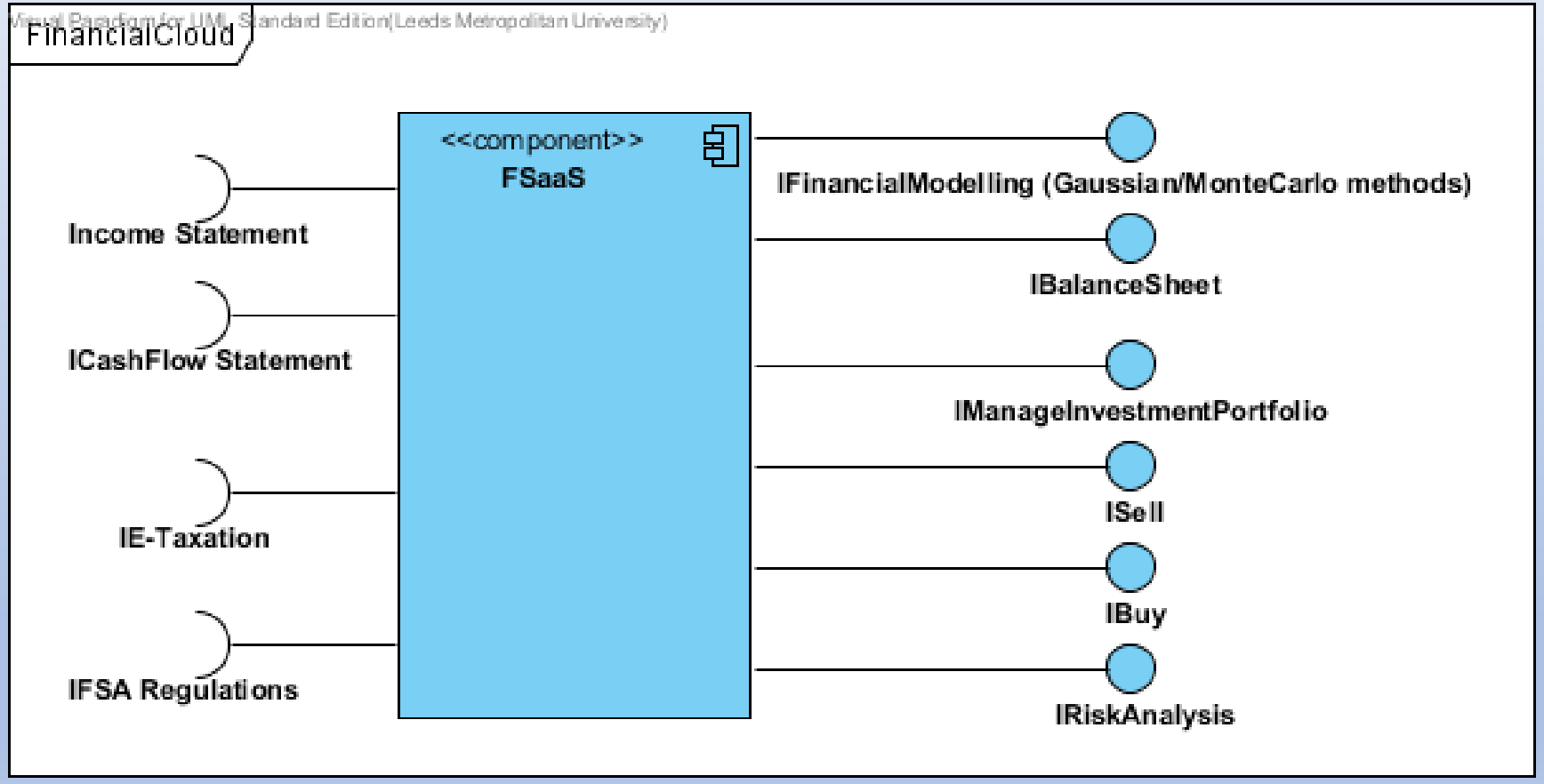
Jiang, J., Zhao, F., and Qiu,, N (2012) SOA-based Architecture of Collaborative Product Commerce, 2012 IEEE Symposium on Robotics and Applications(ISRA)

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

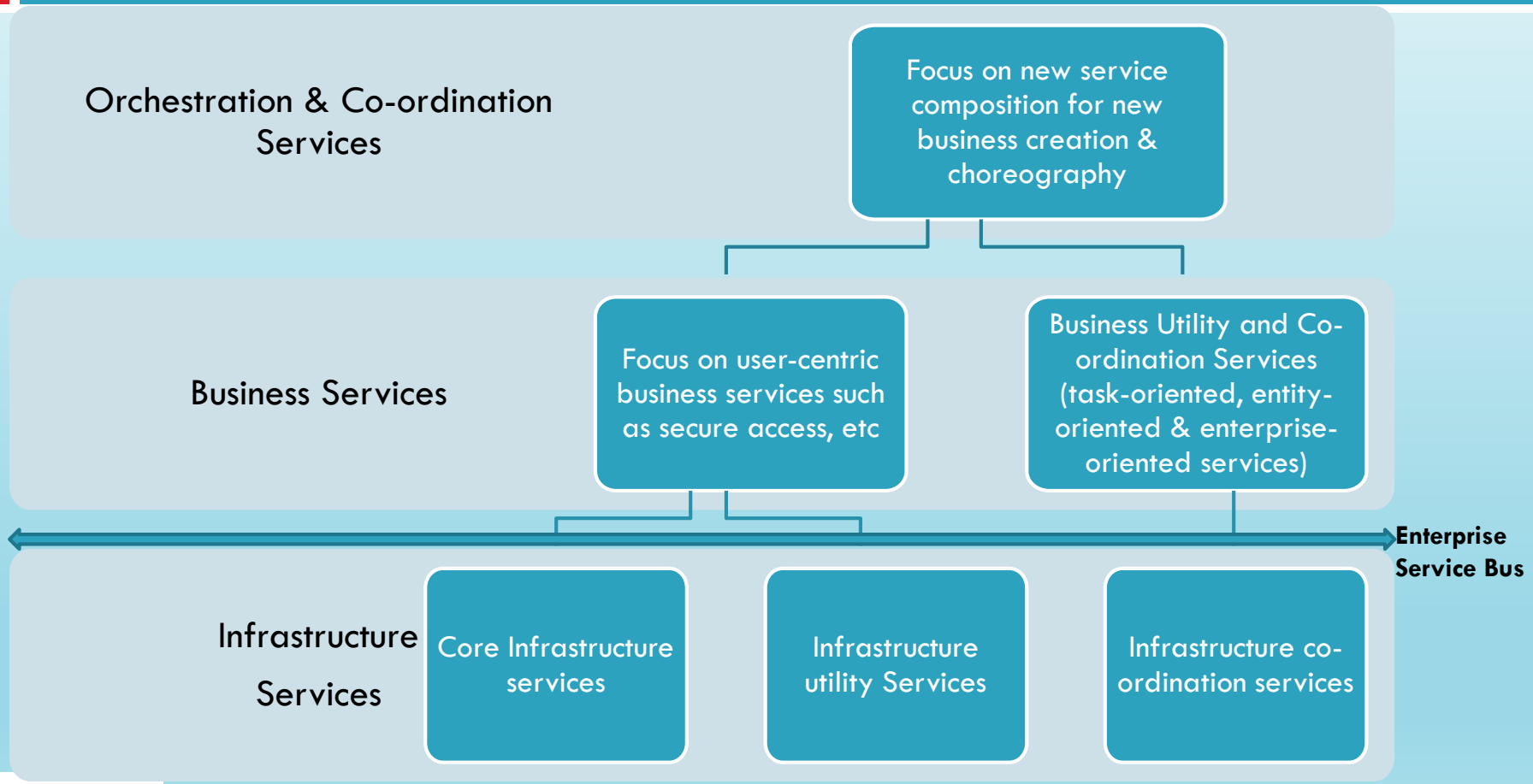


Financial Accuracy & Predictive Mathematical Models & Algorithms

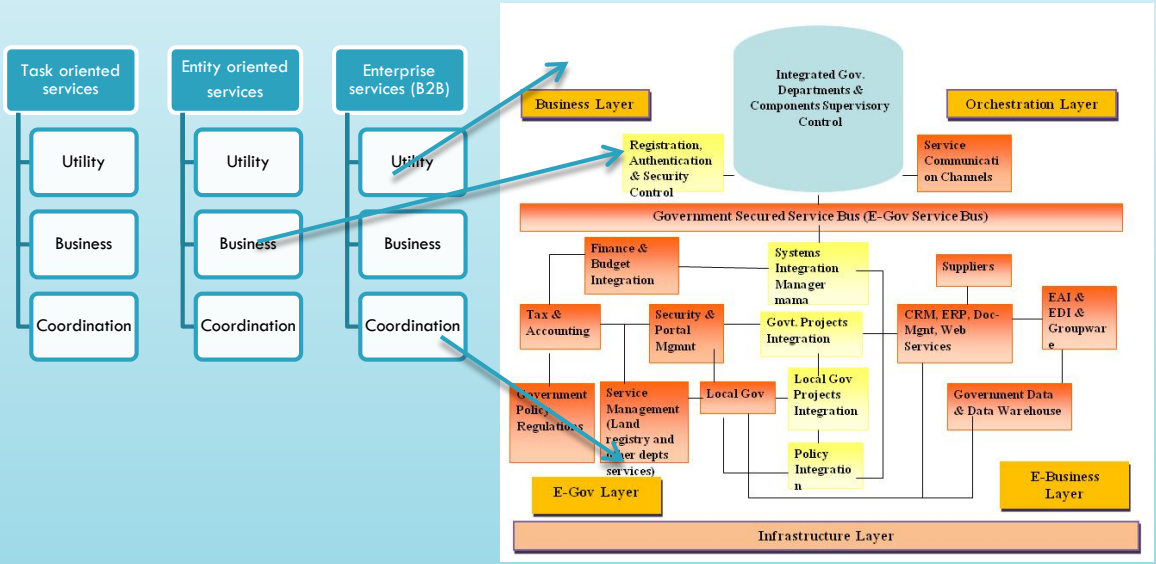
- Models behind FAaaS are essential for the calculation, processing and presentation of financial computation in the Cloud.
- 1. Heston Model
- 2. Wiener Process
- 3. CIR (Cox, Ingersoll and Ross) Model
- 4. Runge–Kutta method (RKM)

- The use of all the models for FSaaS can match accuracy and optimize the performance.

SEF-CC Reference Architecture for Service Computing



Mapping Services to SOA Design



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

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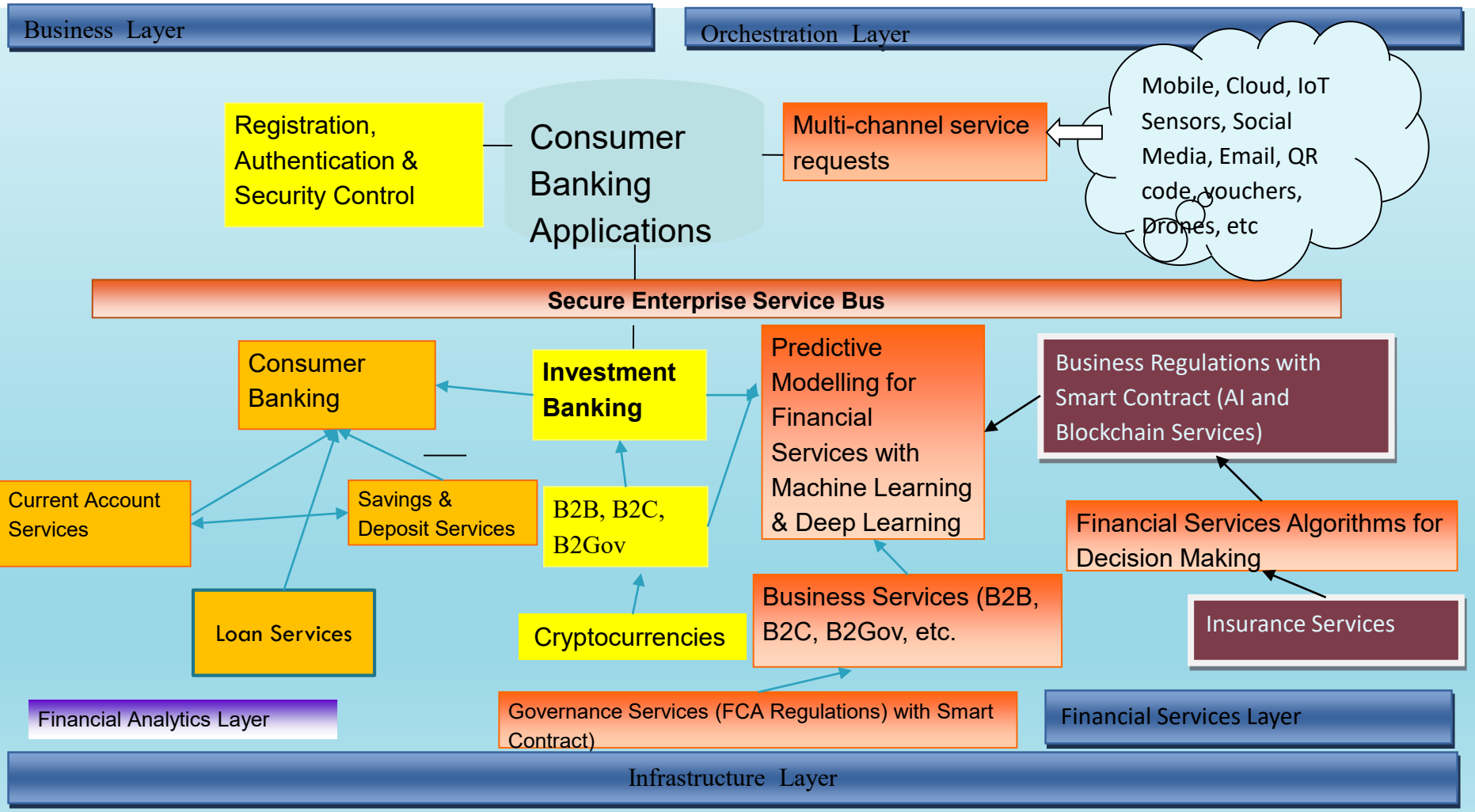
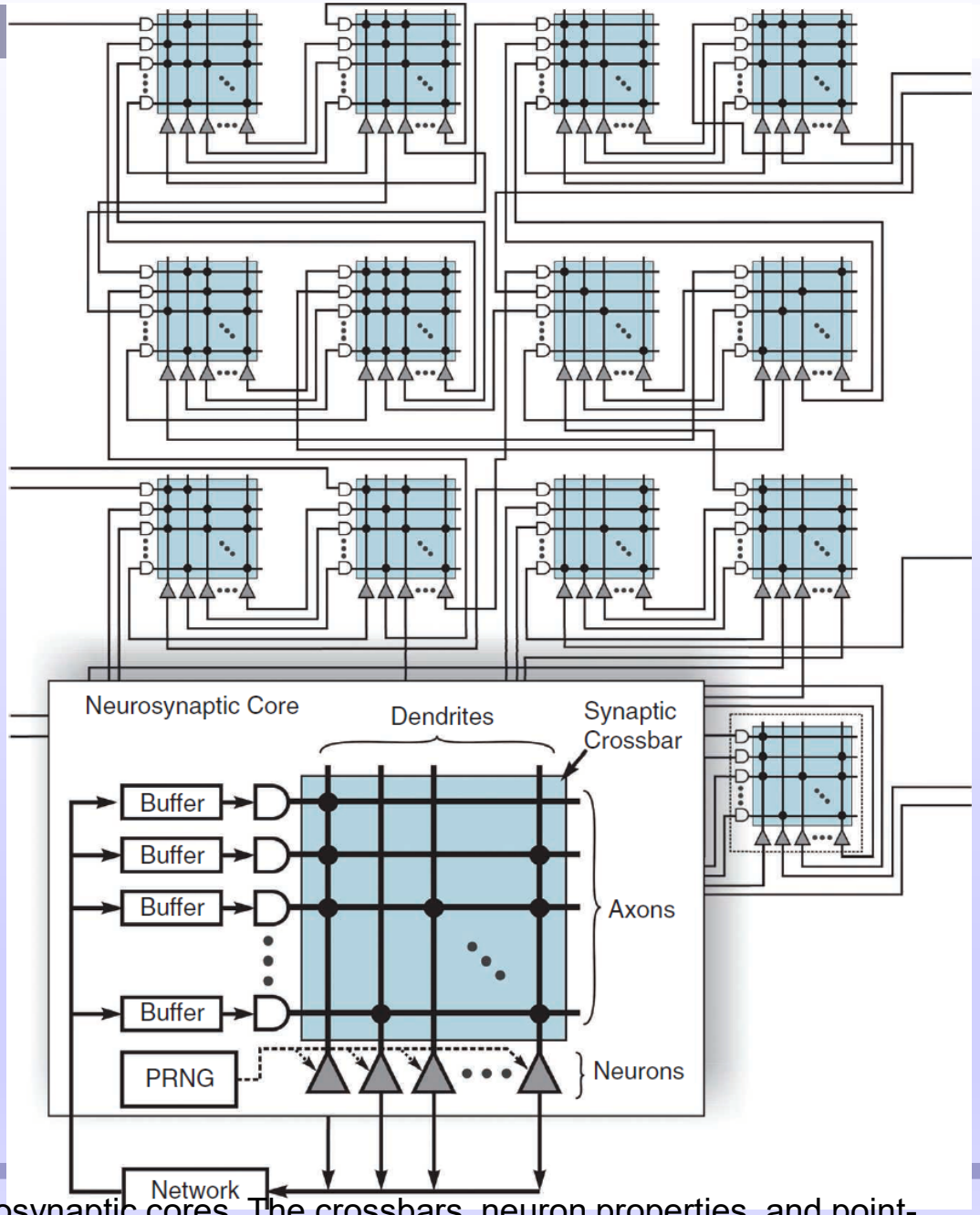
Reference Architecture for Financial Cloud



COGNITIVE ARCHITECTURES

TrueNorth: Neurosynaptic architecture



DeBole, V.M. et al. (2019) TrueNorth: Accelerating From Zero to 64 Million Neurons in 10 Years, IEEE Computer, May 2019

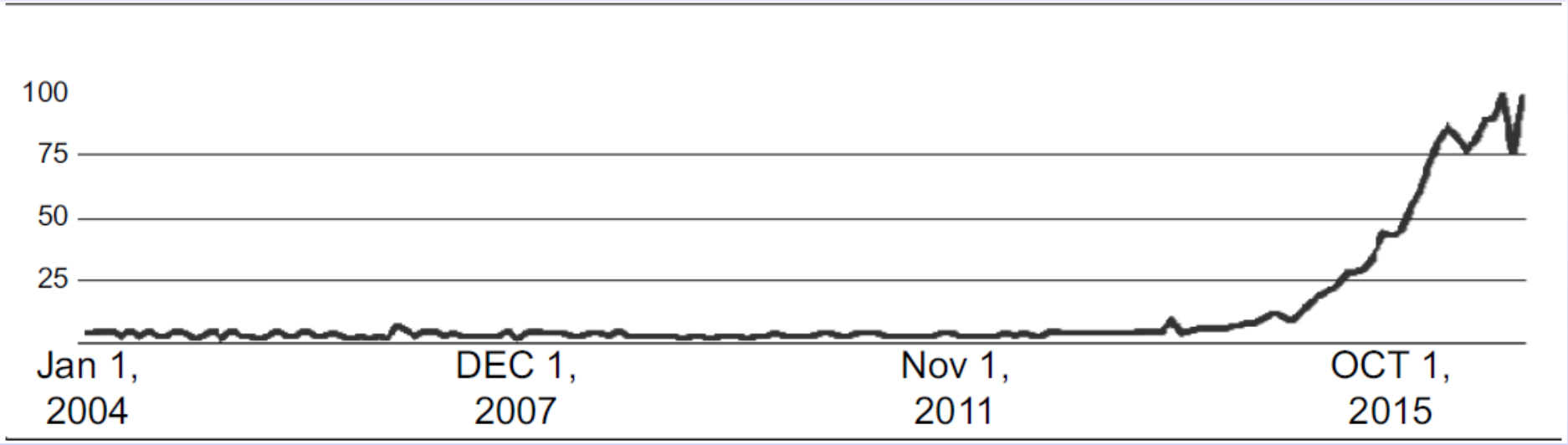
The TrueNorth architecture, a network of neurosynaptic cores. The crossbars, neuron properties, and point-to-point connections are all configurable.

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.

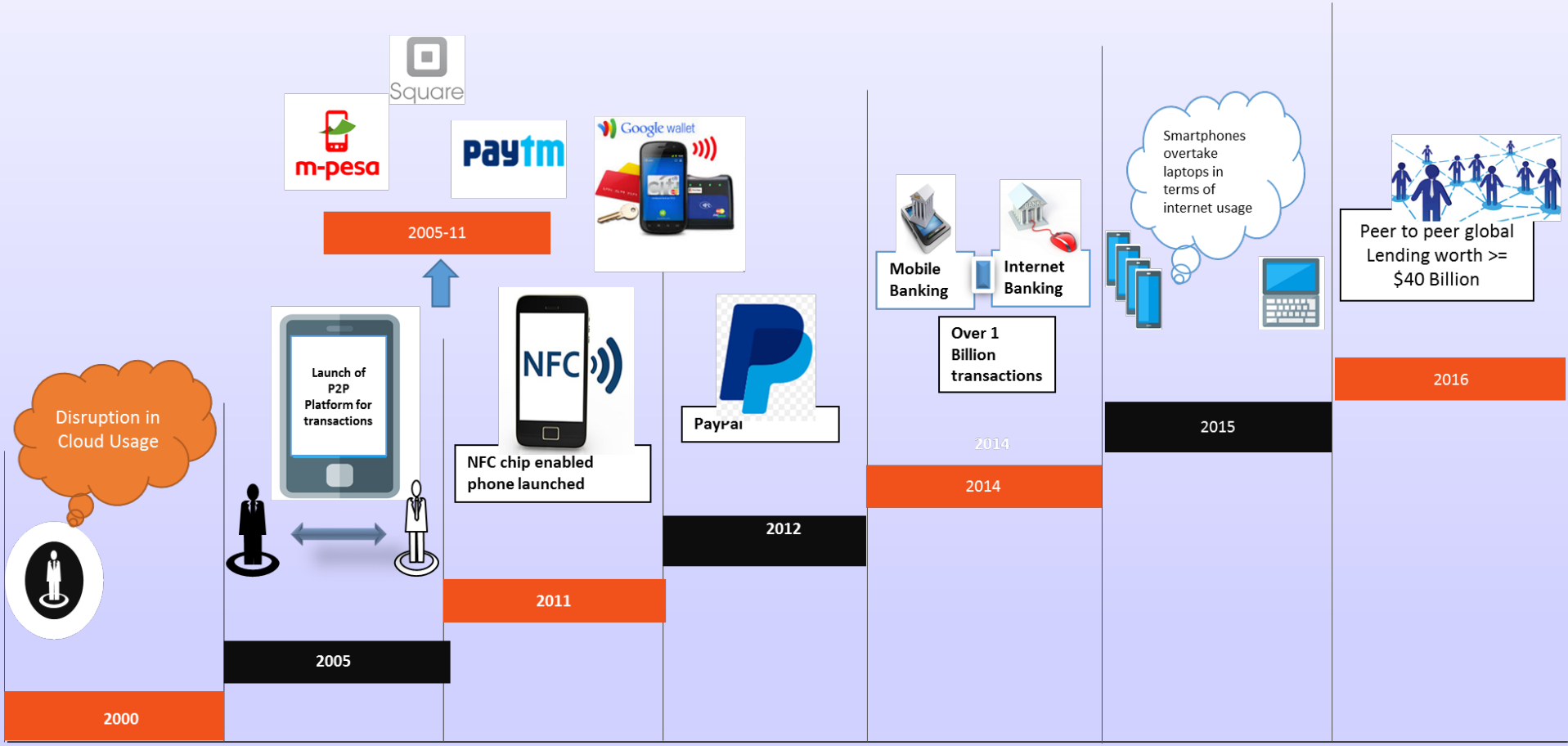
FinTech Growth



Current Applications

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

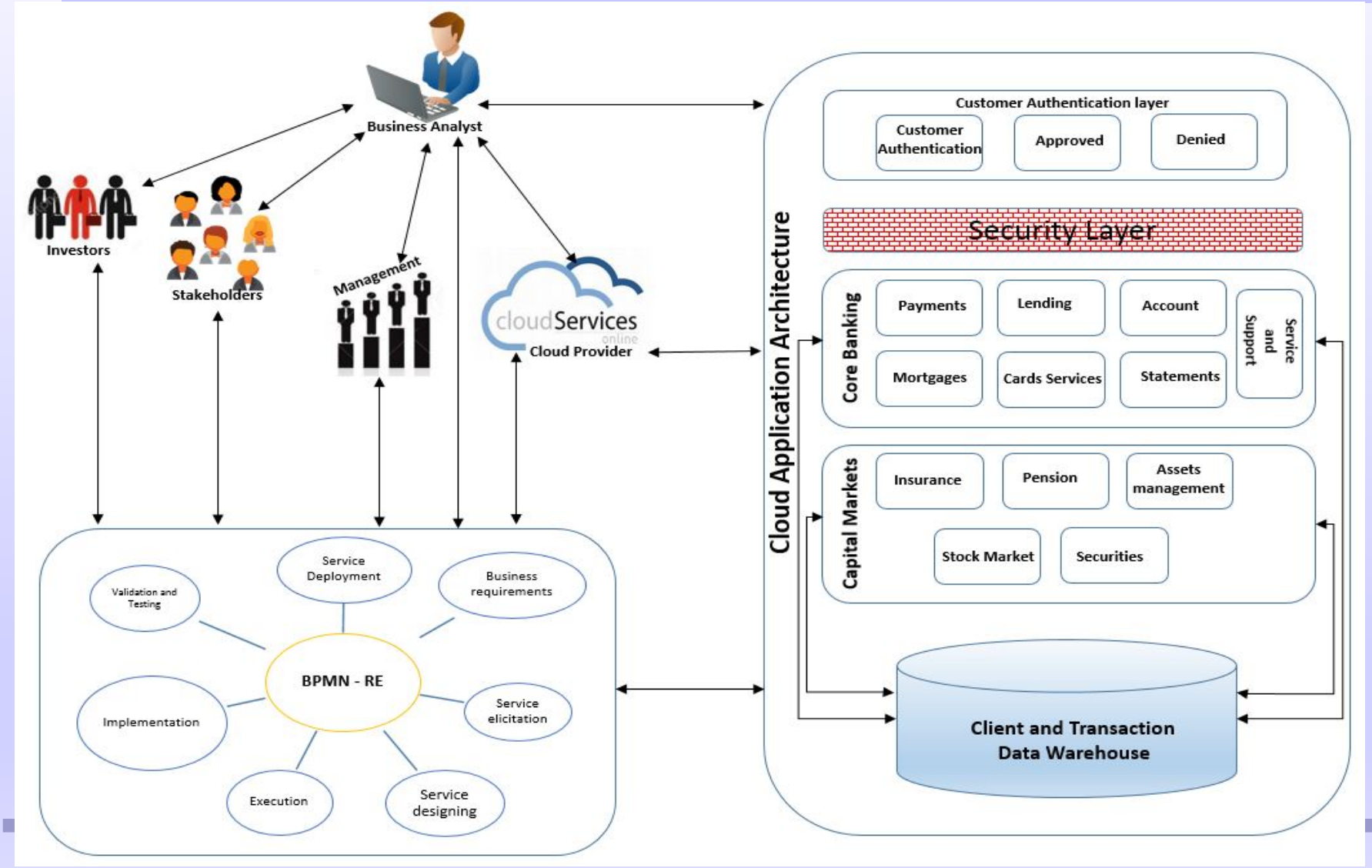
FinTech


Square
m-pesa
paytm
Google wallet
2005-11
Launch of P2P Platform for transactions
NFC
NFC chip enabled phone launched
Payrai
Mobile Banking
Internet Banking
Over 1 Billion transactions
Smartphones overtake laptops in terms of internet usage
Peer to peer global Lending worth >= $40 Billion
Disruption in Cloud Usage
2000
2005
2011
2012
2014
2014
2015
2016

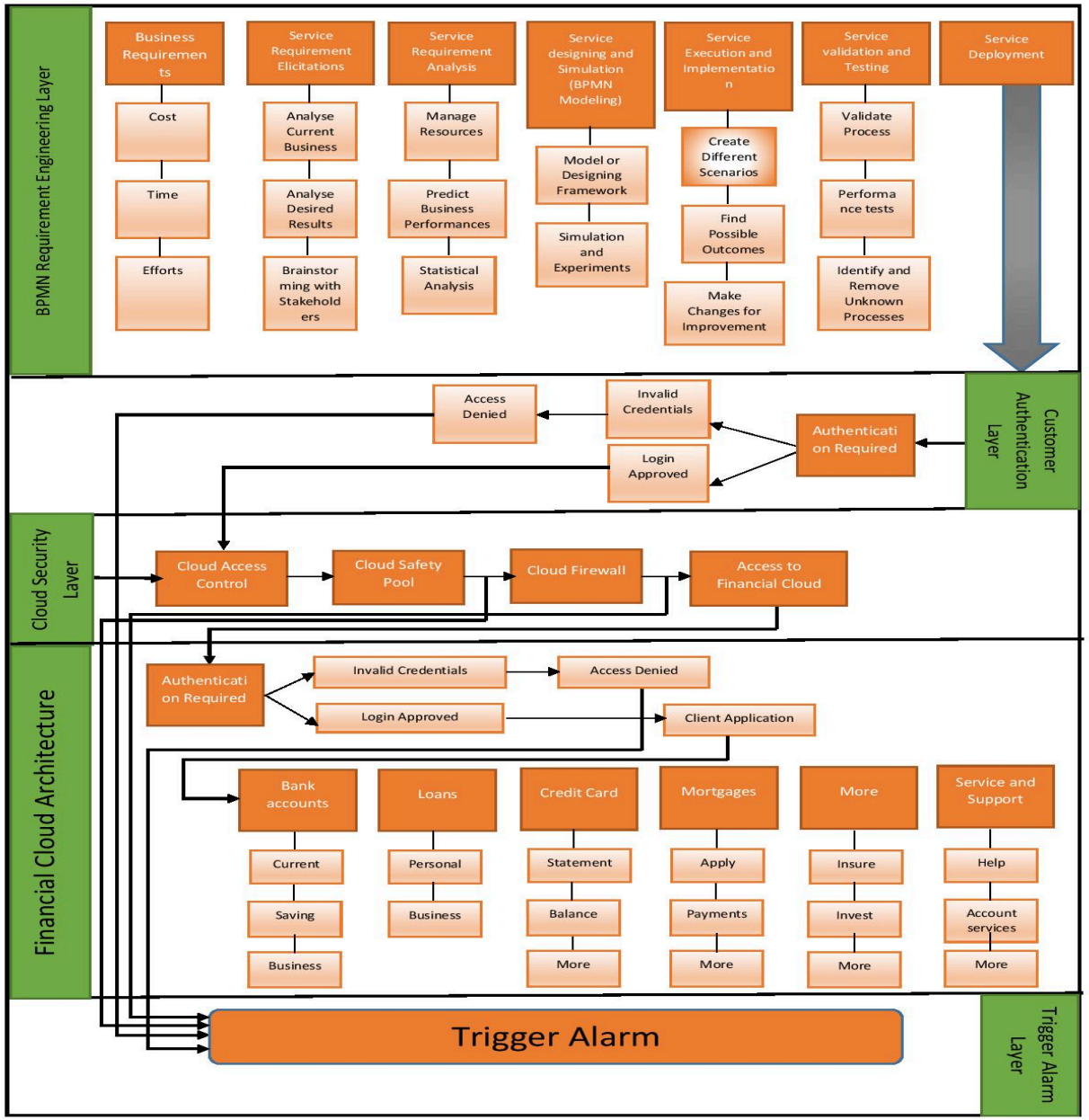
Technologies

- E-Commerce
- Machine Learning and AI
- Big Data Analytics
- Predictive Analytics for Decision-Making (Crytal-bal)
- Blockchain
- IoT
- Cryptocurrencies (Bitcoin vs Ethereum (ETH))

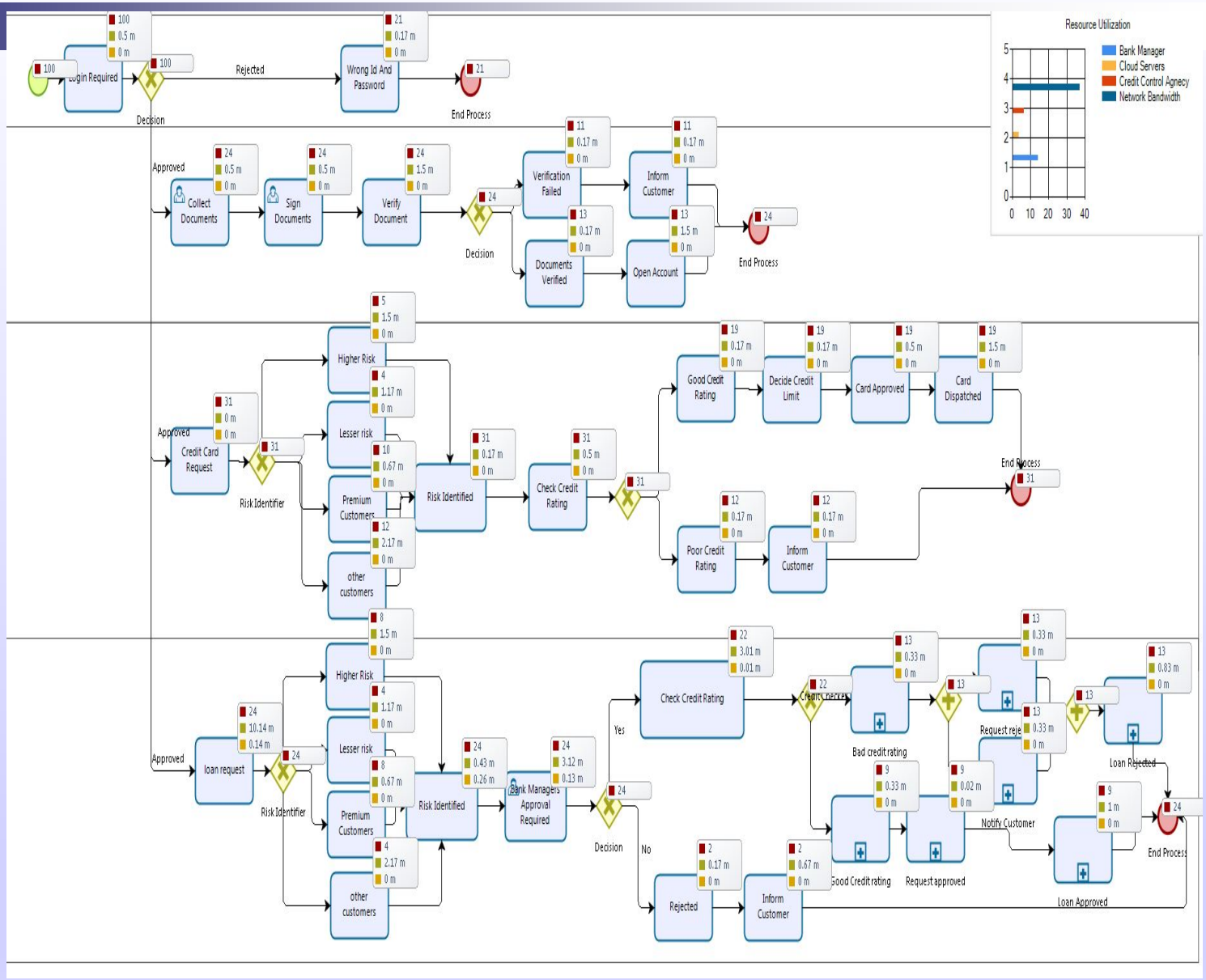
Integrated Financial Cloud Services



Financial Cloud Services



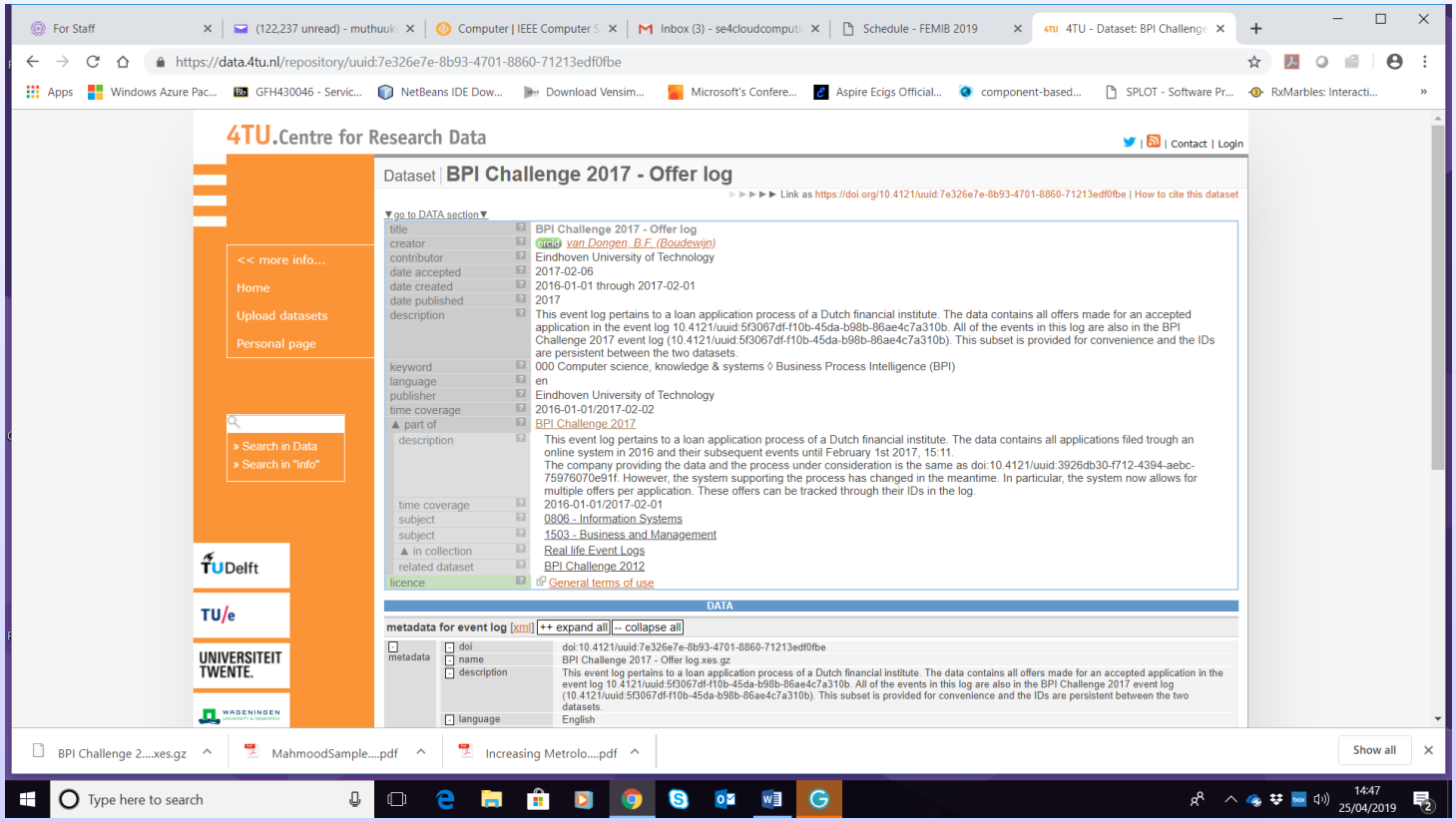
Simulation View of the Financial Cloud Services



MACHINE LEARNING TECHNIQUES TO REQUIREMENTS EVALUATION AND SOFTWARE DEFECT MANAGEMENT WITH REUSE AND KNOWLEDGE DISCOVERY

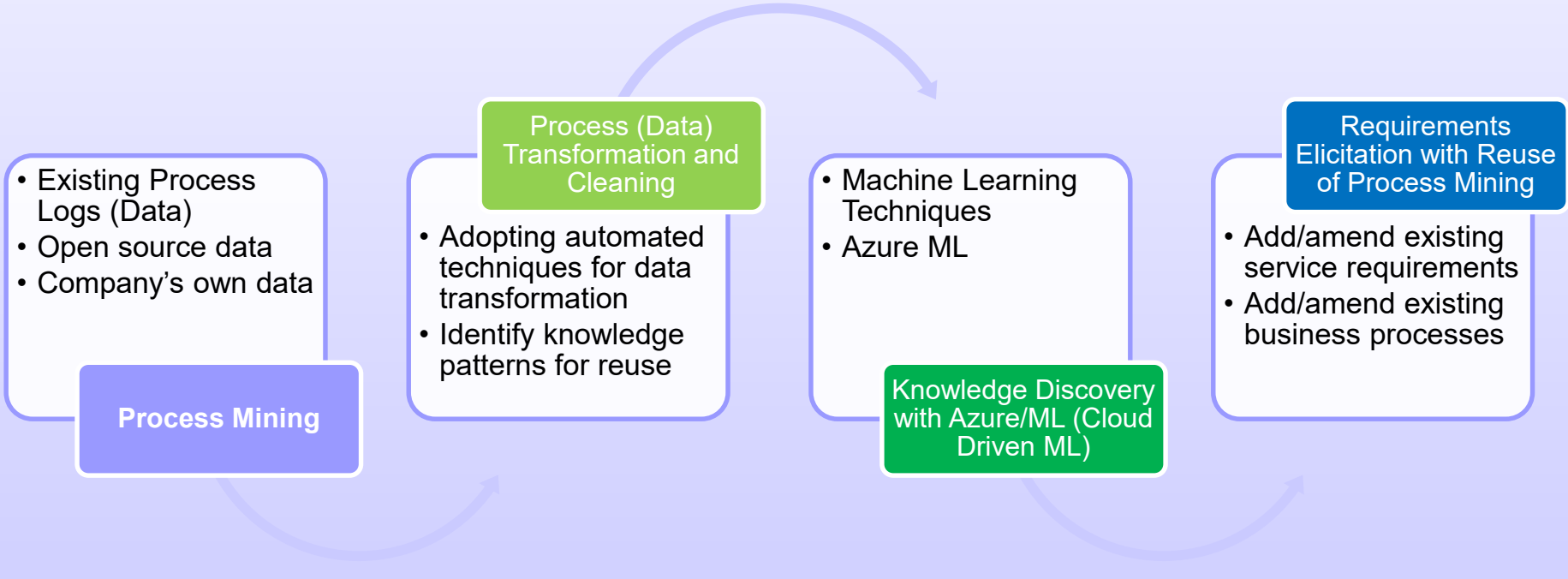
QoS Metrics to Measure for FinTech

Business Process Intelligence for Process Innovation

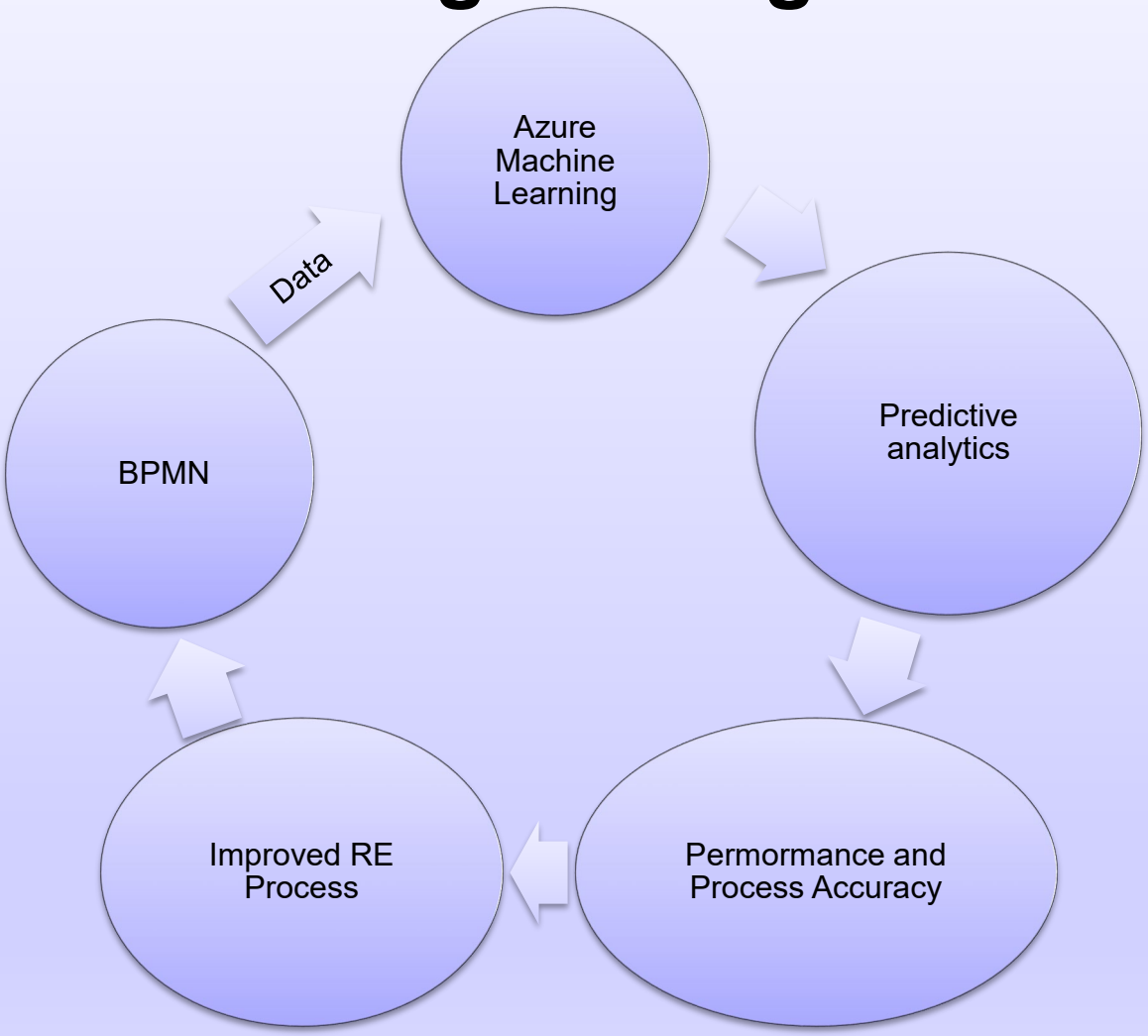


Event Logs Data of Loan Application Process for a Dutch Financial Institution between 2012-17 as part of BPI Challenge, https://tinyurl.com/bpic2017

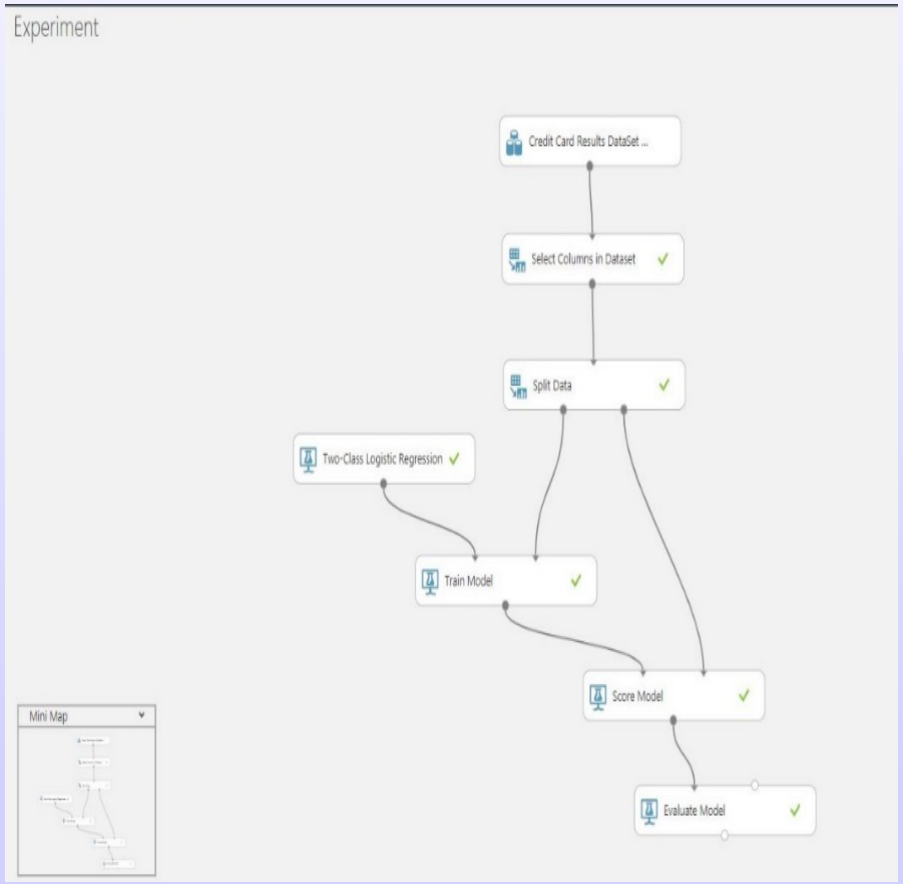
Machine Learning for Process Mining: Improving Efficiency of the Business Processes



Machine Learning to Improve Requirements Engineering Process



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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