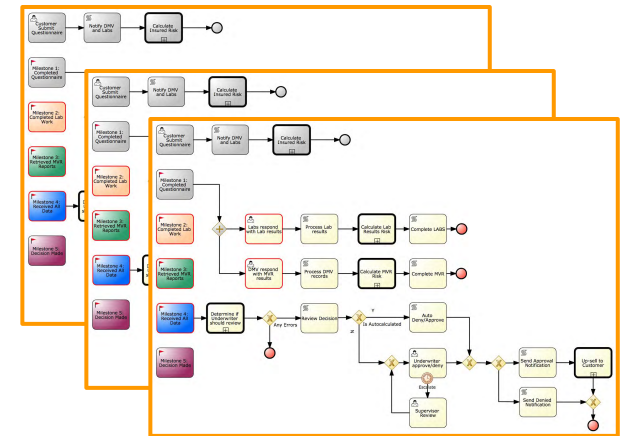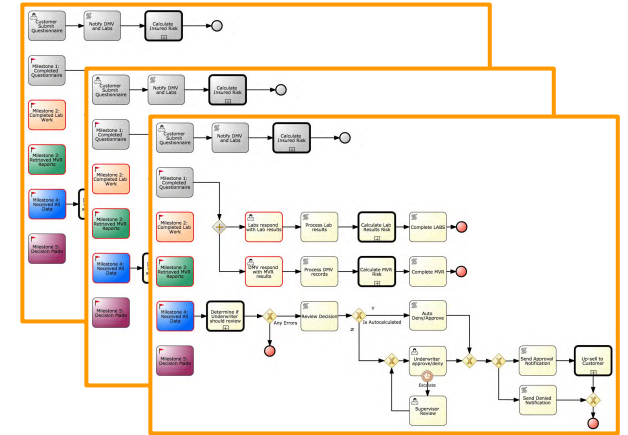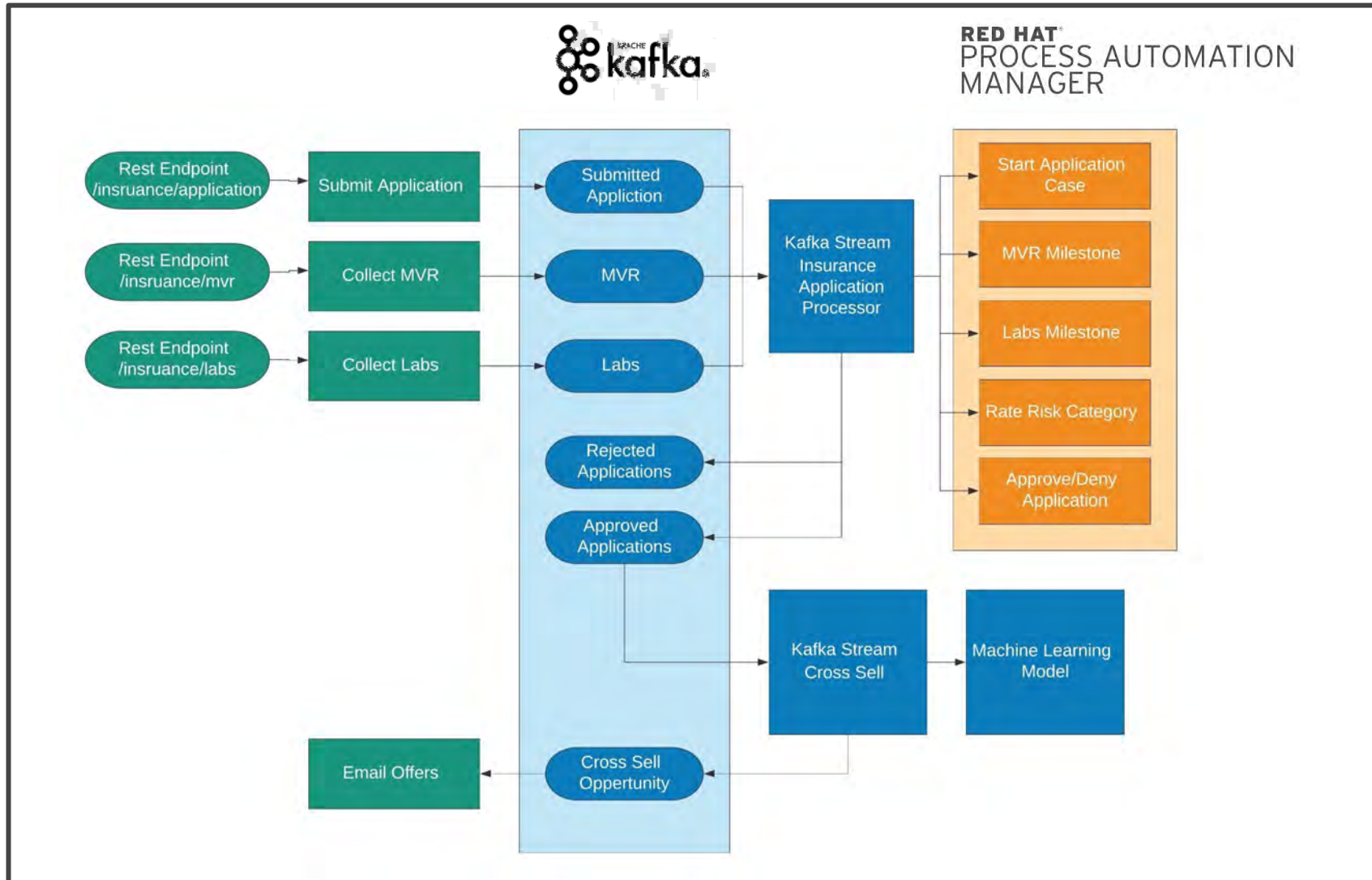# How to extend investments in Decision Management and Microservices to leverage Artificial Intelligence and Machine Learning

# MODERN SOFTWARE ARCHITECTURES

# BEGIN WITH THE END IN MIND

# STREAMING ARCHITECTURE

# ARTIFICIAL INTELLIGENCE (AI)

"The simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction."[1]
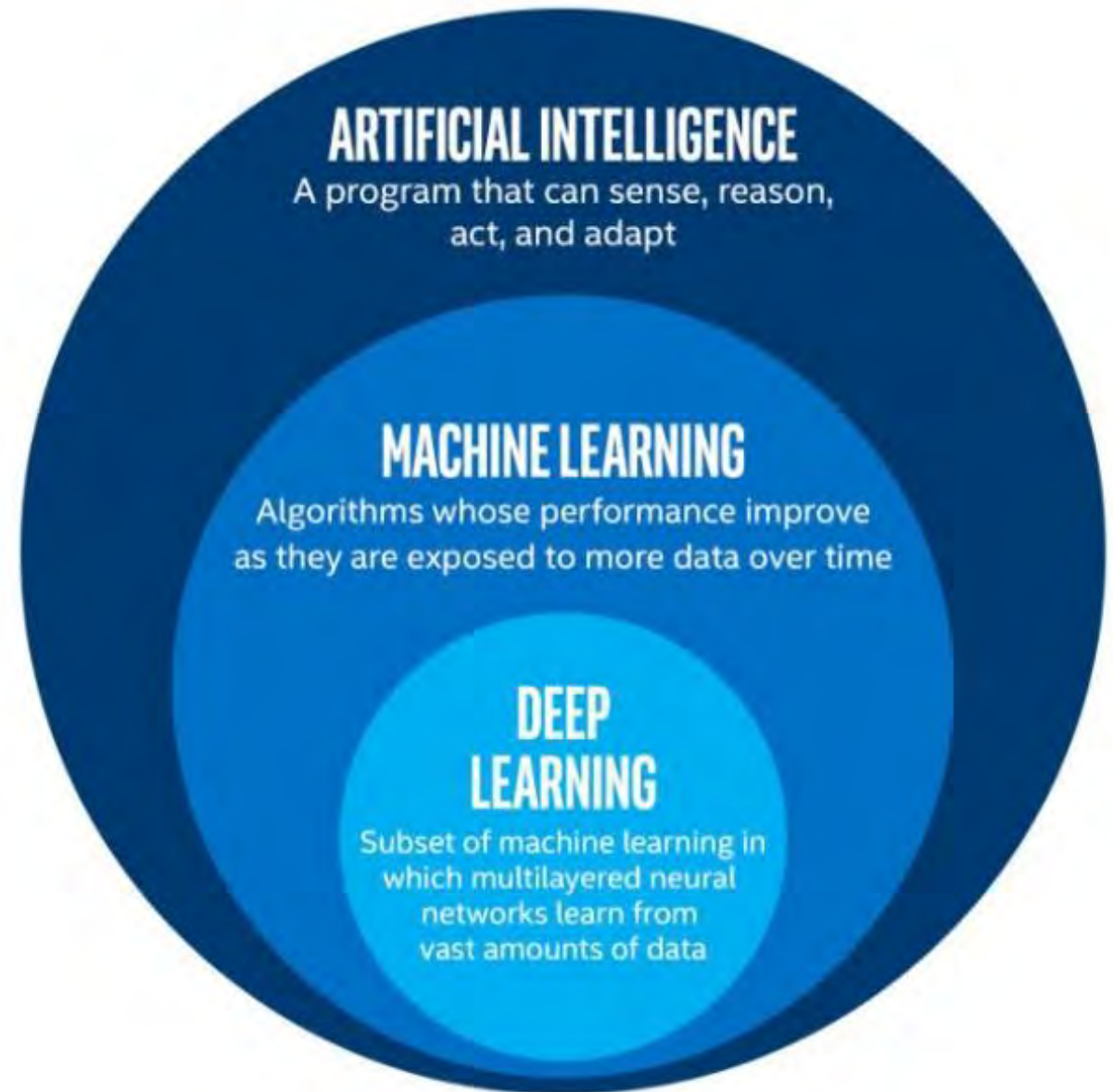
## *AI is a component within a Modern Software Architecture*

[1] *Source: WhatIs.com. (2018).  What is Artificial Intelligence? https://searchcio.techtarget.com/definition/AI*

# ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

- We can classify Artificial Intelligence (AI) into two categories;

  - **symbolic** (declarative) which includes symbolic reasoning, rules engines, and expert systems

  - **non-symbolic** (machine learning) which includes probabilistic models, pattern recognition, and data mining

**ARTIFICIAL INTELLIGENCE**
A program that can sense, reason, act, and adapt

**MACHINE LEARNING**
Algorithms whose performance improve as they are exposed to more data over time

**DEEP LEARNING**
Subset of machine learning in which multilayered neural networks learn from vast amounts of data

# AI - SYMBOLIC vs. NON-SYMBOLIC



- **Symbolic** (declarative)
  - Requires facts and rules
  - Written in a human readable and understandable language
  - Is predictable
  - Can be audited - Explain how a decision was made
  - Business areas:
    - Health Care
    - Financial
    - Insurance
- **Non-symbolic** (machine learning)
  - Lack of model interpretability (Unable to explain why the decision was made)
  - Requires large amount of data
  - Need to be trained
  - Too mathematically, abstract or complex, to be viewed and understood

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# MODERN SOFTWARE ARCHITECTURE

## Mainstream Technologies

- Application Programming Interfaces (APIs)
- Microservices and Enterprise Messaging
- Business Process and Rule Management
- CI/CD, DevOps Automation
- Container Management and Orchestration

## Emerging and Experimental Technologies

- Blockchain
- Artificial Intelligence / Machine Learning
- Apache Spark (cluster computing) / Kafka (stream processing)
- IoT

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# How we define Digital Transformation

# DIGITAL TRANSFORMATION

*"The use of technology to radically improve performance or reach of enterprises… to change customer relationships, internal processes and value propositions"*[1]

### Customer Understanding

- Specific Geographies
- Market Segments
- Lifestyle and Consumer Behaviors

### Customer Touch Points

- Multiple Communication Channels
- Integration across internal and external processes
- Interacting with customers in the channel they desire using their preferred device

### Process Digitization

- Automated Banking Operations
- Airline Reservation, Ticketing, and Boarding Passes
- Seamless transactions across multiple trading partners

[1]*Source: Westerman, G., & Bonnet, D., & McAfee, A. (2014). The Nine Elements of Digital Transformation. MIT Sloan.*

MODERN SOFTWARE ARCHITECTURE

THE FOUNDATION
OF YOUR
MODERNIZATION JOURNEY
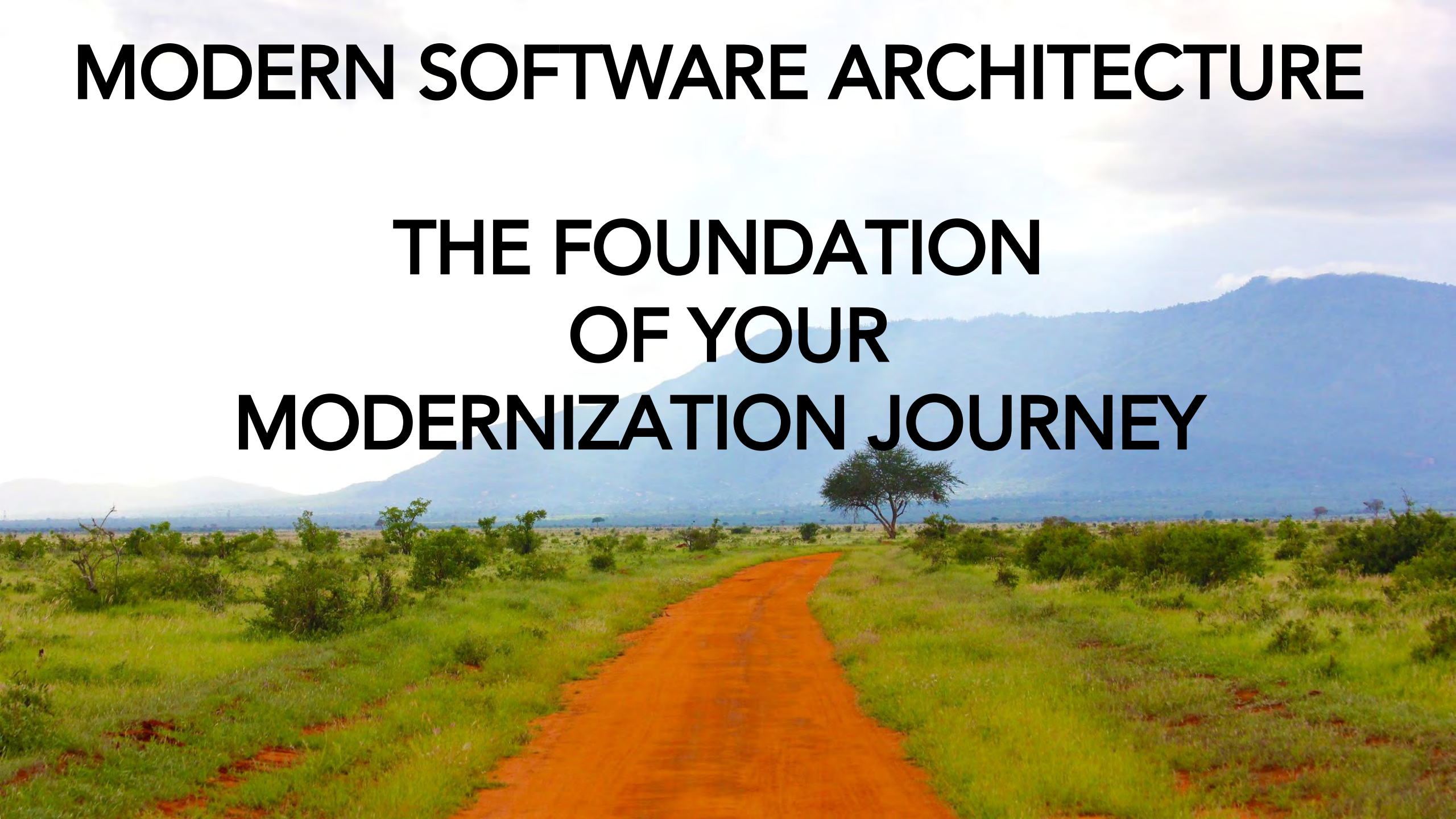
# MODERN SOFTWARE ARCHITECTURE BUSINESS OBJECTIVES

- Eliminate Redundancies - Standardized Processes and Tools
    - **API Gateway** - Establish APIs that exposes an API framework for inter-system communication
    - **Business Process Management** - Define immutable workflows for inter-system process and performance reporting
    - **Business Rules Management** - Isolate knowledge into manageable "domain models" for discrete decision logic that's removed from underlying technology
    - **Microservices and Containers** - Design modern systems using industry best practices **for solution architecture and scalable infrastructure**
    - **Container Orchestration** - Automate the deployment and management of multi-container applications at scale that conforms to Open Container Initiative (OCI) standard for image format and runtimes

# MODERN SOFTWARE ARCHITECTURE IMPLEMENTATION OBJECTIVES

- Minimize Customization - Automate, Integrate, and Measure Performance

  - API Gateway provides standardized interface that is utilized by all stakeholders (internal, external)

  - Business Process Management provides a well defined workflow that provides a unified, versionable and measurable process

  - Business Rules Management codifies decision logic in a centralized location in discrete rule-sets (i.e. domains) for business agility

  - Microservices and Containers establishes a scalable modern solution architecture that enables the modernization and retirement of legacy assets over a period of time

  - Container Orchestration achieves efficiencies through building repeatable, extensible, auditable and compliant frameworks and reference architectures

Innovate & integrate

*Or*

Adapt & stagnate

Joe Dickman – Vizuri, SVP
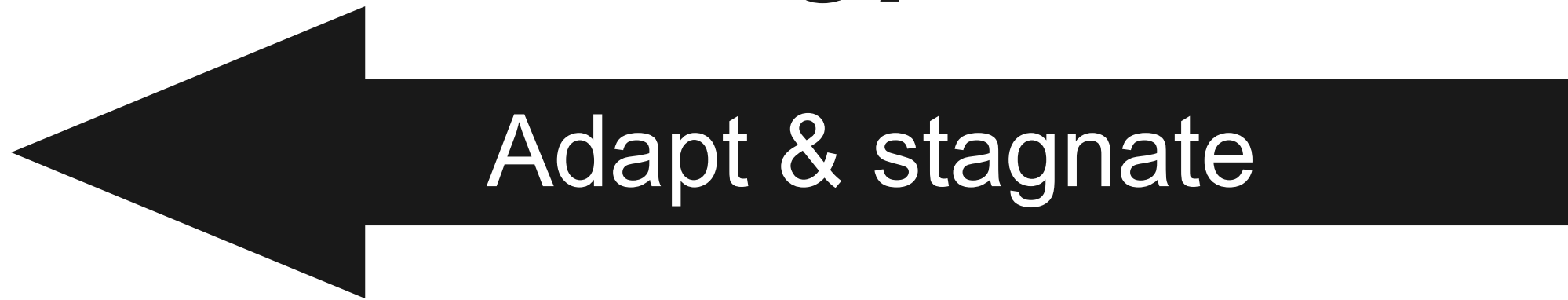
# INNOVATE AND INTEGRATE

- Modernization strategy that requires insight, vision, and leadership to accomplish

  - **Innovate** - requires action to make changes in something established by introducing new methods, ideas, or products

  - **Integrate** - combine (one thing) with another so that they become whole



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# ADAPT AND STAGNATE

- Modernization strategy that requires an organization to make the *smallest* most minimal change to avoid cost
  - **Adapt** - make something suitable for a new use or purpose
  - **Stagnate** - cease to develop, become inactive, and adjust to new conditions

# ADAPT & STAGNATE



54% of innovating companies struggle to bridge the gap between innovation strategy and business strategy

Q: What is your organization's greatest strategic challenge to successful innovation? [1]
Source: PwC's Innovation Benchmark
Base: 1,222

- Business model was "brick and mortar" dependent on "late fees"
  - Consumer Behaviour - Changing customer demographic and expectations
  - Distribution Channels - Ability to interact with customers in the channel they desire using their preferred device
  - Time-to-Market - Ability to quickly capture new markets
- Tried to "adapt" vs. "innovate" their business model
  - Mail to home service
  - Elimination of late fees
  - Entered into the movie kiosk business
  - Started a streaming service

[1] Source: PWC (2019). From blind bets to viable business value, https://www.pwc.com/us/en/services/consulting/library/innovation-strategy.html

# CHALLENGES COMPANIES ARE FACING TODAY

- Changing customer demographic and expectations
- Complex Decisions - Ability to reduce decisions to practice
- Time-to-Market - Ability to quickly capture new markets
- Manual Time - Consuming Tasks
- Consistency - Uniformly apply validation and conformity checks
- Risk Mitigation - Balancing Experience and Knowledge
- Workflow Management - Process and Performance Metrics and Unpredictability

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# Growth, disruption, and reg compliance underpin insurance biz strategies in 2019

## Which of the following initiatives are likely to be your organization's top business priorities over the next 12 months? (% agreeing)

| Initiative | % |
|---|---|
| Improve the experience of our customers | 49% |
| Grow revenue | 47% |
| Improve our ability to innovate | 43% |
| Improve our products /services | 42% |
| Better comply with regulations and requirements | 40% |
| Reduce costs | 39% |
| Increase influence and brand reach in the market | 38% |
| Improve differentiation in the market | 37% |
| Improve the experience of our business partners | 35% |
| Accelerate our shift to digital business | 34% |

Base: Insurance purchase influencers (past 12 months/next 12 months) who are seniority level of manager or higher; Source: Forrester Analytics Global Business Technographics® Priorities And Journey Survey, 2018

**The percentage of US insurance tech budgets earmarked to "run the business"?**

# 66%
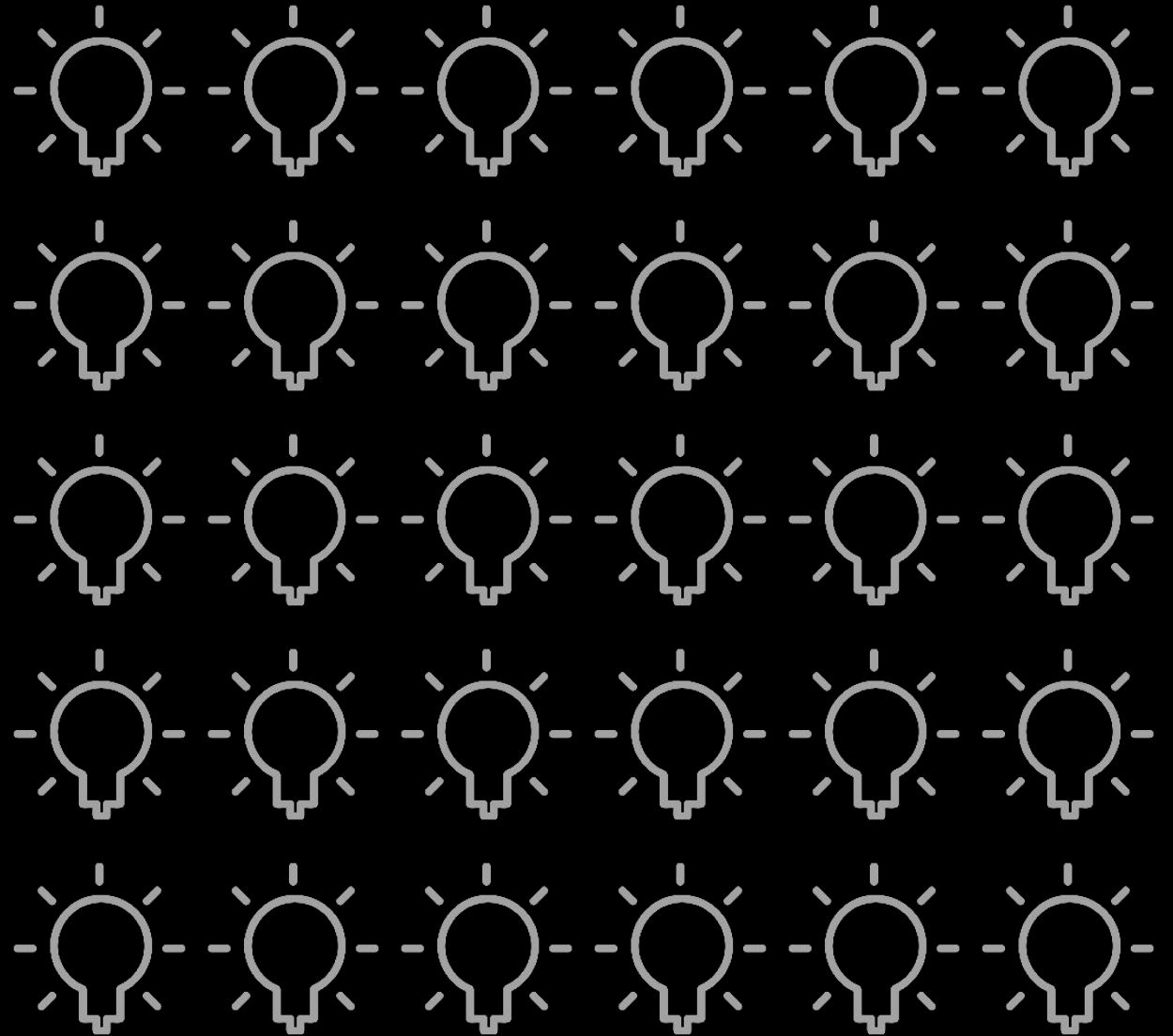
# HOW DO WE BEGIN OUR JOURNEY OF KNOWLEDGE?
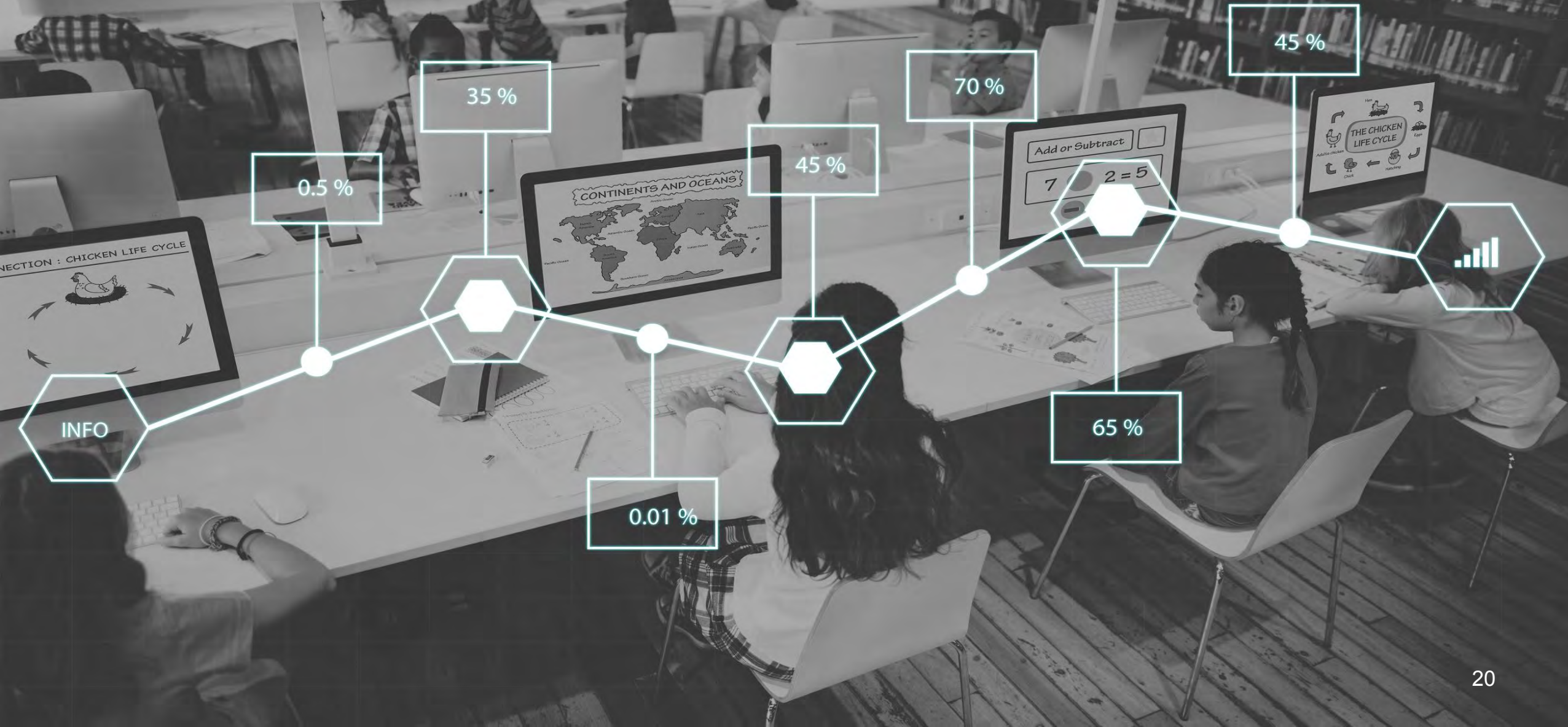
# APACHE KAFKA

A software technology that decouples data streams and applications.

- Created by LinkedIn [in] and Open Sourced in January 2011
- Built to enable reliable real-time streaming of data pipelines and applications
- Allows streaming applications that can react to and transform data published

Kafka provides:

- Publish/Subscribe to streams of records
- Persists streams in a fault-tolerant and durable way
- Processes streams of records in the order received as they occur
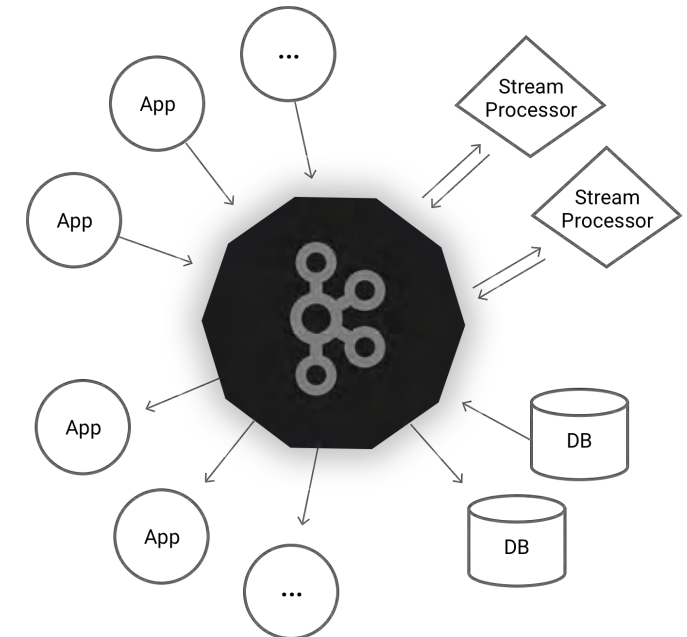
*[1] Image Source: Apache Software Foundation (n.d.). Kafka a distributed streaming platform, https://kafka.apache.org/*

# KAFKA COMPONENTS
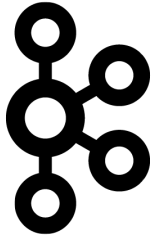
- Run-Time Deployment
    - Runs as a cluster that can be distributed to one or more servers that can be spread across data centers in support of a Continuity of Operations Plan
    - Stores streams of records to one or more servers (potentially across multiple data centers)
- Record Composition
    - Key
    - Value
    - Timestamp
- Core APIs
    - Producer - Publish stream to one or more topics
    - Consumer - Subscribe to and process stream(s) from one or more topics
    - Stream - Functions as a application processor, consumes streams from one or more topics, performs transformations, and publishes refined input streams to output streams
    - Connector - Build and run reusable producers and consumers.  Ability to connect to a Kafka topic or external application system.

# BRIDGING THE COMMUNICATION GAP

- Lack of shared vocabulary
- Different understanding and perspective of the problem
- Different goals and objectives
- Lack of visibility across the entire business
- Distrust by Business that IT will deliver on their objectives

**EXPECTATION**

**OUTCOME**

*Business and IT Stakeholders require new processes and models that "**bridge**" the communications gap.*

# THE SCARECROW HAD IT RIGHT

*"Knowledge Management is the process of capturing, distributing, and effectively using knowledge. It is a **discipline** that promotes an **integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets.** These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers."*

"If I only had a brain"

[1] *Source: Koenig, M.E.D. (2012). What is KM? Knowledge Management Explained,  http://www.kmworld.com/*

# KNOWLEDGE MANAGEMENT

> *Knowledge-based IT accommodates change quickly without being impeded by technology limitations.*

*Collaboration allows organizations to standardize data, information, processes, decisions, and tribal knowledge into a single source of truth.*

## SINGLE SOURCE OF TRUTH

Developed by knowledge engineers
Exposed through APIs
Consumed by developers

**COLLABORATION**

**SHARED PROBLEMS**
Solved faster

**TRANSPARENCY**
Both access and
ability to act

**STANDARDIZATION**
Working together
creates standardization

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# KNOWLEDGE BASED LIFECYCLE

**CONCEPT MODEL**

- Shared Business Vocabulary
- Organizational Concept of Operations
- Defined Processes and Workflows
- Business Key Performance Indicators (KPIs)

**DOMAIN MODEL**

- Multiple Domain Models
- Decompose Problem to Manageable Models

**RULES IMPLEMENTATION**

- Rule Lifecycle and Version Control
- Business Centric Services

360 Degree Feedback Loop

SDLC

# KNOWLEDGE-BASED SYSTEM

A *Knowledge-Based System (KBS)* focuses on systems that use knowledge-based *techniques* to *support* human *decision-making*, *learning* and *action*[1]

**Knowledge-Based IT (KB-IT)** is the application of KBS techniques aligning Business and IT

- Design process
- Models and methods
- Software tools
- Decision-support mechanisms
- Digital representation, and
- System architectures
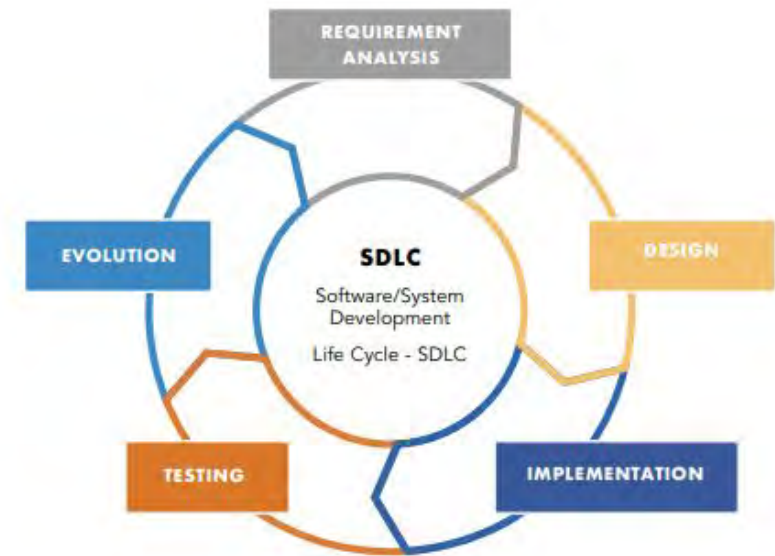
**KNOWLEDGE-BASED LIFE CYCLE**

[1]Source: Fujita, H., & Lu, J. (2012). *Knowledge-based Systems*, *Volume*(31), pp. 1-211.

# KNOWLEDGE MANAGEMENT DISCIPLINE

- Establishes the cornerstone in your transformation foundation

- Produces understandable, maintainable, extensible, and composable framework for process and decision management

- Relies on systems and software tools to develop and integrate domains of knowledge allowing for dynamic changes in both process and decisions.

# PROCESS AUTOMATION WITH CASE MANAGEMENT

- Business Process Management (BPM):
  - A management practice for automating a **sequential set of tasks** that are repeatable and have a common pattern
  - Requires a lot of **predictability**
  - End-to-end flow of work and data
  - Clearly defined paths leading to a business goal

- Case Management makes all the difference
  - Is **an extension** of Business Process Management (BPM) allows for the manage of adaptable and composable business processes
  - Many real-world applications cannot be described completely from start to finish
  - Provides problem resolution for **non-repeatable, unpredictable or ad hoc processes**
  - Manages **one-off situations** when the process cannot be predicted in advance
  - Usually **consists of loosely coupled process fragments** that can be connected directly or indirectly to lead to certain milestones (KPIs) and ultimately a business goal

# DECISION MANAGEMENT



- Compliance and Eligibility
- Risk Mitigation to reduce risk of unnecessary iterations or re-keying of information
- Dynamic collection of information to collect pertinent data from …
- Data validation and verification
- Improve user interface and experience especially with the millennial demographic
    - Cater for next generation users having mechanisms for personalization and tailored user experiences
    - Performance dashboards - Key Performance Indicator (KPI) , Quality of Service (QoS),
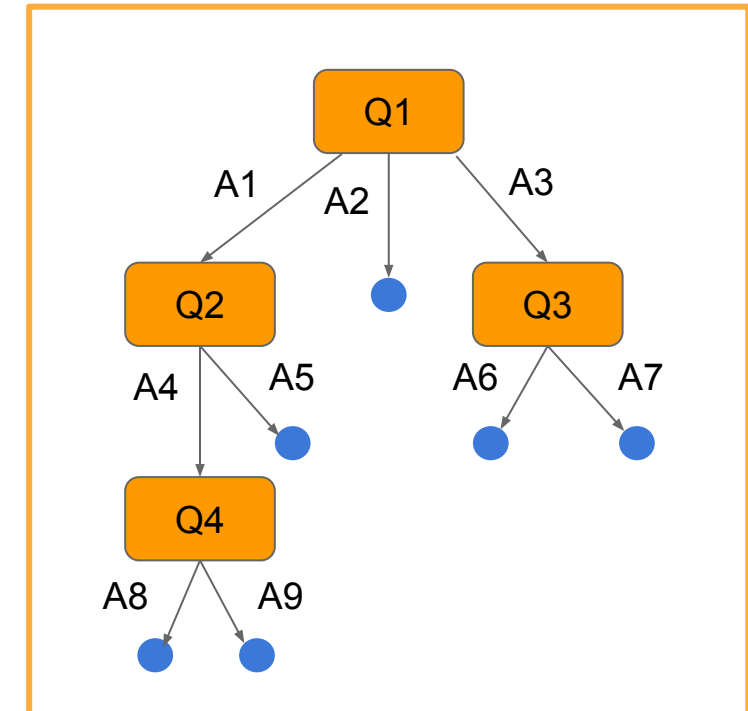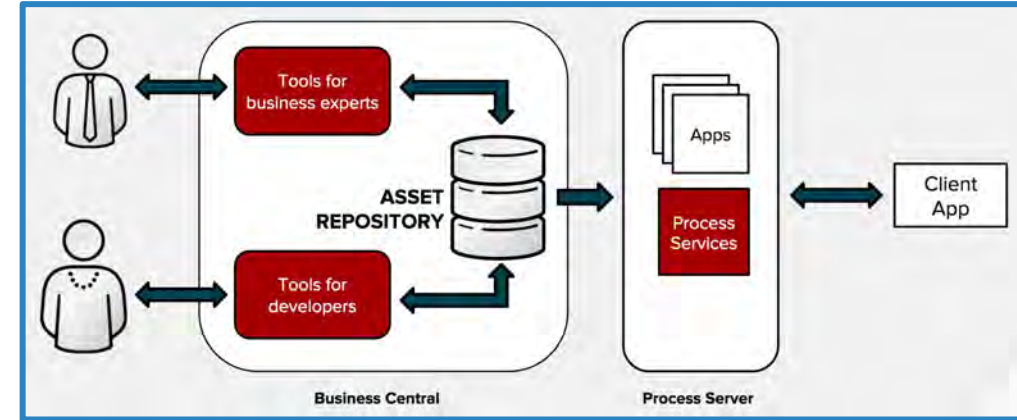
ARTIFICIAL INTELLIGENCE
&
MACHINE LEARNING

INSURANCE UNDERWRITING LIFECYCLE

# BUSINESS TRANSFORMATION

INSURANCE UNDERWRITING

- Limited supply of knowledgeable underwriters
- Consistency of risk rating assessments
- Avoid business risk of "adverse selection"
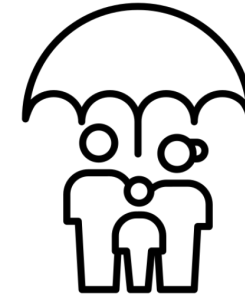
DYNAMIC RULES-DRIVEN QUESTIONNAIRE

- Apply Actuarial guidelines to evaluate Risk rating
- Validate both data and Eligibility Requirements
- Codify institutional Knowledge in a centralized Process/Decision Management System
- Orchestrate process and decision management across all stakeholders

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# DYNAMIC QUESTIONNAIRE AND VALIDATION USING RULES

# MICROSERVICE ARCHITECTURE

Applications have to be developed, tested, and released faster than ever before. Methodologies such as agile and DevOps help break down the code into deliverable sizes to help speed up teams sprints through features and new services.

This allowed developers and architects to reimagine their application design — and that has led to a natural, incremental introduction of microservices

- Allow for fast instant auto scaling
- Allow to leverage and integrate InsureTech offerings
- Integration into existing agency management systems
- Support online 3rd party data providers, such as MIB, DMV, MVR, etc.
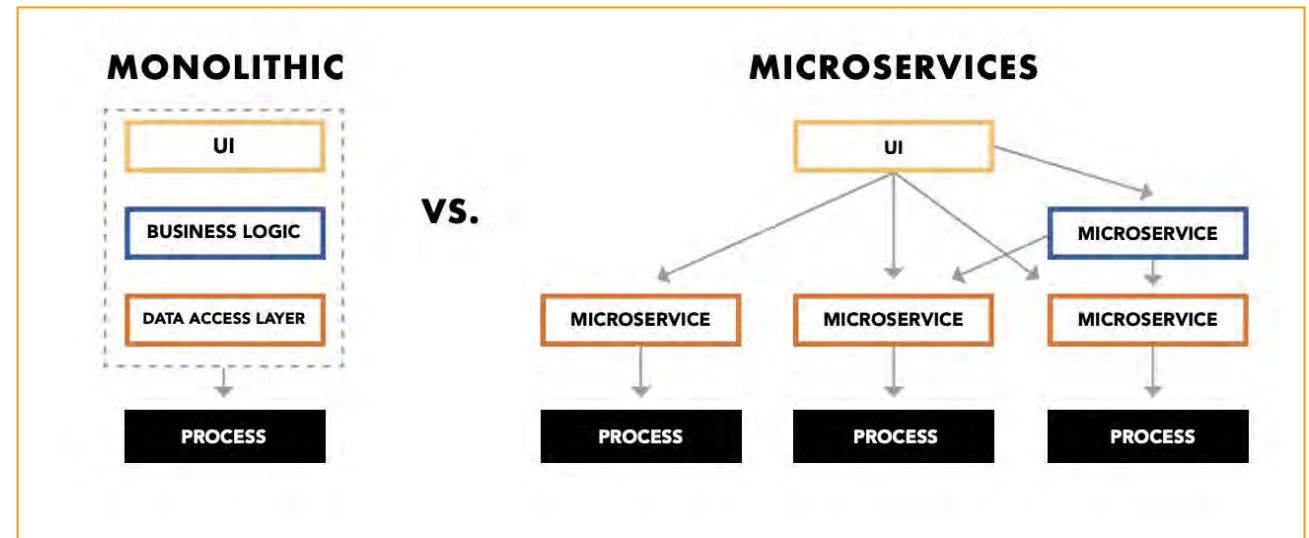
# CASE MANAGEMENT & PROCESS FLOW

- Extension of BPM
- Problem resolution for non-repeatable, unpredictable or ad hoc processes
- Track goals via Milestones
- Can dynamically add or remove tasks and sub processes
- Concept of a Case file
- Case lifecycle (close, reopen, cancel, destroy)
- Per case runtime strategy
- Support Stages
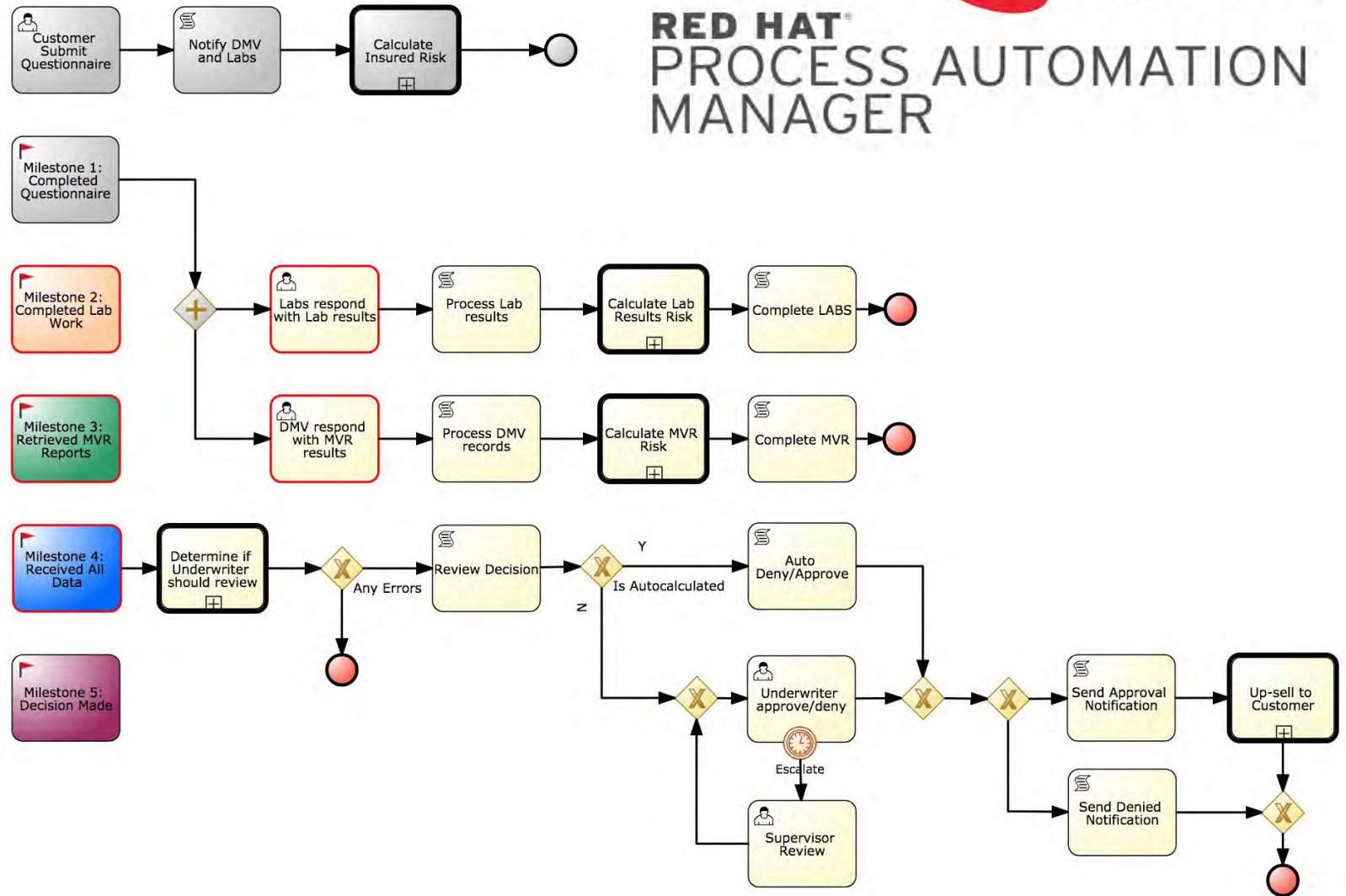
# REPLAYABLE - A/B TESTING

- Also known as split testing
- Can use the same data set to produce two or more different outcomes
- Allow for fine tuning of rules to produce the best outcome/results
- Impossible to do if rules are embedded into an application or spread over multiple systems and databases
- Kafka can replay or process historical, stored data to provide the ability for trade-off analysis of premium revenue vs. risk of loss
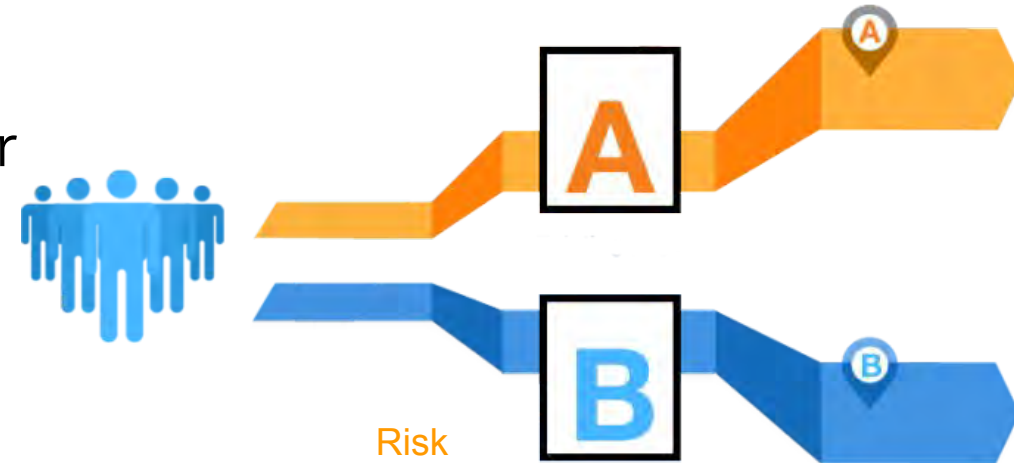
# STREAMING ARCHITECTURE
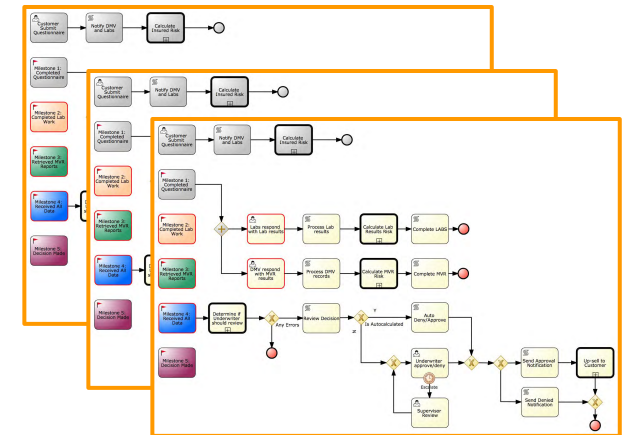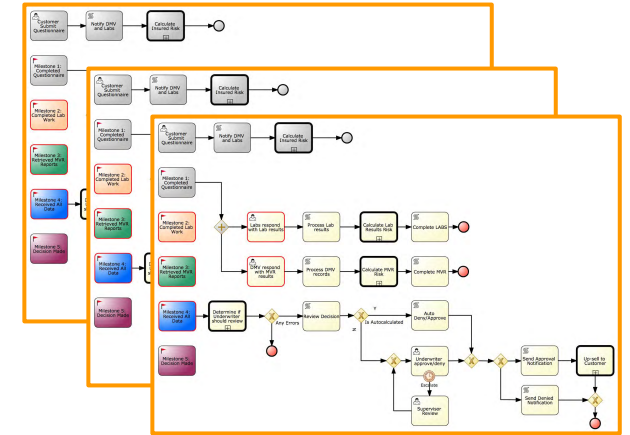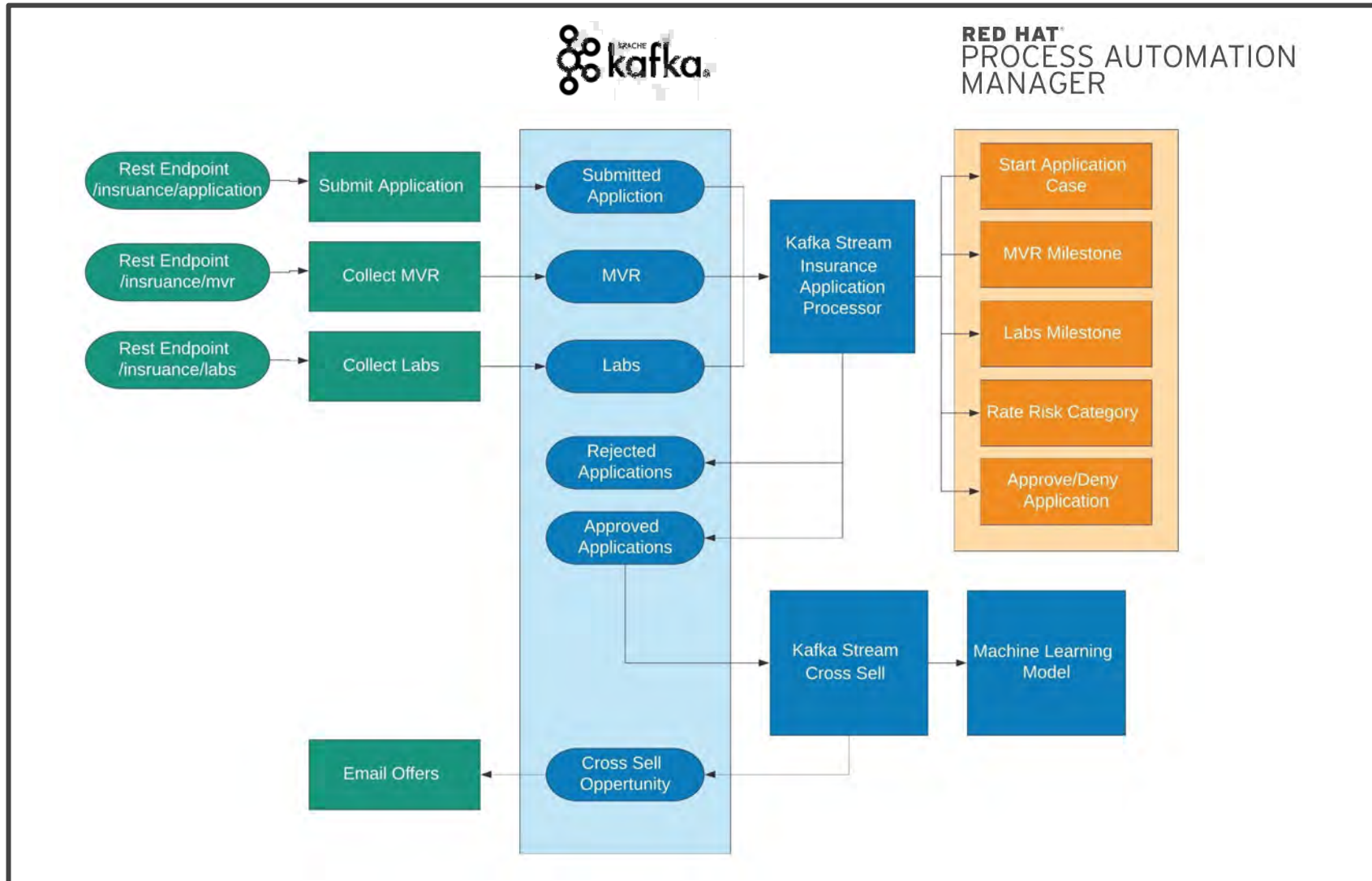
INDUSTRY TRANSFORMATION

# EVERYDAY EXAMPLES OF DIGITAL TRANSFORMATION

The airline industry has been changing the way they interact with customers and partners through the use of technology to *streamline* operations across the enterprise

# ATPCO CASE STUDY

Customer wanted to improve its ability to deploy software and features faster to its customers on complex pricing and shopping data from 430 airlines.

Took a holistic approach by defining a "*Modernization Roadmap*" that automated the entire application life cycle including provisioning, application deployment, testing, and migration.  Write once and deploy to any environment, whether cloud, on-premise, or hybrid.

# ATPCO

## APPROACH

- Deconstruct monolithic applications into **small discrete microservices.**

- Automate Decisions and **remove "Tribal Knowledge"** that is personally and regionally known.

- Leverage OpenShift Container Platform to speed adoption vs. learning/building container and orchestration offerings internally.

## IMPLEMENTATION

- Used **Agile Sprints** and kept User Stories small and discreet to not over engineer microservice.

- Defined **Microservices** to keep decision logic isolated.

- Expose **Microservices using APIs** to enforce security, maintain versions, and use APIs as a business.

- Utilize **OpenShift, CloudForms, Ansible Tower, and Jenkins to create images, fix bugs quickly, and speed production launch times.**

## COST-SAVINGS

- With Red Hat Software, ATPCO is not tied to one datacenter or cloud.

- Company can deploy applications without rewriting or adjusting its architecture to support different use cases.

- Microservices architecture provides ATPCO with a more effective and scalable way to build APIs for better integration with customers.  APIs can be tailored to individual customers while isolating their proprietary solutions and enabling third-party partners to consume and integrate.

- ATPCO has enabled customer and partners to leverage, integrate, and build new solutions utilizing ATPCO data to provide additional revenue streams.
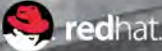
**RED HAT OPENSHIFT** Container Platform

# LOGISTICARE CASE STUDY

Customer wanted to improve its app to better manage rider eligibility and scheduling, including making scheduling rides easier through more efficient transportation provider selection.

# LOGISTICARE

## APPROACH

- Deconstruct monolithic Borland Delphi Client/Server application to **small discrete microservices.**

- Automate Decisions and **remove "Tribal Knowledge"** that is personally and regionally known.

- Leverage already built platforms (AWS) to speed adoption vs. learning/building internally.

## IMPLEMENTATION

- Used **Agile Sprints** and kept User Stories small and discreet to not over engineer microservice.

- Define "**Rules as a Microservice**" to keep decision logic isolated.

- Expose **Microservices using APIs** to enforce security, maintain versions, and use APIs as a business.

- Utilize **AWS and OpenShift** for dynamically scaling infrastructure and services to meet user demand.

## COST-SAVINGS

- $500,000 per month - Reduced time spent on phone with each call representative by 1 minute. Reduced number of weeks required to train call center representatives.. Support Call Center failover due to all business rules being Microservices for Federal, State, and Managed Care Organizations (MCOs) ensuring compliance.

- Custom B2B API to lyft that generates 50-80,000 rides per month with the ability to be scheduled, increased reliability, shortened response times, lower operating costs, and increased customer satisfaction.

- Ability to recognize revenue immediately. Removed the end customer from the reimbursement process (i.e. receipt, mailing, waiting, etc.). Improved client satisfaction and provided the ability to take on additional customers with same staff.

# LOGISTICARE
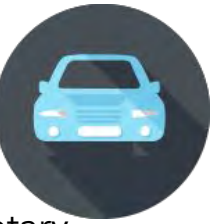
## CHALLENGES

- Business processes, rules, and workflows were locked into costly technology from a proprietary vendor, making it slow to integrate with modern technologies and third-party services
- App's inflexibility also made updating to meet new government regulations difficult

## SOLUTION

- Created a microservices architecture to develop applications as independent, modular services
- Defined complex rules within each service or process for regulatory compliance, scheduling, etc.
- Established a lightweight, flexible integration platform for creating and connecting APIs quickly.
- Scaled customer's IT environment using containers, and consistent releases and provisioning

## RESULTS

- Application development and IT operations teams can create and deploy apps with the speed and consistency that business demands
- App reduced agent interaction times by one minute per call and speeding the process for members to gain access to services
- Reduced length of its formal training curriculum for call center agents from eight weeks to just one week due to simplified, easy-to-understand business rules provided by its new application

# *"Success begets Success"*

## Lyft And Blue Cross Partner To Get Patients Rides To The Doctor

*Blue Cross and Blue Shield plans will partner with the ride-hailing company Lyft to provide certain health plan enrollees "no-cost" transportation to the doctor's office in an effort to improve compliance with healthcare appointments.*

- Reduce costs and improve outcomes for commercially insured enrollees who don't have adequate access to transportation
- Moving away from fee-for-service medicine to value-based care and population health models that make sure patients are getting quality care in the right place and at the right time
- Using Lyft's ride sharing services to "reduce missed appointments,"the Blue Cross association said it will better reach its members for "non-emergency care."  which totals 106 million

*Source: https://www.forbes.com/sites/brucejapsen/2017/05/10/lyft-and-blue-cross-partner-to-get-patients-rides-to-the-doctor/#c9dd7c63b9ee*

# THANK YOU

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