Realizing a Vision of the Cognitive Enterprise through Business Architecture

"Innovation is about seeing the world not as it is, but as it could be."

Roger Martin, "The Design of Business", Harvard Business Press, 2009

William Ulrich

President, TSG, Inc.

Partner, Business Architecture Associates

President, Business Architecture Guild

Fellow, Cutter Consortium

wmmulrich@tsgconsultinginc.com

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Cognitive Enterprise Topics

- The cognitive enterprise: What and why
- Breaking down the cognitive enterprise
  - Business knowledgebase
  - Cognitive computing
- Cognitive computing scenarios
- Making the transition
- Ethical considerations
- What next?

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What is the Cognitive Enterprise?

- A cognitive enterprise is:
  - An organization that learns, adapts and scales on an evolutionary basis
  - A sense-and-respond organization, which is "a collection of capabilities and assets managed as a purposeful adaptive system."*
  - An organization that fuses a deep and formal understanding of its business ecosystem** with a cognitive computing environment

*"Adaptive Enterprise: Creating and Leading Sense-and-Respond Organizations", Stephen H. Haeckel, Harvard Business School Press, 1999.

**Business Ecosystem: "One or more legal entities, in whole or in part, that exist as an integrated community of individuals and assets, or aggregations thereof, interacting as a cohesive whole toward a common mission or purpose."

BIZBOK® Guide, Part 1, Business Architecture Guild®

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Why Should an Organization Pursue the Cognitive Enterprise Vision?

- To become more effective
  - Successful execution of strategy remains elusive
  - Two percent of leaders are confident that they will achieve 80-100% of their strategy's objectives.*
  - Ten percent of organizations achieve at least two-thirds of their strategy objectives, with 36% achieving between 50%-67% and 54% achieving less than 50%*
- To become more efficient
  - Tapping productivity gains, going beyond perceived productivity limits
- To maximize customer value delivery
  - Too often value is viewed from the inside-out and not from the outside-in and is not systemically integrated into the business ecosystem

*Strategy Implementation Survey Findings, 2012, https://www.slideshare.net/SpeculandRobin/strategy-implementation-survey-results-2012

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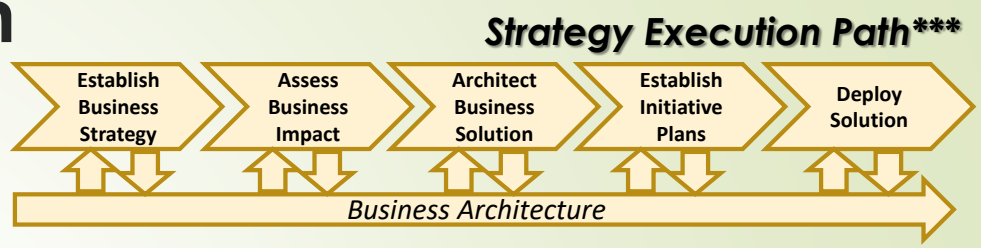
Expanding Strategy to Consider an Overall Vision as a Sense-and-Respond Organization



- Adaptability is a key aspect of the sense-and-respond organization, which becomes increasingly self-organizing, easing the pathway to strategy execution
- "The only kind of strategy that makes sense in the face of unpredictable change is a strategy to be come adaptive"*
- The underlying business knowledgebase**, coupled with cognitive computing technology, enables rapid impact analysis of strategic objectives across the business domains and enabling technologies impacted by those objectives

*Adaptive Enterprise: Creating and Leading Sense-and-Respond Organizations, Stephen H. Haeckel, Harvard Business School Press, 1999.

**A business knowledgebase is a formally organized, readily navigated realization of the business ecosystem, representing an organization's capabilities, information, stakeholders, value delivery perspectives, organizational structure, policies, products, initiatives and strategies.

***Source: Business Architecture Guild, BIZBOK® Guide, Part 1

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What Do We Know About Productivity?

- Productivity in manufacturing from McKinsey Research Institute findings*
  - New technology and automation will continue to impact workforces across the globe
  - It is technically feasible to automate 78 percent of these [manufacturing] activities
- A second McKinsey study went beyond manufacturing and found**
  - Activities requiring "tacit" knowledge or experience that is difficult to translate into task specifications are no longer immune to automation
  - Automation can already match, or even exceed, the median level of human performance required
  - 45 percent of work activities could be automated using already demonstrated technology
  - If technologies that "understand" natural language were to reach the median level of human performance, an additional 13 percent of work activities in the US economy could be automated
- Is there even more potential for automation – are we just scratching the surface?

* The Upside Of Automation: New Jobs, Increased Productivity And Changing Roles For Workers, Forbes, Oct. 2018, Kweilin Ellingrud

**Four Fundamentals of Workplace Automation, Michael, Chui, James Manyika, Mehdi Miremadi, 2019

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Do Productivity & Automation Targets Underestimate Organizational Potential?

- Consider a cognitive enterprise where the following would occur
  - Customer preferences derived through one point of engagement, in one business unit, are rapidly reflected and integrated for that customer across all business units, regions and product lines
  - Partner relationships, contracts and deliverables are optimized across the business ecosystem in rapid fashion
  - Virtual product manager conceptualizes and designs new products while automatically considering related products with similar capabilities, reframing the product portfolio in the process
  - Virtual program manager identifies cross-project impacts and conflicts, leveraging a comprehensive understanding of proposed and inflight projects across business units, producing an optimized set of programs and projects, sequenced based on strategic priorities and interdependencies
  - Requirements analysis is formally structured in a way where machine-assisted guidance reduces analytical time while producing formal, event-based solutions that are automation-ready
- The implication of these scenarios is a high degree of technology-enabled execution that has the potential to drive productivity numbers beyond current projections

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Customer / Stakeholder Value Delivery is Integrated into Cognitive Enterprise DNA

- Enabling customer and general stakeholder value delivery is based on:
  - An ability to quickly foresee and respond to shifts in customer demands
  - Stakeholder value delivery being formally defined, where targets for increasing customer value delivery are integrated into the business knowledgebase
  - Highly automated, rationalized and work-optimized value streams, based on a high percentage capability reuse and automation
  - A business ecosystem that exposes formal points of stakeholder engagement, highlighting where technology may augment or replace human resources

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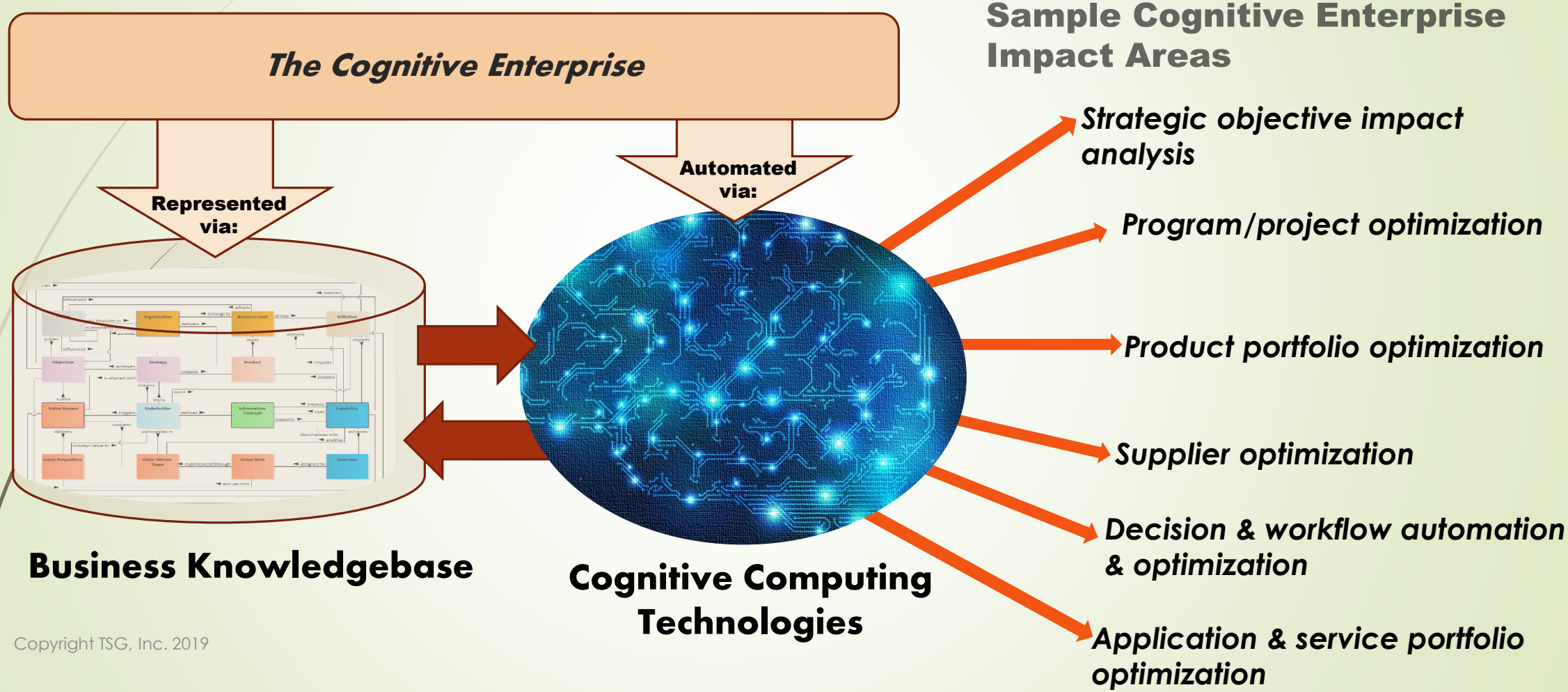
Breaking Down the Cognitive Enterprise



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Business Architecture Frames the Knowledgebase & Delivers Cognitive Enterprise Differentiator

- Business ecosystem wide scalability
- Foundational business knowledgebase that spans the ecosystem
- Deep, expansive and highly rationalized understanding of object-based capabilities, stakeholders, information and stakeholder value delivery
- Impact assessments and strategy execution that scales across business unit, product line, partner and regional boundaries
- Rigorous adherence to formal architecture principles – required to pursue the cognitive enterprise vision
- Requires alignment to a formal business architecture metamodel*

*Scaling Business Architecture: Establishing a Foundation for Success, Business Architecture Guild, Metamodel Team, Jan. 2019, https://cdn.ymaws.com/www.businessarchitectureguild.org/resource/resmgr/ba_next_level_foundation_for.pdf

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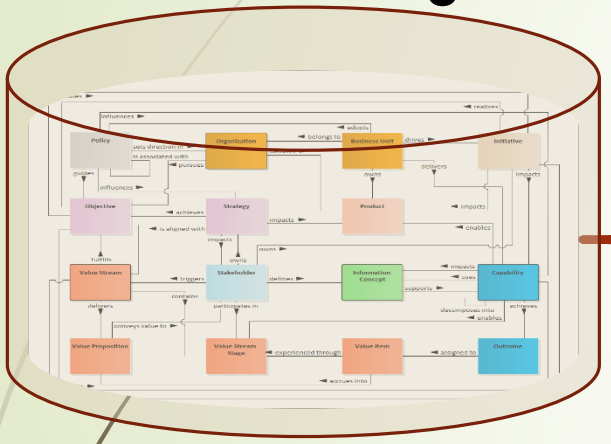
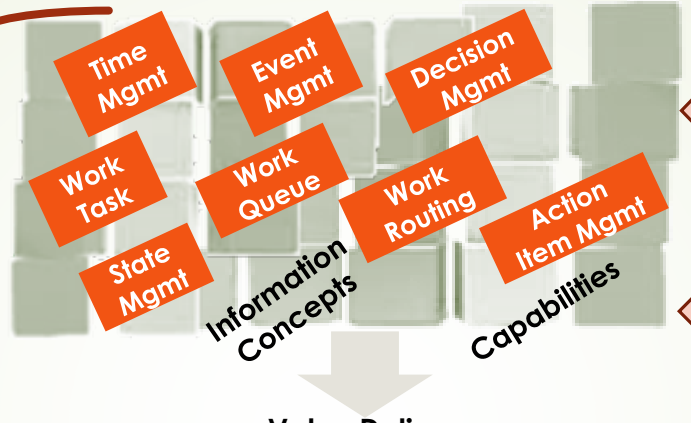
Principled Business Architecture Establishes a Foundation for Event-Driven, State-Based Technology Deployments

Business Knowledgebase



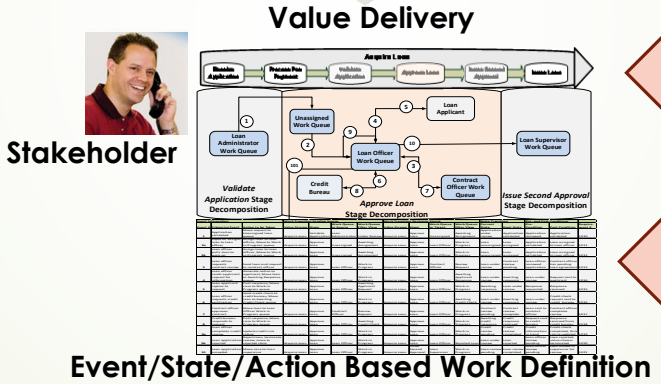
Formal knowledgebase built on an open standard metamodel*

Enables formalization of business architecture as a basis for framing business-driven technology solutions



Highly rationalized object-based capability map, where every object has a set of allowable actions

Highly rationalized object-based information map, with relationships, types and finite states



End-to-end framing of every point of stakeholder engagement leveraging state- and event-based work definition

Decomposition of event-based work definitions views into formal event models

Integrated perspectives on strategic objective, organization, product, policy and initiative domains

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*Scaling Business Architecture: Establishing a Foundation for Success, Business Architecture Guild, Metamodel Team, Jan. 2019, https://cdn.ymaws.com/www.businessarchitectureguild.org/resource/resmgr/ba_next_level_foundation_for.pdf

Establishing the Business Knowledgebase Requires Rigorous Adherence to Principles

- Knowledgebase contains a fixed vocabulary defining a rationalized set of business objects, with a finite set of defined states, where actions are triggered by external and internal events, framed by end-to-end stakeholder value delivery
- Articulating the business knowledgebase based on business architecture principles*
  - Decompose its business ecosystem into a rationalized set of business objects (e.g. asset, customer, agreement, claim, product, location, competency, job, human resource)
  - Define actions that act upon those objects (e.g. Customer Preference Determination) to create the finite set of cross-ecosystem capabilities
  - Create a corresponding set of information concepts aligned to each capability
  - Map end-to-end, value-centric stakeholder points engagement, with event-triggered, object-based stage gates delineating each value-item point of delivery (i.e. value streams)
  - Associate enabling capabilities and participating stakeholders with each value-delivering stage
  - Frame product offerings, strategic objectives and initiatives (programs and projects) based on impacts

*"A Guide to the Business Architecture Body of Knowledge® (BIZBOK® Guide)", Business Architecture Guild.

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Cognitive Computing Technologies

- According to Peter Fingar*
  - "Cognitive computing systems learn and interact naturally with people to extend what either humans or machines could do on their own"
  - "Cognitive computing systems get better over time as they build knowledge and learn a domain. Unlike expert systems of the past that required rules to be hard coded into a system by a human expert, cognitive computing systems can process natural language and unstructured data and learn by experience, much in the same way humans do."
- According to Curt Hall**
  - Cognitive computing refers to a class of systems that can learn at scale, reason, and interface with humans in a manner more in tune with the way people interact with one another."

*"Cognitive Computing: A Brief Guide for Game Changers", Fingar, Peter, January 2015, Meghan-Kiffer Press.

**"What Is Driving Cognitive Computing?", Cutter Consortium, June 14, 2017,

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Cognitive Computing Incorporates Multiple Technology Categories

- Artificial intelligence (AI): Technology able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making and translation between languages
- Deep learning: An approach where a system learns on its own, without human intervention*
- Neural networks: Software that operates at multiple levels based on artificial neurons of interconnected layers modeled after the brain's cortex that deals with complex tasks like vision and language
- Natural language processing: Field of computer science, concerned with interactions between computers and human (natural) languages
- Rule-based machine learning: Machine learning method that identifies, learns or evolves 'rules' to store, manipulate or apply
- Finite State machines: A mathematical model of computation that can be in exactly one of a finite number of *states* at any given time, able to change from one state to another in response to event triggers**
- Predictive analytics: A branch of advanced analytics used to make predictions about unknown future events, applying techniques such as data mining, statistics, modeling, machine learning and artificial intelligence***
- Quantum computing: Use of quantum-mechanical phenomena such as superposition and entanglement to perform computation. A quantum computer is used to perform such computation****

*Deep Learning, Demis Hassabis, Founder Deepmind, BCC.com, https://www.youtube.com/watch?v=lge-dl2JUAM

**Wagner, F., "Modeling Software with Finite State Machines: A Practical Approach", Auerbach Publications, 2006, ISBN 0-8493-8086-3.

***Pat Research, https://www.predictiveanalyticstoday.com/

****The National Academies of Sciences, Engineering, and Medicine (2019). Grumbling, Emily; Horowitz, Mark (eds.). *Quantum Computing : Progress and Prospects (2018)*. Washington, DC: National Academies Press. p. I-5.

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Cognitive Computing Technologies In Use Today

- IBM's Watson's use in healthcare, financial services and retail*
  - Helping agencies and their clients better engage with consumers and increase the effect of advertising and media plans**
  - Assisting medical professionals in choosing treatments for lung and breast cancers
- Hong Kong based Deep Knowledge Ventures appointed a computer algorithm to its board of directors, where a program called Vital can vote on whether to invest in a given company***
- Socio-technical tools and applications boost the performance work teams engaged in collaborative tasks, such as decision making***
- Enabling manufacturing industry stakeholders to form collaborative R&D, implementation and advocacy groups to create approaches, standards, platforms and shared infrastructure****
- Associated Press's use of robot-written stories where technology is used to produce more and more earnings reports

*Smart Machines: IBM's Watson and the Era of Cognitive Computing (Columbia Business School Publishing)

**Nielsen Innovation Lab

*** IBM's Cognitive Systems Institute

**** Smart Manufacturing Leadership Coalition

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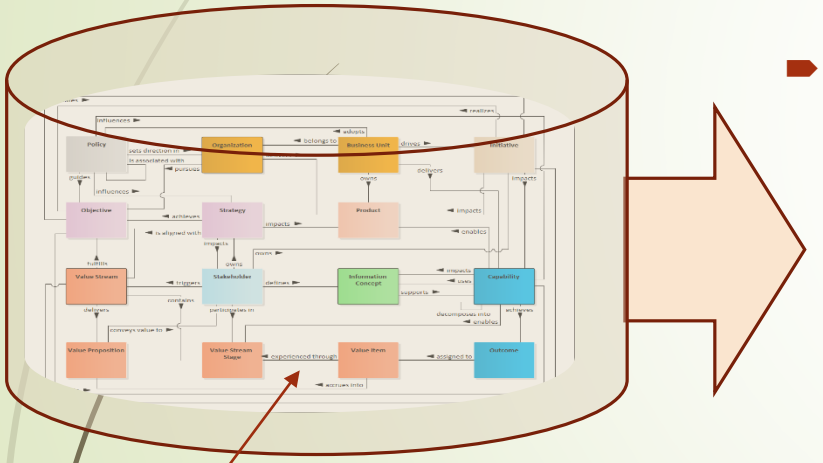
Integrating the Business Knowledgebase & Cognitive Computing

Business Knowledgebase



Formal metamodel

- Assume that cognitive computing technologies gain access to highly rationalized view of a business ecosystem based on formal business vocabulary
- Can we "teach" technology what humans could do using the same meta-data, only faster, more reliably and more holistically across an ecosystem?
- For example:
  - Performing keyword matches against strategic objectives to highlight stakeholder, capability and information impacts
  - Determining value delivery, product, policy, initiative, business unit and technology impacts or ripple effects
  - Determining feasibility, exposing risks or framing scope of programs, projects and related investments
  - Generating business requirements scope and framing business context
- As organizations adopt and mature the business knowledgebase and cognitive computing, benefits will begin to emerge early in the cycle and increase over time

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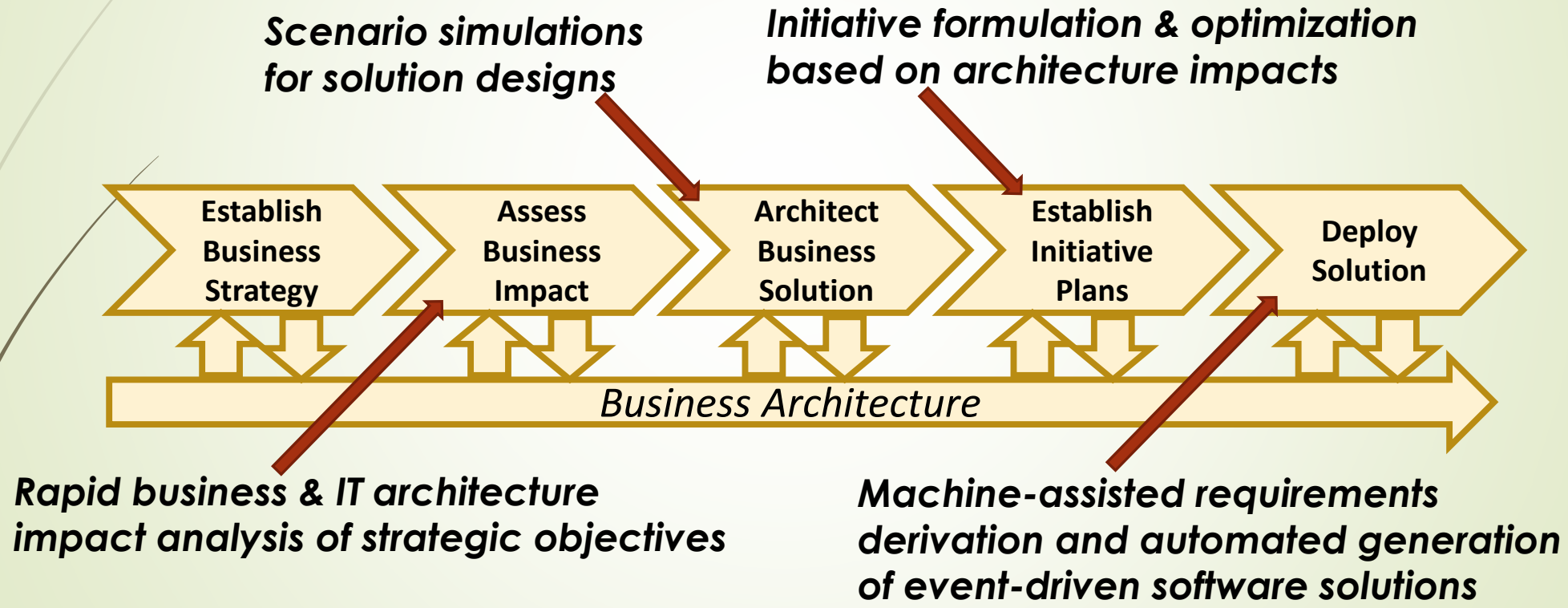
Adaptability Means Expediting, Streamlining the Strategy Execution Pathway



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Source: Business Architecture Guild, BIZBOK® Guide, Part 1

Cognitive Enterprise Scenario: Supplier Optimization*

- Viewing a business ecosystem from an outside-in as well as an inside-out perspective means that all third-party touchpoints are highlighted through a combination of value stream and stakeholder cross-mapping.
- Stakeholder engagement includes all customer, partner and internally directed human resources where a given stakeholder may be a partner in one scenario and an internal human resource in another
- Stakeholder frame of reference, coupled with cognitive computing technologies, enables "what if" simulations to optimize partner-related, stakeholder engagement
- Consider a "transport operator" mapped to an *Execute Route* value stream for a trucking company where in various scenarios the stakeholder may be a) an internal human resource, b) a partner contractor or c) automate conveyor control software
- Running "what if" scenarios across multiple routes, conveyor types, shipment types, policy (legal) constraints, incidents, events and other inputs (stored in the knowledgebase) would enable the company to assess cost, safety, legal, regulatory and other considerations as input to decisions

*Source: The Cognitive Enterprise: Envisioning the Business of the Future, William Ulrich, 2019

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Cognitive Enterprise Scenario: Product Portfolio Optimization*

- Product planning is often done by multiple managers across multiple business units with little transparency into other planned or deployed products, capability dependencies, and related automation deployments
- Virtual product manager leverages the business knowledgebase to rapidly assess overlapping products across product lines and business units
- Approach applies a business architecture technique called product mapping, which links products to enabling capabilities
- Virtual product manager examines a cross-section of product, capability, business unit, stakeholder, information and other views to deliver product options and cross-product consolidation and alignment recommendations
- Virtual product manager would also deliver rapid assessment of technology impacts based on business-to-IT architecture cross-mappings
- Result is a rapid elimination of non-viable product options and a decrease in time to move product ideas through concept, design and market deployment

*Source: The Cognitive Enterprise: Envisioning the Business of the Future, William Ulrich, 2019

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Cognitive Enterprise Scenario: Program & Project Optimization*

- In spite of all of the work around project and program management, and analysis and deployment methodologies, challenged and failed projects remain the norm
- Successful projects are still only achieved less than 30% of the time based on 25 years of data**
- Culprit is often inadequate scope and impact analysis based on a lack of business transparency
- Virtual program manager leverages the business knowledgebase to:
  - Ensure that impacts of strategic objectives are incorporated into program and project definition
  - Assist human planning efforts to expose business ecosystem impacts of proposed programs, highlighting cross-program impacts or conflicts
  - Validate that a fully coordinated set of programs are deployed so teams can define and stay within their lanes
- Ensures that cross-program coordination is not left to trial and error, expediting program and project startup and execution

*The Cognitive Enterprise: Envisioning the Business of the Future, William Ulrich, 2019

**"A Look at 25 Years of Software Projects: What Can We Learn?", Standish Group, 2017, https://speedandfunction.com/look-25-years-software-projects-can-learn/

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Cognitive Enterprise Scenario: IT Architecture Portfolio Optimization*

- Experience to date highlights two factors:
  - Number of technology deployments per capability is very high, where, for example, agreement management is replicated and fragmented across hundreds of technology deployments
  - Many capabilities lack automation entirely and IT often lacks visibility into these automation gaps
- The above and other factors increase "business/IT alignment debt"
- The cognitive enterprise leverages the business knowledgebase to highlight business/IT alignment debt and recommend actions to reduce the debt and streamline time deliver results
- Approach applies to organizations looking to maximize the value of IT investments while concurrently seeking to shrink their IT portfolio footprint
- This approach would use cognitive and more traditional technologies to expedite the pathway to becoming a cognitive enterprise

*Source: The Cognitive Enterprise: Envisioning the Business of the Future, William Ulrich, 2019

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Evolution of Cognitive Enterprise Maturity Mirrors AI Adoption Framework

- According to IDC Research, there are 5 stages of AI evolution*:
  1. Human Led
  2. Human Led, Machine Supported
  3. Machine Led, Human Supported
  4. Machine Led, Human Governed
  5. Machine Controlled
- Stages mirror adoption of and transition to cognitive enterprise by necessity and by design
- Becoming a cognitive enterprise is a journey – not a jump

*IDC Blog, Introducing AI-Based Automation Evolution Framework, January 2019, https://blogs.idc.com/2019/01/09/idcs-ai-based-automation-evolution-framework-a-new-way-to-think-about-ai-automation/

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Cognitive Enterprise Benefits Accrue Early and Scale Over Time

- The road to becoming a cognitive enterprise allows organizations to achieve benefits early and along the way
- For example:
  - Establishing portions of the business knowledgebase will allow planning and other teams to perform certain analysis
  - Building human expertise in applying scenarios manually provides a baseline for "schooling" cognitive technologies in those methods
- While a roadmap to full maturity for the cognitive enterprise is a long-term proposition, the journey delivers increasing value along with way

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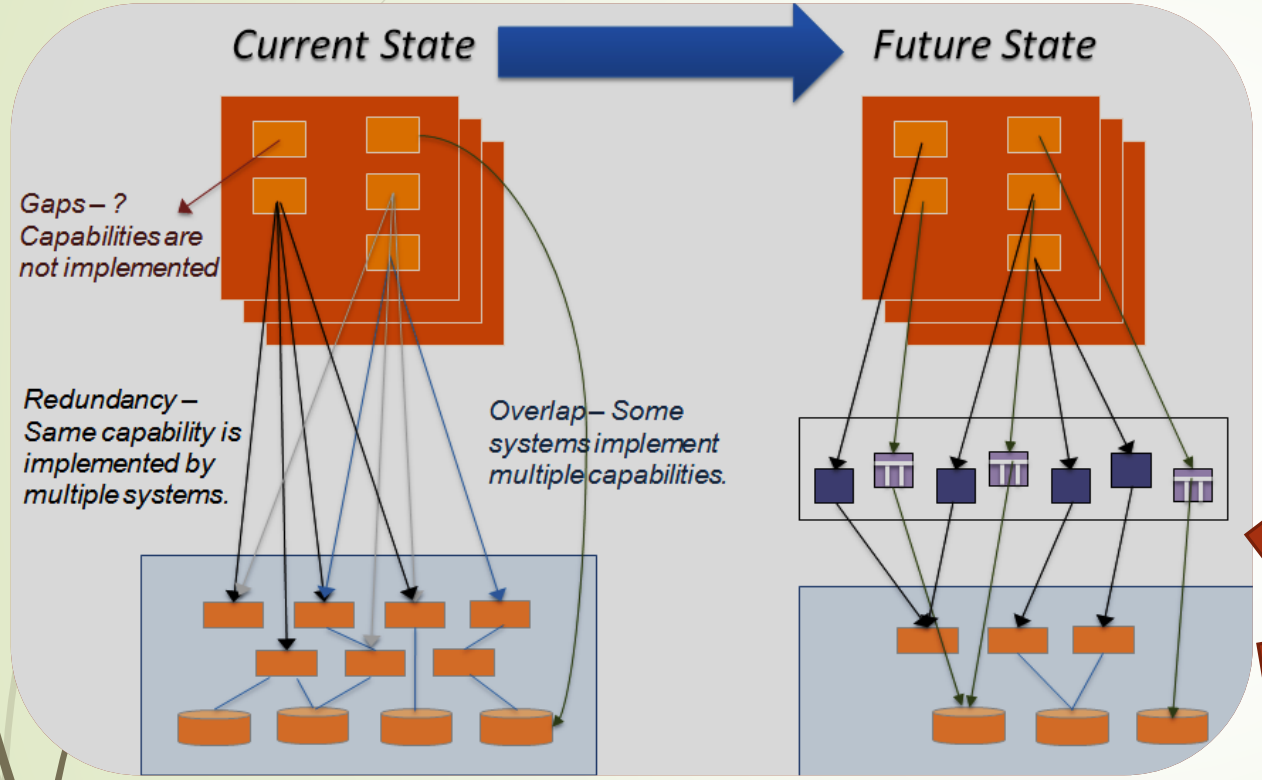
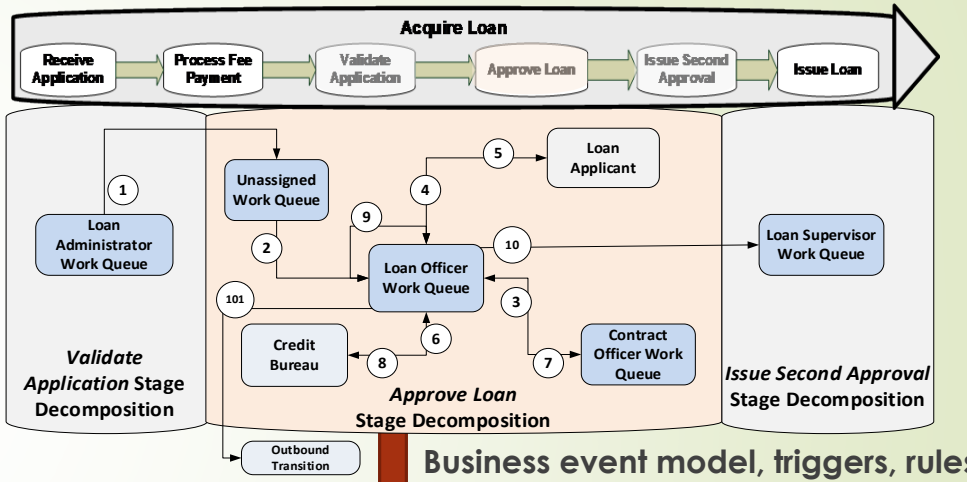
Cognitive Enterprise Example for Decision & Workflow Automation & Optimization: A Transitional Perspective



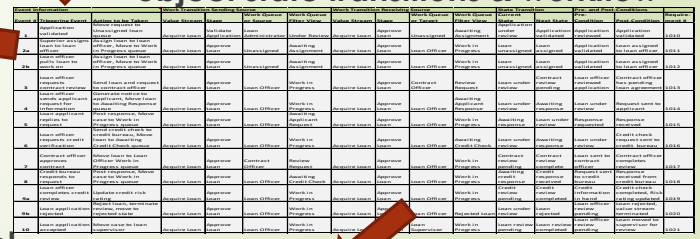
Source: "The Business Capability Map: The "Rosetta Stone" of Business/IT Alignment", William Ulrich & Michael Rosen, Executive Report, Cutter Consortium, EA Vol.14, No. 2

Not shown: Capability and information mappings that enable value delivery, formalize work management, and establish the basis for software services and microservices

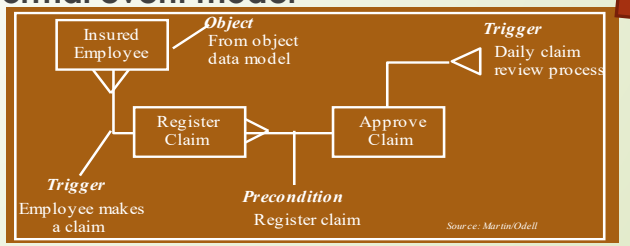
Value stream-framed, event-based workflow model



Business event model, triggers, rules, object state transitions & workflow



Formal event model



Source: TSG, Inc. 2019

Cognitive Enterprise Example: Decision & Workflow Automation & Optimization*

- Work management capabilities and event and state decompositions, a natural outgrowth of business architecture, establish foundation for reevaluating how work is performed to enable stakeholder value delivery
- When value stream, capability and stakeholder mappings are cross-mapped and coupled with dynamic rules-based routing maps, it allows organizations to envision workflow and work automation in highly formal ways
- Optimized work management perspectives help surface opportunities where automation can take the role of a given stakeholder and provides the added benefit of highlighting state and event-based work that can be taken over by cognitive computing technologies
- Absence of these value-centric cross-business perspectives will continue to lead organizations to invest in "cow path repaving", spending more while gaining less in return
- ***Business architecture, if framed effectively, defines the architectural foundation for deploying a highly optimized, event-driven business environment***

*Source: The Cognitive Enterprise: Envisioning the Business of the Future, William Ulrich, 2019

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Ethical Challenges of the Cognitive Enterprise

- What ethical rules should guide the evolution of the cognitive enterprise as it moves through maturity into a machine controlled ecosystem?
- Isaac Asimov's Three Laws of Robotics* provide guidance:
  - 1st Law: A robot may not injure a human being or, through inaction, allow a human being to come to harm
  - 2nd Law: A robot must obey the orders given it by human beings except where such orders would conflict with the First Law
  - 3rd Law: A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws
  - 4th Law (added later): A robot may not harm humanity, or, by inaction, allow humanity to come to harm
- But what if no human is giving orders?
- As (not if) businesses automate more and more, they need to ensure that principles are built into those automation
- Policy mapping – a key business architecture domain, provides knowledgebase support for alignment to ethics and principles as well as statutes and regulations

*Asimov, Isaac (1950). "Runaround". *I, Robot* (The Isaac Asimov Collection ed.). New York City: Doubleday

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Ethical Challenges of the Cognitive Enterprise: The People Factor*

- McKinsey study found that automation
  - Is the trend that raises most anxiety for the workforce
  - Ultimately can create more jobs for people, but different types of jobs
- Research indicates that fears may be overstated based on what tasks are actually automatable
- New roles that workers can play and the jobs that can be created through automation came into being
- Crown Equipment increased its workforce from 200 to 335 workers* as demand soared based on the company's scalability of work and delivery

* The Upside Of Automation: New Jobs, Increased Productivity And Changing Roles For Workers, Forbes, Oct. 2018, Kweilin Ellingrud

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Cognitive Enterprise: Getting Started & Next Steps

- Establish a vision – and sell the value proposition
- Evolve the knowledgebase, which requires:
  - Commitment to formal business architecture framework
  - Resources to evolve and apply the discipline
- Research and begin to experiment with cognitive computing technologies
- Establish a benefit / milestone oriented roadmap, with KPIs
- Check progress, document values gained

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