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Service Systems Innovations with Cloud and Cognitive Computing

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In collaborations with Dr. Jim Spohrer, Director IBM Global University Programs and Institute of Cognitive Systems

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IBM Distinguished Engineer, Lead Cloud Advisor, IBM Cloud
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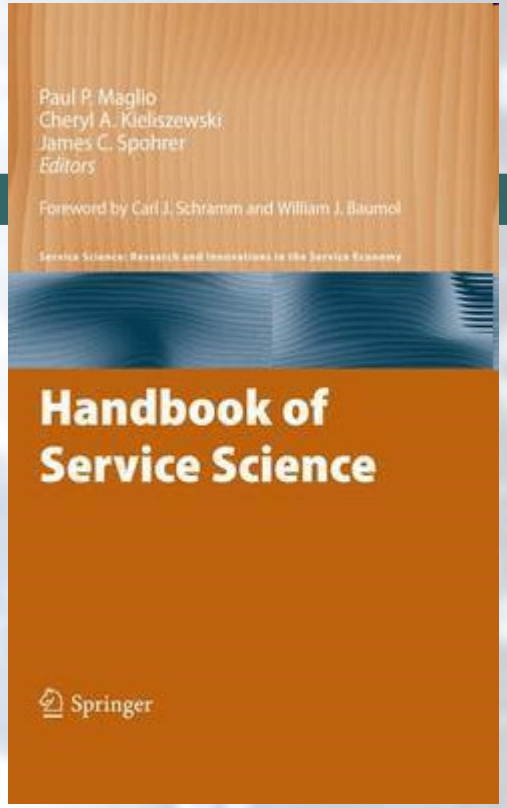
- Named IT Professional of the Year (Technology) by Singapore Computer Society (2016), one of 50 featured in SG50 – A Nation of Skilled Talents
- Lead Cloud Advisor of IBM Cloud (since 2015)
- Chief Technology Officer of IBM ASEAN and IBM Singapore (2007-2015)
- Named IBM Distinguished Engineer (2007/2008)
- IBM Academy of Technology Leadership Team, Chair of IBM Distinguished Engineer Board in Growth Market Unit
- Serves on Keppel Corp Technology Advisory Panel and several academic and government advisory committees
- Banking, Defense, Healthcare institutions

Agenda

- **Service Systems Innovations**
  - **Smarter, yes; But wiser?**
  - **How can we be sure?**
- **Progressions**
  - **Tool, assistant, collaborator, ?**
  - **? = cognitive machine, moral entity**
- **Cognitive Systems Institute**
- **Example of an Application in Banking**
- **Cognitive IoT of Systems**



"A service science perspective considers the evolving ecology of service system entities, their capabilities, constraints, rights, and responsibilities.

Smarter, Yes

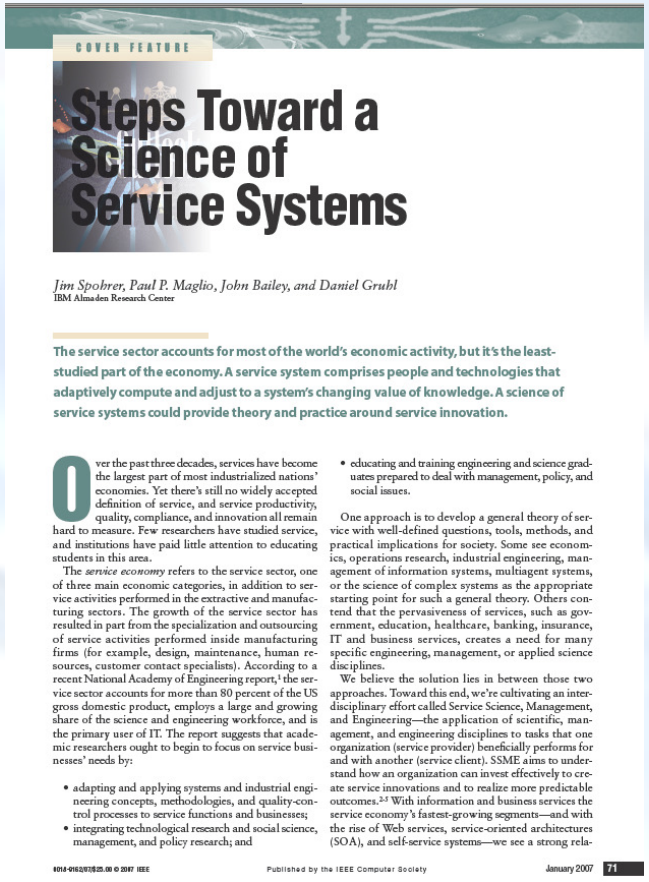
Ken Jennings jokingly wrote: "(I for one welcome our new computer overlords)"

But Wiser?

"Wise leaders make decisions only after they figure out what is good for the organization and society."

"Practical wisdom is tacit knowledge acquired from experience that enables people to make prudent judgments and take actions based on the actual situation, guided by values and morals."

Service System (Spohrer et. al.)



COVER FEATURE

Steps Toward a Science of Service Systems

Jim Spohrer, Paul P. Maglio, John Bailey, and Daniel Gruhl
IBM Almaden Research Center

The service sector accounts for most of the world's economic activity, but it's the least-studied part of the economy. A service system comprises people and technologies that adaptively compute and adjust to a system's changing value of knowledge. A science of service systems could provide theory and practice around service innovation.

Over the past three decades, services have become the largest part of most industrialized nations' economies. Yet there's still no widely accepted definition of service, and service productivity, quality, compliance, and innovation all remain hard to measure. Few researchers have studied service, and institutions have paid little attention to educating students in this area.

The *service economy* refers to the service sector, one of three main economic categories, in addition to service activities performed in the extractive and manufacturing sectors. The growth of the service sector has resulted in part from the specialization and outsourcing of service activities performed inside manufacturing firms (for example, design, maintenance, human resources, customer contact specialists). According to a recent National Academy of Engineering report,[1] the service sector accounts for more than 80 percent of the US gross domestic product, employs a large and growing share of the science and engineering workforce, and is the primary user of IT. The report suggests that academic researchers ought to begin to focus on service businesses' needs by:

- adapting and applying systems and industrial engineering concepts, methodologies, and quality-control processes to service functions and businesses;
- integrating technological research and social science, management, and policy research; and
- educating and training engineering and science graduates prepared to deal with management, policy, and social issues.

One approach is to develop a general theory of service with well-defined questions, tools, methods, and practical implications for society. Some see economics, operations research, industrial engineering, management of information systems, multiagent systems, or the science of complex systems as the appropriate starting point for such a general theory. Others contend that the pervasiveness of services, such as government, education, healthcare, banking, insurance, IT and business services, creates a need for many specific engineering, management, or applied science disciplines.

We believe the solution lies in between those two approaches. Toward this end, we're cultivating an interdisciplinary effort called Service Science, Management, and Engineering—the application of scientific, management, and engineering disciplines to tasks that one organization (service provider) beneficially performs for and with another (service client). SSME aims to understand how an organization can invest effectively to create service innovations and to realize more predictable outcomes.[2,3] With information and business services the service economy's fastest-growing segments—and with the rise of Web services, service-oriented architectures (SOA), and self-service systems—we see a strong rela-

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IEEE Computer, Jan 2007

- **Service systems are value co-creation configurations of people, technology, internal and external service systems connected by value propositions and shared information (such as language, laws, measures, models)**

- **Service systems are designed**
  - **computer systems**
- **Service systems evolve**
  - **linguistic and social systems**
- **Service systems have scale**
  - **emergent properties**
  - **economic systems**

Thinking About Value

- **Service as value co-creation**

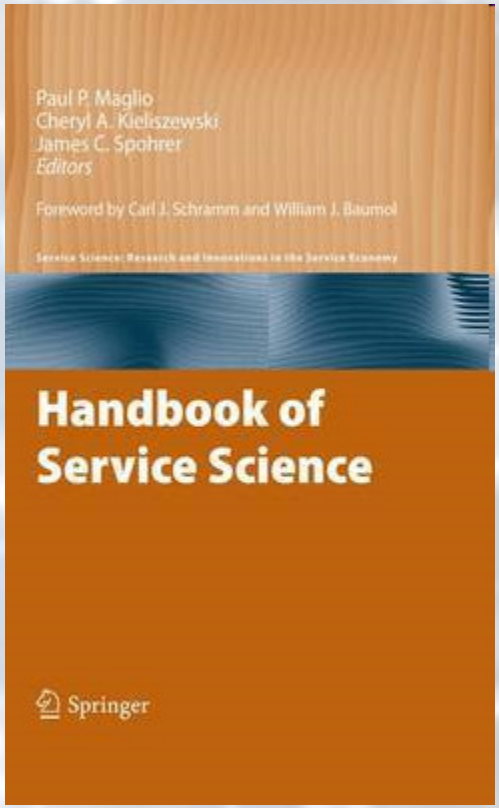
  The application of knowledge for mutual benefits (outcomes) when entities interact

- **Service innovations scale benefits**

  Role of platforms (tech, biz, social)

- **Service experience**

  Expectations, Interactions, Outcomes



Basics

- **Service science is the study of service systems and value-cocreation interactions and outcomes, through the lens of a service-dominant logic (SDL) worldview**

  All economic interactions are direct or indirect service interactions

  Goods are vehicles for indirect service interactions

- **SDL (Vargo & Lusch) defines service as…**

  the application of competence (e.g., knowledge) for the benefit of another entity

  slightly more specific, easier to understand

- **Service science (Spohrer & Maglio) defines service as…**

  value-cocreation interactions among service system entities

  slightly more general, harder to understand

Service Science: Conceptual Framework

Ecology
(Populations & Diversity)

Entities
(Service Systems, both Individuals & Institutions)

Interactions
(Service Networks, link, nest, merge, divide)

Outcomes
(Value Changes, both beneficial and non-beneficial)

Identity
(Aspirations & Lifecycle/ History)

Value Proposition
(Offers & Reconfigurations/ Incentives, Penalties & Risks)

Governance Mechanism
(Rules & Constraints/ Incentives, Penalties & Risks)

Reputation
(Opportunities & Variety/ History)

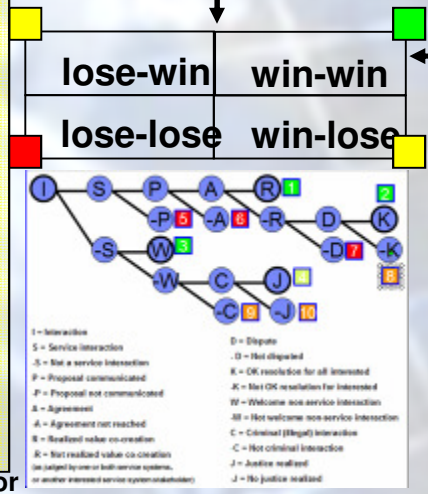
Access Rights
(Relationships of Entities)

Measures
(Rankings of Entities)

Resources
(Competences, Roles in Processes, Specialized, Integrated/Holistic)

Stakeholders
(Processes of Valuing, Perspectives, Engagement)

- *Resources:* Individuals, Institutions, Infrastructure, Information
- *Stakeholders:* Customers, Providers, Authorities, Competitors
- *Measures:* Quality, Productivity, Compliance, Sustainable Innovation
- *Access Rights:* Own, Lease, Shared, Privileged

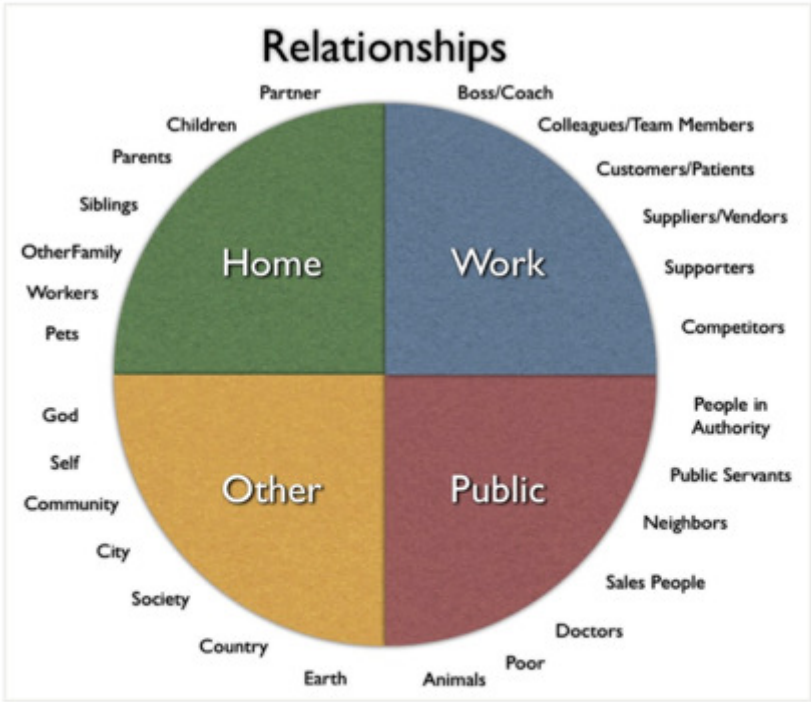


prefer sustainable non-zero-sum outcomes, i.e., win-win

Spohrer, JC (2011) On looking into Vargo and Lusch's concept of generic actors in markets, or "It's all B2B …and beyond!" Industrial Marketing Management, 40(2), 199–201.

Iwano: Cyber + Reality 1.0 = Reality 2.0
The emerging "cyber-coated reality"

- **Reality 1.0 Relationships →**
- **Reality 2.0 Relationships include Cyber-relationships:**
  - **"Cogs" for all roles**
    - **People-people**
    - **People-organizations**
    - **People-things**
    - **People-information**
  - **Cogs = cognitive assistant intermediary**



Summary. It could be said that our lives are made up of relationships. The chart above shows just some of the many relationships we establish and nurture throughout life. The *Relationship Resource Group* is committed to providing access to timely and progressive resources for strong relationships in all areas of life.

Source: ResourcesForLife.com

What is “cyber-coated reality” like?

- From Bacteria to “nervous-system-coated reality”
- From Simple Machines to “cyber-coated reality”
- Complex Adaptive Systems with moral entity?
  - Physical systems
  - Chemical systems
  - Biological systems
  - Social systems
  - Socio-technical systems
  - Physical symbol systems
  - Cognitive systems
  - Service systems
    - Capabilities & Constraints
    - Rights & Responsibilities
  - Smart service systems
    - AKA “cognitive service systems”
  - Wise service systems

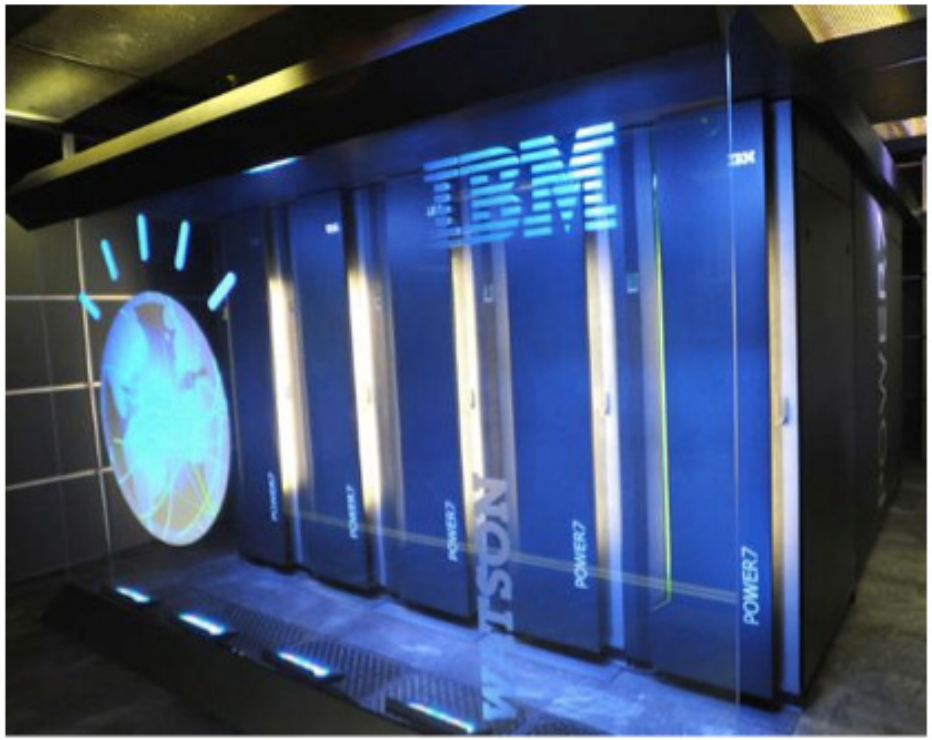
Source teachersparadise.com

Brief History of AI

- 1956 – Dartmouth Conference
- 1956 – 1981 Micro-Worlds
- 1981 – Japanese 5th Generation
- 1988 – Expert Systems Peak
- 1990 – AI Winter
- 1997 – Deep Blue
- 1997 – 2011 Real-World
- 2011 – Jeopardy! & SIRI
- 2013 – Cognitive Systems Institute
- 2014 – Watson Business Unit
- 2015 – "Cognition as a Service" on IBM Bluemix Cloud

Spohrer said:

> *Our view is that these new cognitive systems will accelerate progress immensely. Up until now we have been using cognitive shovels, but these new tools will be like cognitive bulldozers, enabling us to do a lot more in terms of decision support systems that augment human performance. And from the global university perspective they will also have profound implications regarding the ways we teach. Just as the calculator changed how students did math problems, cognitive computers will transform higher education.*



IBM's Watson cluster supercomputer beat the human champions on the television quiz show Jeopardy.

Vision: Augment & Scale Expertise

TO AUGMENT AND SCALE HUMAN EXPERTISE

Watson Discovery Advisor

MIT Technology Review

Monday, November 25, 2013

Software Mines Science Papers to Make New Discoveries

Software digests thousands of research papers to accurately identify proteins that could be productive targets for cancer drugs.

Tom Simonite

The software, developed in a collaboration between IBM and Baylor College of Medicine, was set loose on more than 60,000 research papers that focused on p53, a protein involved in cell growth, which is implicated in most cancers. By parsing sentences in the documents, the software could build an understanding of what is known about enzymes called kinases that act on p53 and regulate its behavior; these enzymes are common targets for cancer treatments. It then generated a list of other proteins mentioned in the literature that were probably undiscovered kinases, based on what it knew about those already identified. Most of its predictions tested so far have turned out to be correct.

"We have tested 10," Olivier Lichtarge of Baylor said Tuesday. "Seven seem to be true kinases." He presented preliminary results of his collaboration with IBM at a meeting on the topic of Cognitive Computing held at IBM's Almaden research lab.

Lichtarge also described an earlier test of the software in which it was given access to research literature published prior to 2003 to see if it could predict p53 kinases that have been discovered since. The software found seven of the nine kinases discovered after 2003.

Simonite, T. 2014. Software Mines Science Papers to Make New Discoveries. MIT. November 25, 2014.
URL: http://m.technologyreview.com/news/520461/software-mines-science-papers-to-make-new-discoveries/

User Models

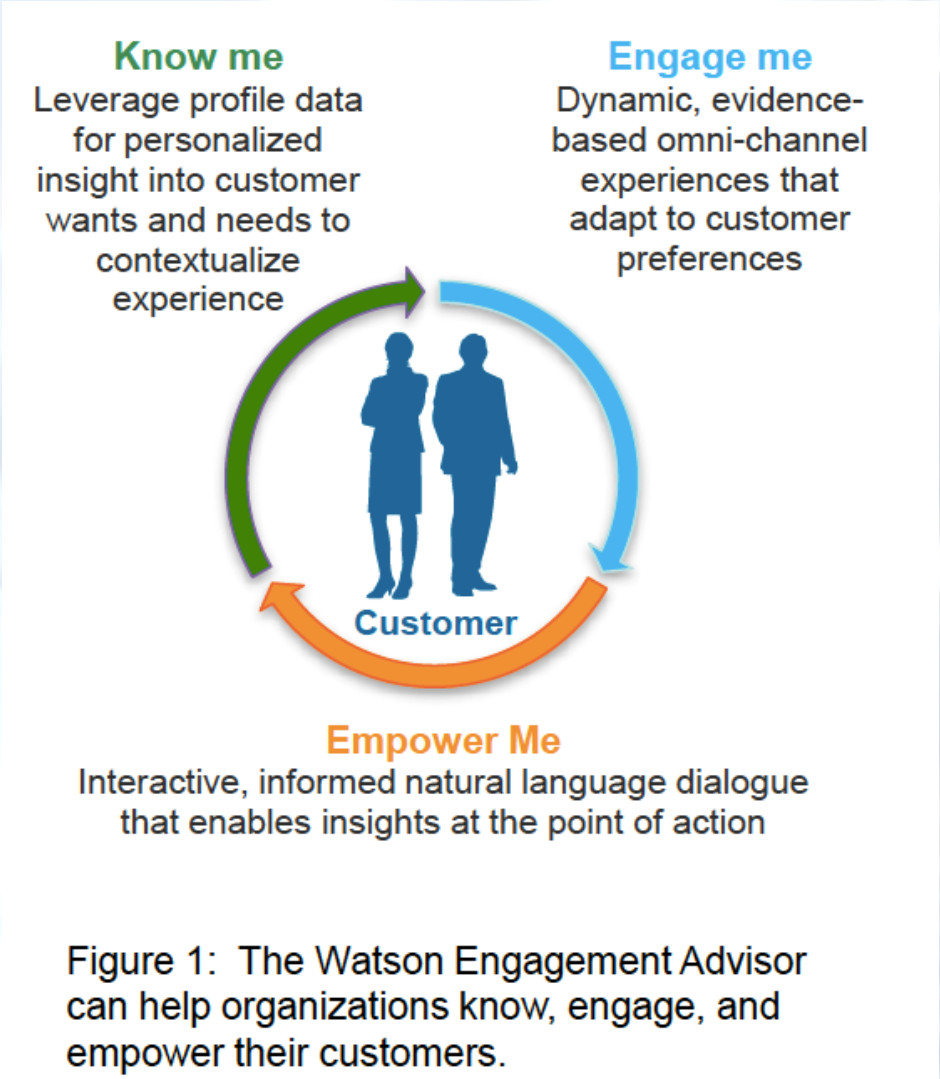


Figure 1: The Watson Engagement Advisor can help organizations know, engage, and empower their customers.

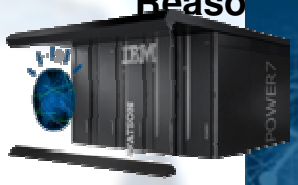
New Era of Computing: Cognitive Technologies & Componentry

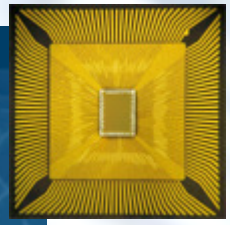
- **Natural Language**
  - Reasoning, Logic & Planning
  - Symbolic Processing
  - Natural Language Processing
  - Ranking of Hypotheses
  - Knowledge Representations
  - Domain-Specific Ontologies
  - Information Storage/Retrieval
  - Machine Learning, Reaso

- **Pattern Recognition**
  - Recognition, Sensing & Acting
  - Pattern Processing
  - Image & Speech Processing
  - Ranking of Hypotheses
  - Pattern Representations
  - Domain-Specific Neural Nets
  - Information Storage/Retrieval
  - Machine Learning, Perception
  - Neuromorphic Componentry
  - TrueNorth & Corelets Systems

AI for IA: Intelligence Augmentation

Cognitive Systems ("Cogs") that boost learning, discovery, engagement, transformation, and long-range





Watson Platform on BlueMix

IBM Investor Briefing

IBM

Watson today

IBM Watson Solutions

Healthcare	Financial Services	Public Sector	Other

IBM Watson Products

Engagement	Discovery	Policy	Other

IBM Watson Platform (built on BlueMix)

Domain Specialization	Cognitive Services				Tooling
Models Annotators Content	Perceiving Gaining a new level of insight into our world	Reasoning Drawing inferences to reach new conclusions	Relating Adapting/personalizing interactions by individual	Learning Continuously improving insight with experience	Assemble Ingest Train Deploy Admin

Data Lake

IBM Watson Foundations Methodology

Requirements → Inventory → Prioritization → Preparation

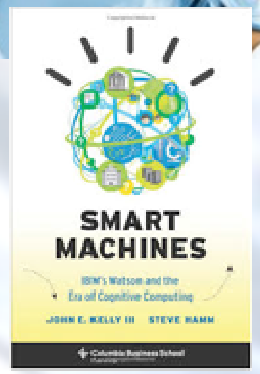
Information Lifecycle Management

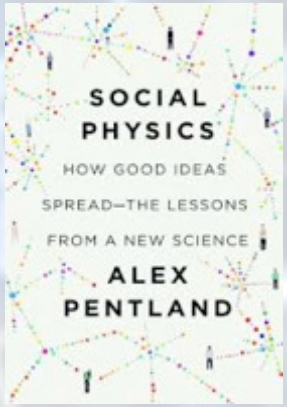
Grand Challenges

Data Sets, Tools & Services

- **Artificial Intelligence**
  - Cognitive Sport & Games
  - Deep Blue (Chess)
  - Watson (Jeopardy!)
  - Robocup
  - TradingAgents
  - DARPA Grand Challenges
  - NIST Competitions
  - Hutter Prize
  - Loebner Prize

- **Intelligence Augmentation**
  - Pass professional certification exams
  - Improve performance – both productivity and creativity
    - Problem-solving professionals
    - Researchers
    - Research Teams
    - Research Universities
    - Regions
    - Cognitive Enterprise





CSIG: Cognitive Systems Institute Group

- **LinkedIn discussion**
  - **Cognitive-Systems-Institute-6729452**
- **Web site for resource sharing**
  - **cognitive-science.info**
- **Bluemix**
  - **ibm.biz/HackBluemix**
  - **ibm.biz/LearnBluemix**
  - **$0.07 per GB-Hour (*)**

*** = check online for current pricing info**

Cognitive Systems Institute

- Virtual Institute to encourage and to advance cognitive systems research:
  - POVs from Academia, Industry, Governments, Professional Associations
  - Development of Curriculum, Data Sets, Tools & Services, Grand Challenges
  - Cognitive Science the Study of Cognitive Systems – Their Design & Evolution
    - Cogs = Individual Cognitive System Entities (Local Capabilities)
    - CogNets = Ecology of Nested, Networked Cogs (Collective Capabilities)
- Theme: Cognitive Science and the Transformation of Business & Society
  - How will advanced cognitive systems **change** what and how we learn, work & play?
  - How will cognitive systems improve performance (productivity & creativity) of:
    - Researchers & their teams? Research universities & their regions?
  - How will "cognitive bulldozers plow through big data" to accelerate:
    - Learning? Discovery? Engagement (scaling innovations for benefit of society)?

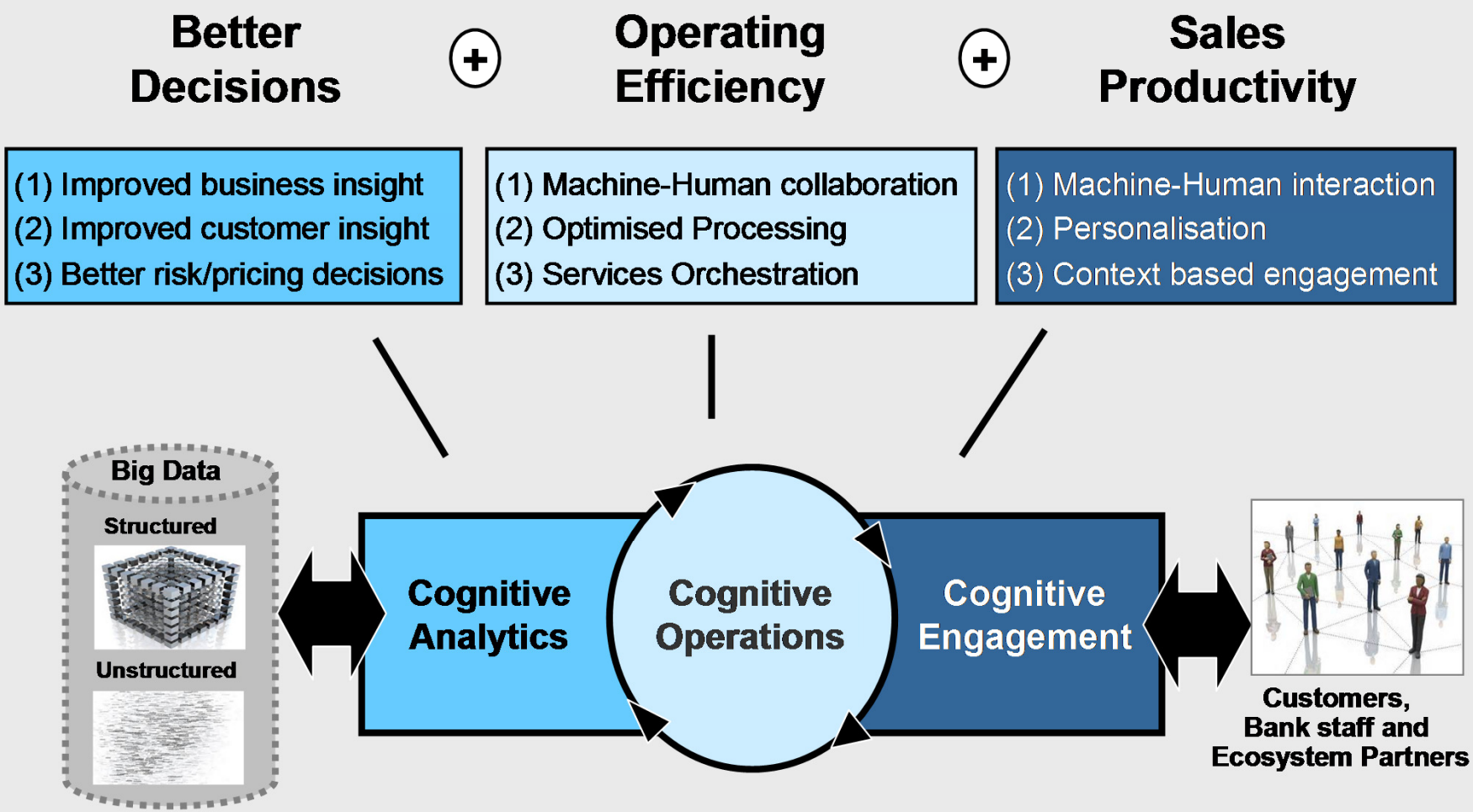
Cogs & CogNets

- Cogs: Degrees of capability for processing information about environment, self-others
  - Living: Biological Reproduction (Natural)
    - Examples: People, Animals
    - Awareness Levels: Spatial, SocialRoles, Temporal
  - Non-Living: Manufactured Production (Human-Made)
    - Example: Sophisticated Sensors, Smart Phones
    - Capability Levels: Memory, Processing, Bandwidth
- CogNets: Ecology of nested, networks Cogs – design and evolution
  - Rights: Governance Infrastructure Scaling (Governed)
    - Examples: Businesses, Governments
    - Responsibility Levels: To Customers, Citizens, Employees, Shareholders, etc.
  - No-Rights: Technology Infrastructure Scaling (Owned)
    - Examples: Data Centers, Internet Nodes
    - Capability Levels: Self-healing, learning, threat-detection

BORO Method (http://en.wikipedia.org/wiki/BORO_method)

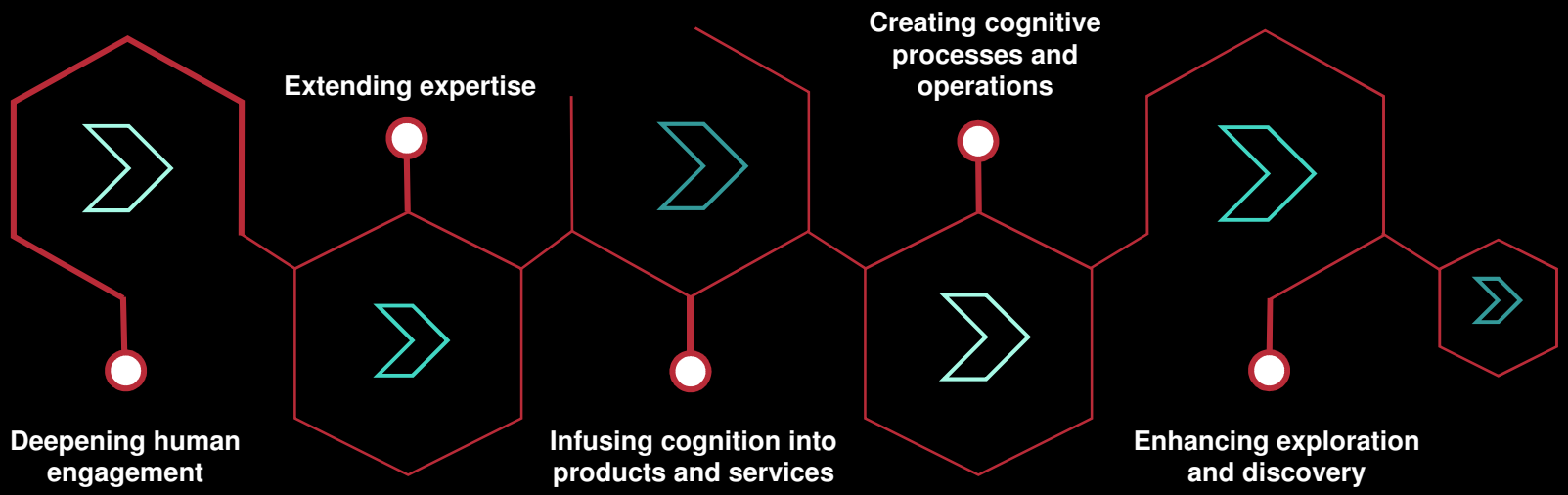
- Entities
- Set of Entities
- Relations

Example: Cognitive will transform banking …



Cognitive IoT of Systems

- Interaction among humans and machines
- Sharing expertise among humans and machines
- Understand your intent
- Embedding intelligence into every device from clouds
- Co-value creation into business and industrial processes



What I had covered in today's talk

- **Service Systems Innovations**
  - **Smarter, yes; But wiser?**
  - **How can we be sure?**
- **Progressions**
  - **Tool, assistant, collaborator, ?**
  - **? = cognitive machine, moral entity**
- **Cognitive Systems Institute**
- **Example of an Application in Banking**
- **Cognitive IoT of Systems**

"A service science perspective considers the evolving ecology of service system entities, their capabilities, constraints, rights, and responsibilities.