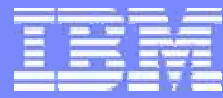


IBM Research – Almaden Services Research

Emergence of Service Science:
Services Sciences, Management, Engineering (SSME) as the Next Frontier in Innovation

Jim Spohrer & Paul Maglio
Director, Almaden Services Research
(spohrer@us.ibm.com)

Japan SSME Workshop | Tokyo | Sept 8, 2005

Today's Talk

- A trend
  a global challenge for our time – systematic service innovation
  claim: new academic discipline, SSME, is needed
- An analogy
  IBM and the emergence of computer science
- A spotlight
  find the pioneers of service innovation research & practice
- A grand challenge
  empirical platform for business and information services studies

A global challenge for our times

- Governments need to make service innovation a priority – GDP growth depends on it.
- Businesses need to make systematic approaches to service innovation a priority – revenue and profit growth depend on it.
- Academics need to bridge discipline silos – service innovation is multidisciplinary – students' futures depend on it.

Why should governments care?

Because the world is becoming a service system.

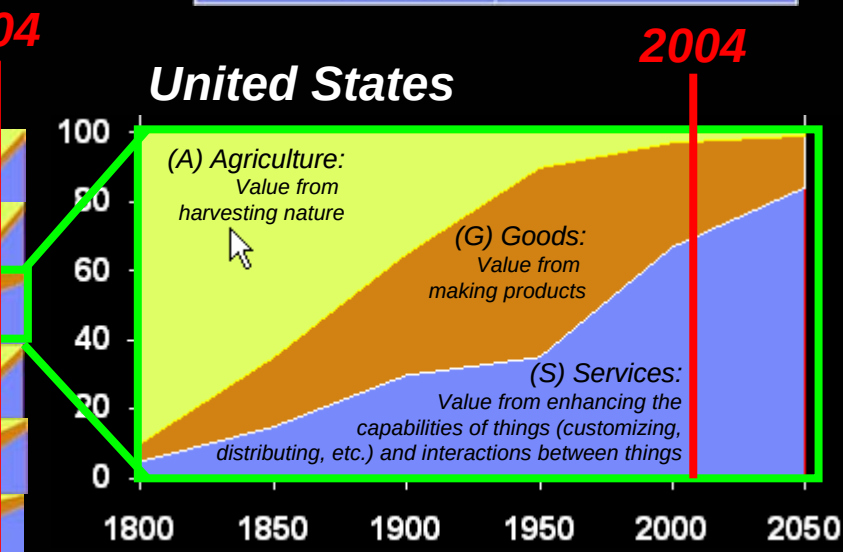
Top Ten Nations by Labor Force Size

(about 50% of world labor in just 10 nations)

A = Agriculture, G = Goods, S = Services

Nation	% ww Labor	% A	% G	% S	25 yr % delta S
China	21.0	50	15	35	191
India	17.0	60	17	23	28
U.S.	**4.8**	**3**	**27**	**70**	**21**
Indonesia	3.9	45	16	39	35
Brazil	**3.0**	**23**	**24**	**53**	**20**
Russia	**2.5**	**12**	**23**	**65**	**38**
Japan	**2.4**	**5**	**25**	**70**	**40**
Nigeria	2.2	70	10	20	30
Banglad.	2.2	63	11	26	30
Germany	**1.4**	**3**	**33**	**64**	**44**

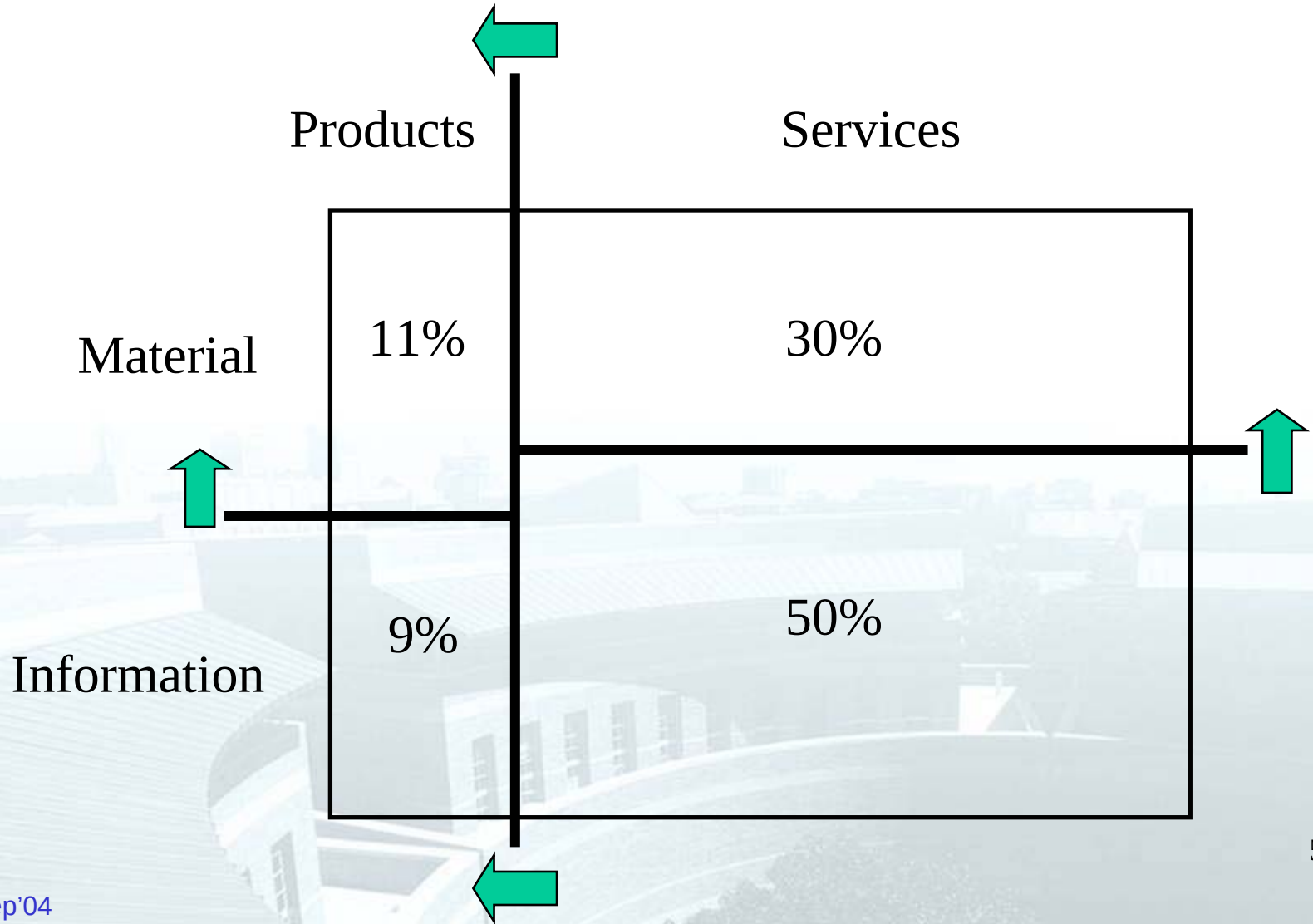
>50% (S) services, >33% (S) services



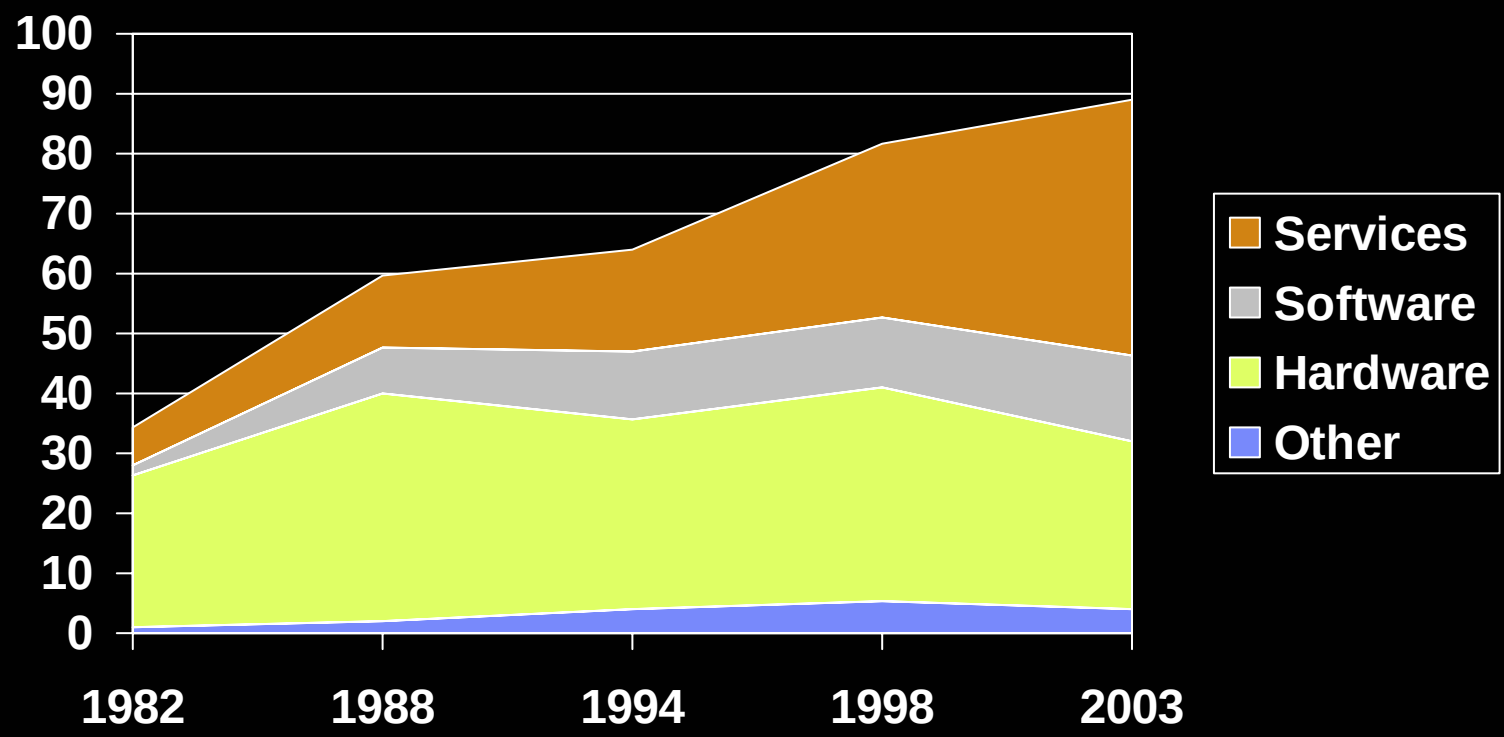
The largest labor force migration in human history is underway, driven by urbanization, global communications, low cost labor, business growth and technology innovation.

Information services is fastest growth

Uday Karmarkar & Uday Apte: "Service industrialization in the global economy"
Author of HBR article: "Will you survive the services revolution?"

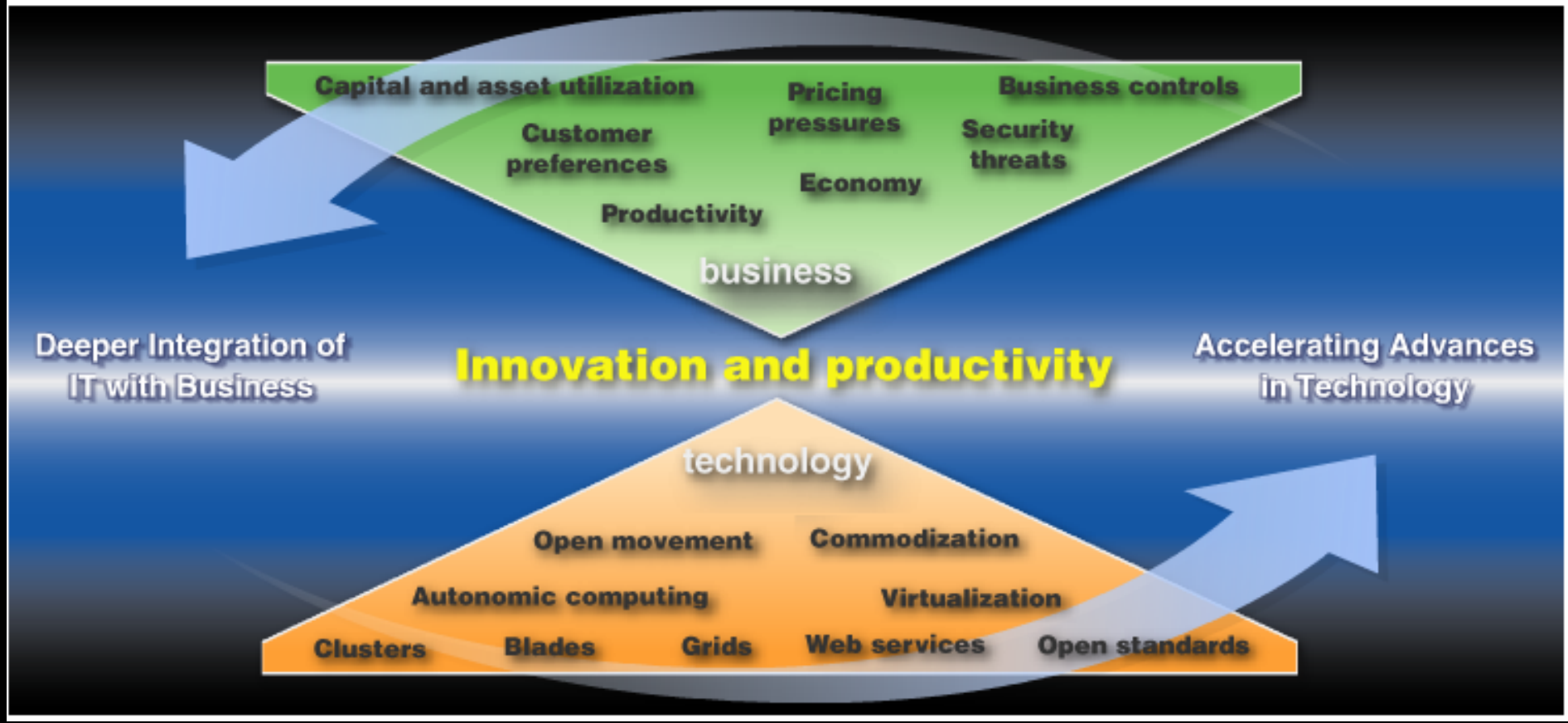


Service Innovation: Why does IBM care?



Service Innovation: Why does IBM care?

Our business is about innovation and productivity



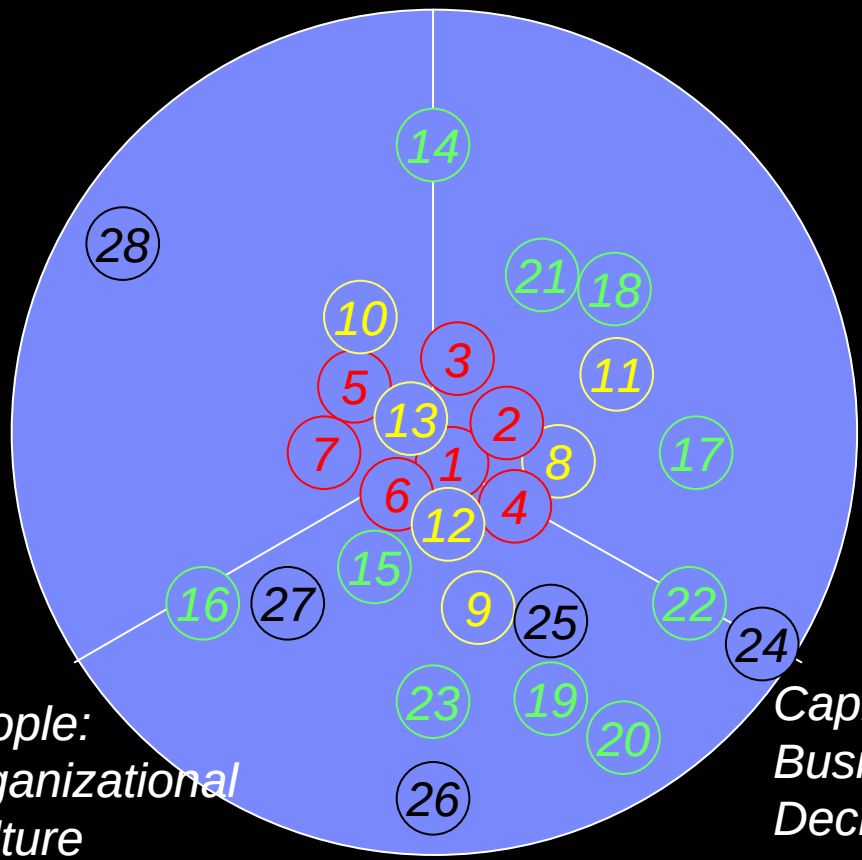
IBM works with our clients to transform their capabilities, On Demand Business maturity.

Why should academics and their students should care?

The center balances three key factors: business value, IT process, organizational culture

1. Information Sci & Sys
2. Service Ops & Mgmt
3. Service Engineering
4. Service Marketing
5. Social Complexity
6. Agent-based comput-ational economics
7. Computational Organization Theory
8. Management of Innovation & Tech (MoT)
9. Experimental Economics
10. AI & Games
11. Management of Information Systems
12. Computer Supported Collab. Work (CSCW)
13. Performance Support Systems In Business & Organization

1990-2004



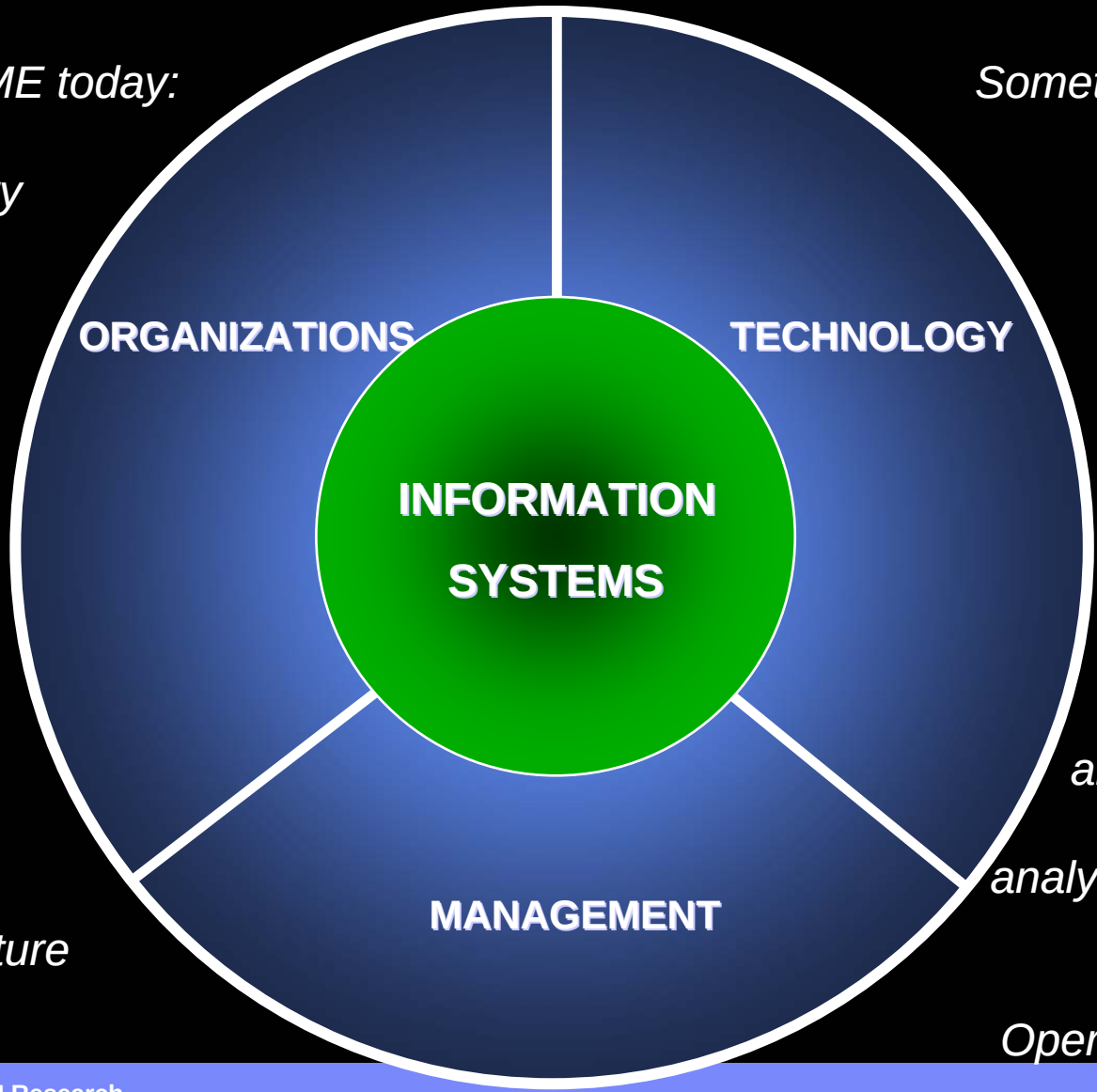
1900-1960

14. Computer & Information Sciences
15. Human Capital Management (HCM)
16. Organization Theory
17. Operations Research
18. Systems Engineering
19. Management Science
20. Game Theory
21. Industrial Engineering
22. Marketing
23. Managerial Psychology
24. Business Administration (MBA)
25. Economics
26. Law
27. Sociology
28. Education

INFORMATION SCIENCE & SYSTEMS

Closest to SSME today: emphasis on multidisciplinary teams creating solutions to complex business and societal problems.

Sometimes inadequate coverage of service economy and service innovations.



Somewhat weak on B2B cases and on motivation and incentive structure design.

Often does not fully balance artistic design with more formal and analytical approaches, as found in Economics and Operations Research.

A trend that matters to governments, businesses, and academics… the rise of the service economy

- Governments need to make service innovation a priority – GDP growth depends on it.
- Businesses need to make systematic approaches to service innovation a priority – revenue and profit growth depend on it.
- Academics need to bridge discipline silos – service innovation is multidisciplinary – students' futures depend on it.

So what?

- Yes, there needs to be more emphasis on systematic approaches to creating service innovations…
- But what can IBM and other businesses do to work with governments and academics who also care about service innovation?
- For one possible answer this question, we need to take one step back …

IBM Research hires talent worldwide for out labs

IBM Research – we hire physicists

This achievement is a major milestone toward creating a microscope that can make three-dimensional images of molecules with atomic resolution

scientific discussions. We are also grateful to P. Fabiani Bendicho for help with the numerical solution of the 3D radiative transfer equation. This research was supported by the Spanish Plan Nacional de Astronomia y Astrofisica and by the European Commission via the INTAS programme and the Solar Magnetism Network.

Competing interests statement The authors declare that they have no competing financial interests.

Correspondence and requests for materials should be addressed to J.T.B. (jtb@iac.es).

Single spin detection by magnetic resonance force microscopy

D. Rugar, R. Budakian, H. J. Mamin & B. W. Chui

IBM Research Division, Almaden Research Center, 650 Harry Rd, San Jose, California 95120, USA

Magnetic resonance imaging (MRI) is well known as a powerful technique for visualizing subsurface structures with three-dimensional spatial resolution. Pushing the resolution below 1 μm remains a major challenge, however, owing to the sensitivity limitations of conventional inductive detection techniques. Currently, the smallest volume elements in an image must contain at least 10^{12} nuclear spins for MRI-based microscopy[1], or 10^{7}

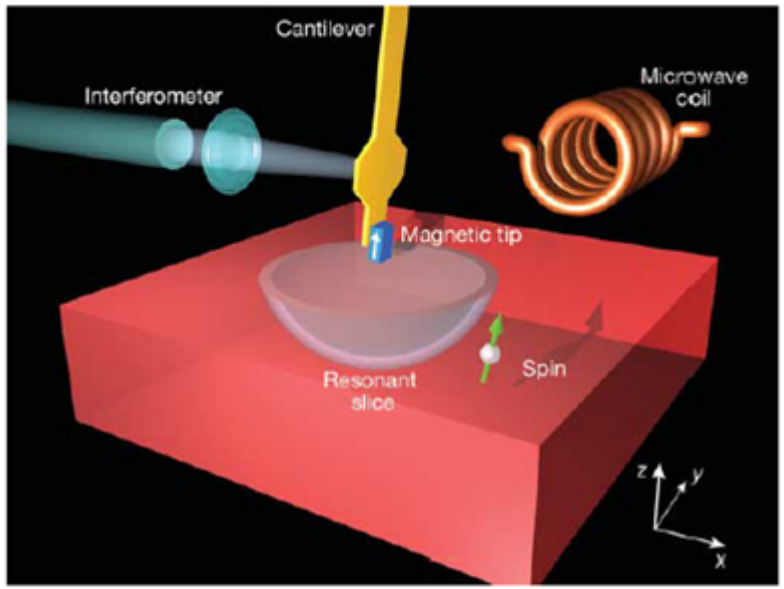
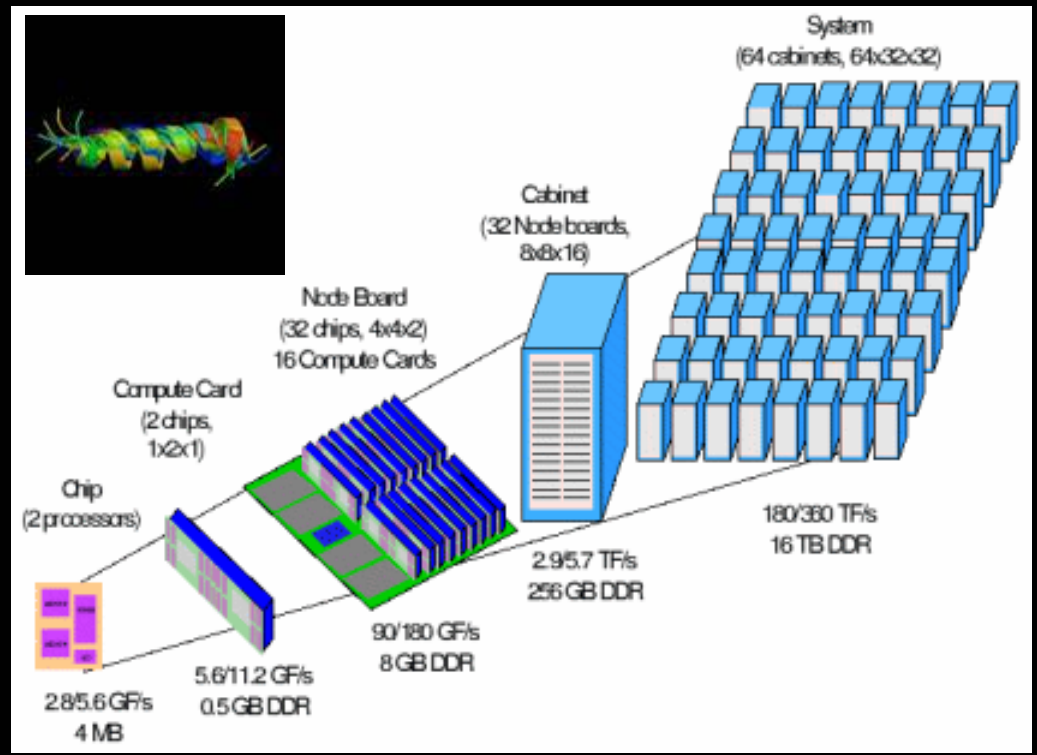


Figure 1 Configuration of the single-spin MRFM experiment. The magnetic tip at the end of an ultrasensitive silicon cantilever is positioned approximately 125 nm above a polished SiO_2 sample containing a low density of unpaired electron spins. The resonant slice represents those points in the sample where the field from the magnetic tip (plus an external field) matches the condition for magnetic resonance. As the cantilever vibrates, the resonant slice swings back and forth through the sample causing cyclic adiabatic inversion of the spin. The cyclic spin inversion causes a slight shift of the cantilever frequency owing to the magnetic force exerted by the spin on the tip. Spins as deep as 100 nm below the sample surface can be probed.

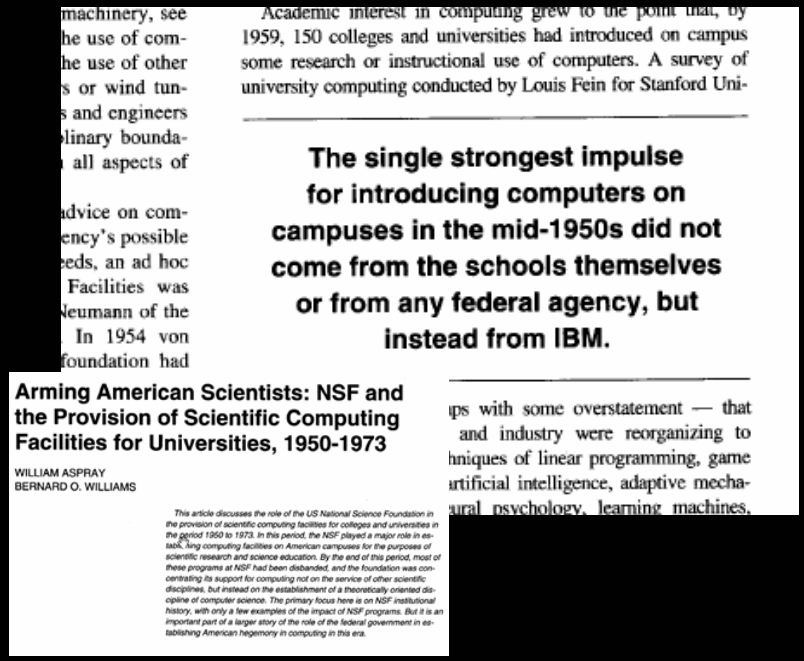
IBM Research – we hire computer scientists

Blue Gene, as its name suggests, is aimed at the drug-development market. Scientists hope eventually to model how proteins fold – a process that is important in designing drugs that can block cancer cells and other diseases.

70.72 teraflops on 11/2004
183.5 teraflops on 3/2004
(Linpack benchmark)



What you may not know… IBM worked with government and academics to help establish computer science departments



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Facilities was
Neumann of the
In 1954 von
foundation had

Academic interest in computing grew to the point that, by 1959, 150 colleges and universities had introduced on campus some research or instructional use of computers. A survey of university computing conducted by Louis Fein for Stanford Uni-

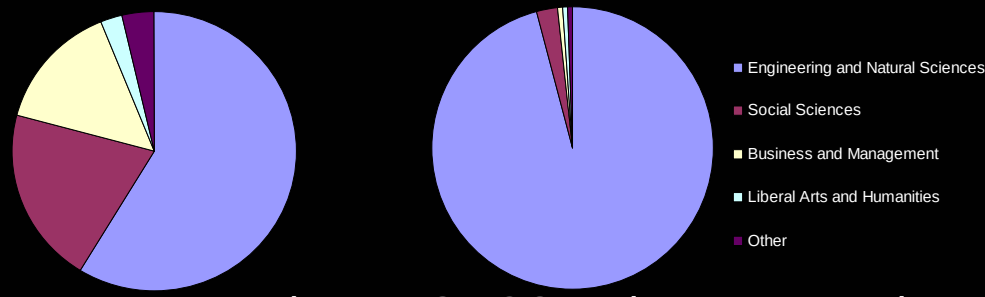
The single strongest impulse for introducing computers on campuses in the mid-1950s did not come from the schools themselves or from any federal agency, but instead from IBM.

Arming American Scientists: NSF and the Provision of Scientific Computing Facilities for Universities, 1950-1973

WILLIAM ASPRAY
BERNARD O. WILLIAMS

ups with some overstatement — that and industry were reorganizing to hniques of linear programming, game rtificial intelligence, adaptive mecha- ural psychology, learning machines,

Now IBM is working with academics and government to establish Service Science



Percentage PhD's U.S. IGS and IBM Research

Computer Science	Physicists
	Electrical Engineers
	Mathematicians
	Philosophers (Boolean Logic)

Need to hire Computer Scientists

Need to hire Service Scientists

Definitions

- **Service Science,**
  short for Services Sciences, Management, and Engineering (SSME)

- **Definition 1: The application of scientific, management, and engineering disciplines to tasks that one organization beneficially performs for and with another ('services')**

  Make productivity, quality, performance, compliance, security, fairness, growth, innovation, and learning improvements more predictable

  Services deals with the coproduction of value between clients and providers in value production relationships, with alternative work sharing, risk sharing, information sharing, and decision sharing arrangements.

- **Science is a way to create knowledge**
- **Engineering is a way to apply knowledge and create new value**
- **Business Model is a way to apply knowledge and capture value**
- **Management improves the process of creating and capturing value.**

Terms & Definitions

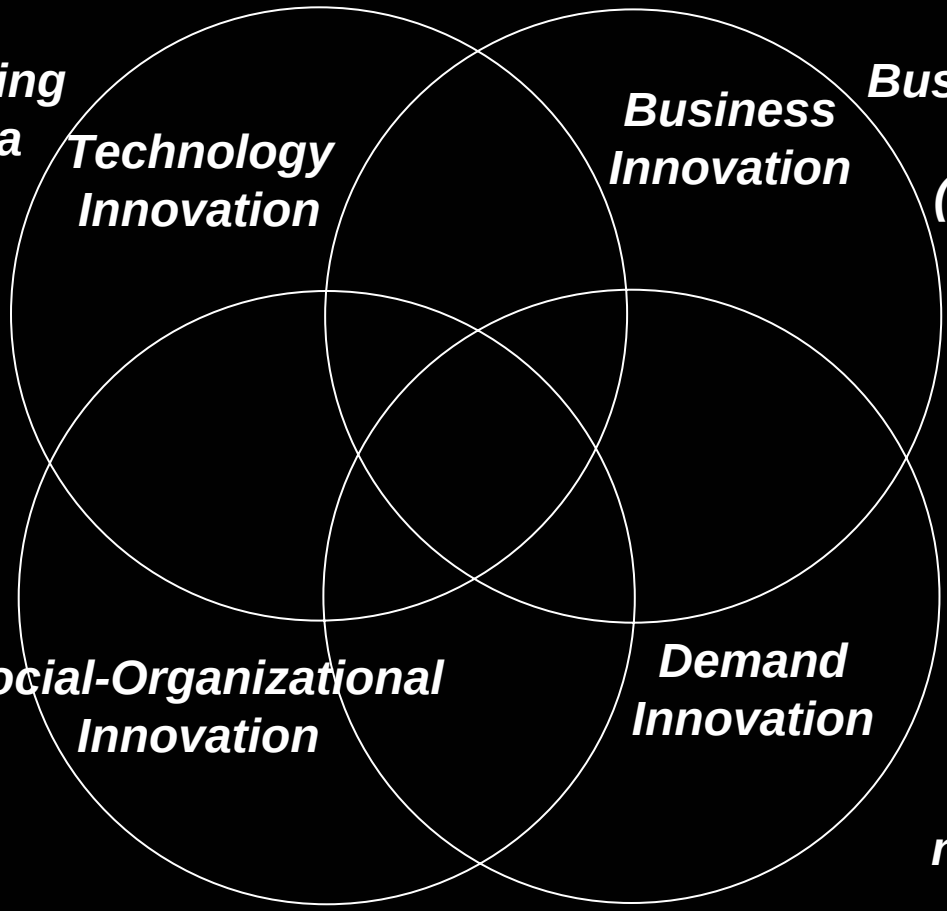
- **Service Science, short for Services Sciences, Management, and Engineering (SSME)**
- **Definition 1: The application of scientific, management, and engineering disciplines to tasks that one organization beneficially performs for and with another ('services')**
  - **Make productivity, quality, performance, compliance, growth, and learning improvements more predictable in work sharing and risk sharing (coproduction) relationships.**
- **Definition 2: The study of service systems.**
  - **Evolution & Design: Services systems evolve in difficult to predict ways because of naturally emergent and rationally designed path dependent interactions between economic entities, acting in the roles of clients and providers coproducing value.**
  - **Interactions & Value Coproduction: Service systems are made up of large numbers of interacting clients and providers coproducing value. Each economic entity is both a client and a provider. Service system dynamics are driven by the constantly shifting value of knowledge distributed among people, organizations, technological artifacts (culture), and embedded in networks or ecosystems of relationships amongst them.**
  - **Specialization & Coordination: One mechanism for creating value is specialization of clients and providers, which results in the need for coordination via markets, organizational hierarchies, and other mechanisms. Specialization creates efficiency. Efficiency creates profits and leisure. Profits and Leisure create investment (profits to innovation) and new demand (leisure to new aspirations).**

Service innovation is inherently multidisciplinary…

Knowledge sources driving service innovations…

Science & Engineering (Study phenomena and create new knowledge)

Business Administration and Management (Study phenomena and create new knowledge)



Social Sciences (Study phenomena and create new knowledge)

Global Economy & Markets (Emergence of new knowledge in practice!)

SSME = Service Sciences, Management, and Engineering

Definitions of Services

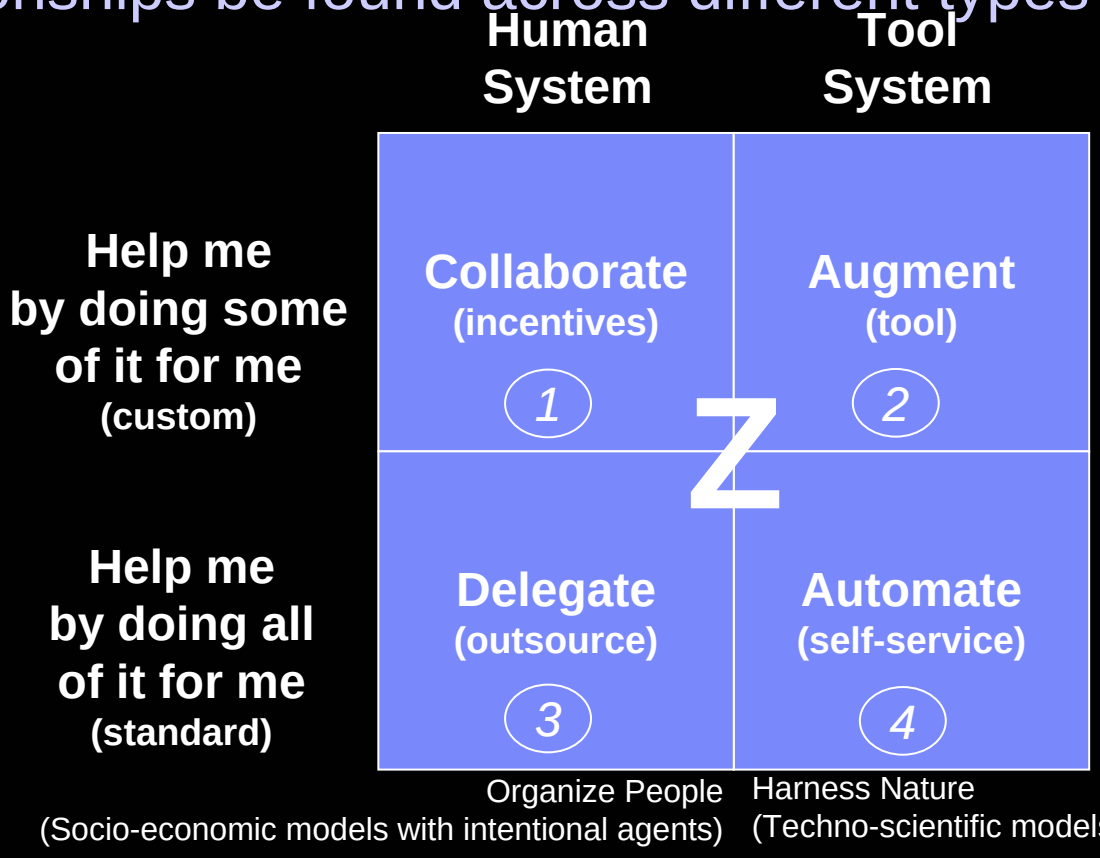
- Deed, act, or performance (Berry, 1980)
- An activity or series of activities… provided as solution to customer problems (Gronroos, 1990)
- All economic activity whose output is not physical product or construction (Brian et al, 1987)
- Intangible and perishable… created and used simultaneously (Sasser et al, 1978)
- A time-perishable, intangible experience performed for a customer acting in the role of co-producer (Fitzsimmons, 2001)
- A change in condition or state of an economic entity (or thing) caused by another (Hill, 1977)
- Characterized by its nature (type of action and recipient), relationship with customer (type of delivery and relationship), decisions (customization and judgment), economics (demand and capacity), mode of delivery (customer location and nature of physical or virtual space) (Lovelock, 1983)
- Deeds, processes, performances (Zeithaml & Bitner, 1996)

So, services are…

Pay for performance in which client and provider coproduce value

- High talent performance
  - Knowledge-intensive business services (business performance transformation services) (e.g., chef's, concert musicians)
- High support performance
  - Environment designed to allow average performer to provide a superior performance (average cook with great cook book and kitchen; average musician with a synthesizer)
- High tech performance
  - Computational services (e-commerce, self service – client does work)
  - Even here… talent builds, maintains, upgrades, etc. the technology
- Routine performance (sometime High Finance)
  - This is being automated, outsourced, labor arbitrage, financial arbitrage, migrated to high talent/value sectors, or otherwise being rationalized

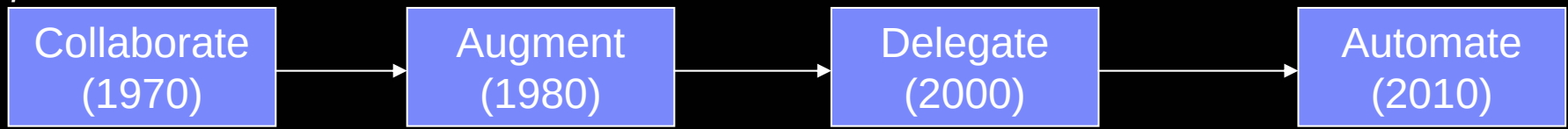
Service Science Core Questions: How do work systems reconfigure? What role does innovation play? Can integration relationships be found across different types of work system?



The choice to change work practices requires answering four key questions:

- **Should we? (Value)**
- **Can we? (Technology)**
- **May we? (Governance)**
- **Will we? (Priorities)**

Example: Call Centers



Experts: High skill people on phones

Tools: Less skill with FAQ tools

Market: Lower cost geography (India)

Technology: Voice response system

High talent performance is on the rise in the US economy

95% of all scientists are alive today.

Type of work system	**1979**	**1996**			Example
		All	Services	Goods	
Tightly Constrained	6%	5%	4%	10%	Call center, Fast food
Unrationalized Labor Intensive	25%	25%	26%	15%	Maid, child care
Semi-Autonomous	35%	30%	30%	35%	Admin., Manager
High-skill Autonomous	34%	40%	40%	40%	Executive, Engineer

From Herzenberg, Alic, Wial (1998)

A spotlight

- Find the pioneers of service innovation research & practice
- IBM has invested well over $1M in faculty awards to service innovation pioneers over the last two years
- IBM invests far more in hiring top talent from universities for our service business and IBM Research in service innovation

Henry Chesbrough, Berkeley, a service science pioneer.

IBM Faculty Award

Harvard Business Review

www.hbr.org

THE HBR LIST

Our annual survey of emerging management ideas considers the downside of reliability and the upside of flip-flops; new directions for evolving technologies; and the persistent questions of who we are and what we fear.

Breakthrough Ideas for 2005

14. Toward a New Science of Services

Services is the name of the game in today's economy. Services represent about 80% of the U.S. gross domestic product and between 60% and 80% of the GDPs of the rest of the world's advanced economies. Getting better at services management must be a priority. Companies like General Electric, Xerox, and IBM that are seeing their own businesses shift from products to services are acutely aware of this. (At IBM, for example, more than half of total revenue now comes from services.)

So why can't we agree that services science is a legitimate field? Even as it is researched,

6 FT Mastering Innovation

HENRY CHESBROUGH

A failing grade for the innovation academy

Services dominate economic activity in developed economies, and yet understanding of innovation in this sector remains very limited

According to a study by the National Academy of Engineering, services in 2003 represented 80 per cent of the

Similarly, customers did not need to understand their suppliers' prior experiences and capabilities, since these were reflected in the products they could see, touch and experience directly.

The services transaction is different. The exchange is generated by both parties, and the process of adoption or consumption is an integral part of the transaction. So, the adopter or customer is also a co-producer, intimately involved in defining, shaping and integrating the service into his or her organisation.

The supplier of the service can extend an offer of what is to be provided but, as we shall see below, it cannot entirely specify the

Berkeley's new ORMS undergraduate major

Rhonda Righter, IBM Faculty Award

http://www.ieor.berkeley.edu/AcademicPrograms/Ugrad/ORMS.pdf

1. Decision Making in Economic Systems

Econ 101B	Economic Theory Macro (4)	Econ 161	Economic Systems (3)
Econ 104	Advanced Microeconomic Theory (4)	Math 104	Introduction to Analysis (4)
Econ 141	Economic Statistics and Econometrics (4)	E120	Princ. of Eng. Econ. (3)
IEOR 165	Engineering Statistics, Quality Control and Forecasting (3)		

2. Decision Making in Industrial and Service Systems

IEOR 150	Production Systems Analysis (3)	EOR 166	Decision Analysis (3)
IEOR 151	Service Operations Design and Analysis (3)	IEOR 170	Human Factors for Eng. Des. (3)
IEOR 153	Facilities Planning and Design (3)	Bus Ad. 123	Managerial Accounting (3)
IEOR 162	Linear Programming (3)	Bus Ad. 142	Prod. and Opns. Mgt. (3)
IEOR 165	Engineering Statistics, Quality Control and Forecasting (3)		

3. Decision Making in Societal Systems

Soc 101A	Sociological Theory (5)	Soc 119	Society and Info. Theory (4)
Soc 105	Introduction to Sociological Methods (5)	Econ C110	Game Th. in the Soc. Sci. (4)
Soc 106	Intermediate Sociological Methods (4)	Econ 101A	Economic Theory Micro (4)
IEOR 165	Engineering Statistics, Quality Control and Forecasting (3)		

4. Algorithmic Decision Making

CS 61B	Data Structures (4)	IEOR 115	Indust. and Comm'l. Data Syst. (3)
CS 170	Efficient Alg. and Intractable Prob. (4)	IEOR 162	Linear Programming (3)
CS 172	Computability and Complexity (4)	IEOR 166	Decision Analysis (3)
CS 174	Combinatorics and Discrete Probability (4)	Math 110	Linear Algebra (4)

School	Discipline	Evolution & Revision	Selection & Aggregation	Transformation & Integration
School of Management	Marketing	Service Marketing	Service & Solutions Excellence Centers (Information Science & Technology Management)	Services Sciences, Management, and Engineering (SSME) and Solutions Engineering
	Operations	Service Operations		
	Accounting	Service Accounting (Activity-Based Costing)		
	Contracts & Negotiations	Service Sourcing (eSourcing)		
	Management Science	Service Management		
	Management of Technology	Management of Innovation		
School of Engineering and Science	Operations Research	Service Operations		
	Industrial & Systems Engineering	Service Engineering		
	Computer Science	Service Computing, Web Services, SOA		
School of Social Sciences	Economics	Institutional Economics Experimental Economics		
	Psychology	Labor Psychology (Human Capital Mgmt)		
	Anthropology	Business Anthropology		
	Organization Theory			
Other	Information Science & Systems, Service professional schools			

Select efforts to promote service science

- Dec. 2002: Almaden Service Research established, the first IBM Research group completely dedicated to understanding service innovations from a sociotechnical systems perspective, including enterprise transformation and industry evolution (http://www.almaden.ibm.com/asr/)
- March 2003: IBM-Berkeley Day: Technology… At Your Service! (http://www.eecs.berkeley.edu/IPRO/IBMday03/)
- September 2003: Coevolution of Business-Technology Innovation Symposium (http://www.almaden.ibm.com/coevolution/)
- April 2004: Almaden Institute: Work in the Era of the Global, Extensible Enterprise (http://www.almaden.ibm.com/institute/2004/)
- May 2004: "Architecture of On Demand" Summit: Service science: A new academic discipline? (http://domino.research.ibm.com/comm/www_fs.nsf/pages/index.html)
- June 2004: Paul Horn, VP IBM Research, briefs analysts on "Services as a Science"
- September 2004: Chesbrough's "A failing grade for the innovation academy" appears in the Financial Times (http://news.ft.com/cms/s/9b743b2a-0e0b-11d9-97d3-00000e2511c8,dwp_uuid=6f0b3526-07e3-11d9-9673-00000e2511c8.html)
- November 2004: IBM's GIO focuses on service sector innovations: government, healthcare, work-life balance (http://www.ibm.com/gio)
- November 2004: Service Innovations for the 21st Century Workshop (http://www.almaden.ibm.com/asr/events/serviceinnovation/)
- December 2004: Samuel J. Palmisano, IBM CEO, Harvard Business Review interview discusses the important role of "values" in organizational performance, "Leading Change When Business is Good" (http://harvardbusinessonline.hbsp.harvard.edu/b01/en/common/item_detail.jhtml?id=R0412C)
- December 2004: IBM expands academic initiatives related to service innovations, including sponsoring Tannenbaum Institute of Enterprise Transformation at Georgia Tech.
- February 2005: Chesbrough's "Service as a Science" in Harvard Business Review Breakthrough ideas of 2005
- 2005 - Oxford, Warwick, Bentley, Penn State, UMaryland, ASU, NCState, Japan, China, Norway, etc.

Work items

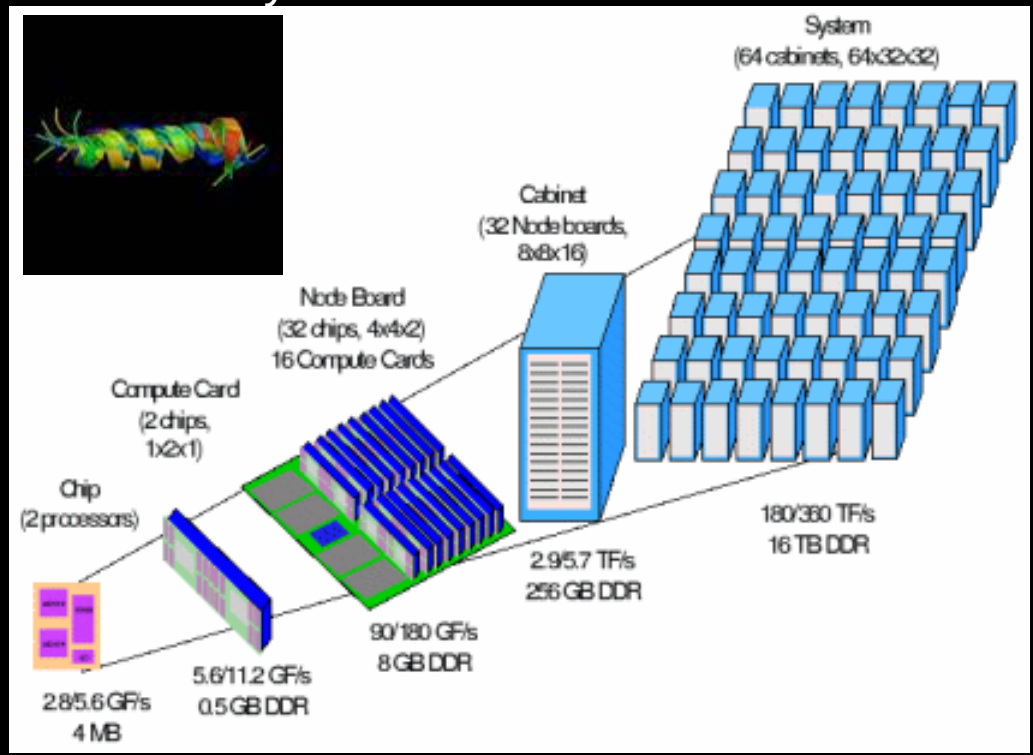
- Establish the importance of getting more systematic about service innovation for academics, business, and government
- Highlight the work of the pioneers and early champions of systematic approaches to service innovation and service science
- Review of components of existing degrees requirements and course elements that should be part of a service science curriculum
- Define the fundamental research questions and grand challenges that the science is seeking answers to (value if answered, methodologies and tools for answering them, etc.)
- Agree on conferences, journals, and other community growth initiatives
- Explore the role of government and industry, especially with respect to accessing the fundamental data on which the science will be based
- Establish a feedback mechanism that surveys graduates who enter IGS to see what skills they used most and the ones they wish they had learned while in school
- Discuss the many roadblocks, challenges, overwhelming political obstacles, etc. to establishing the field.

A grand challenge

- What is the new tool for SSME?
- Most new sciences make rapid advancement when they have a new tool for measurement and rapid empirical studies?
- What might an empirical platform for business and information services studies look like?

Agent-based Simulations of Organizational Designs and Industry Evolution

Mizuta-san (under Kuse-san, Hidaka-san) at TRL is working with Researchers at IBM Almaden to do agent-based simulations of organization on the BlueGene supercomputer. Researchers at Almaden have connected BlueGene to the WebFountain supercomputer that can analyze the enter web and more.



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