

SSMED and SOA:

Service Science, Management, Engineering and Design and Service Oriented Architecture

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This document was created in Lotus Symphony Presentations,
and is clearer when viewed as a Screen Show

Agenda

- A. Why is SSMED important?
- B. SSMED and SOA
- C. Progress to date
- D. Challenges and gaps
- E. Where to start?

Products:
17% of
Delivery
Form

Services:
83% of *Delivery Form*

Material:
37% of *End Product*

Material:
37% of *End Product*

11%
of GNP

(in 1997, ↓
from
19% of 1968
GNP)

27%
of GNP

(in 1997, ↓ from
35% of 1968 GNP)

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Uday M. Apte, Uday S. Karmarkar and Hiranya K Nath, "Information Services in the US Economy: Value, Jobs and Management", *Business and Information Technologies (BIT) Project*, Anderson School of Management at UCLA, June 2007

7%
of GNP

(in 1997, ↓
from
11% of 1968
GNP)

56%
of GNP

(in 1997, ↑ from
36% of 1968 GNP)

Information:
63% of *End Product*

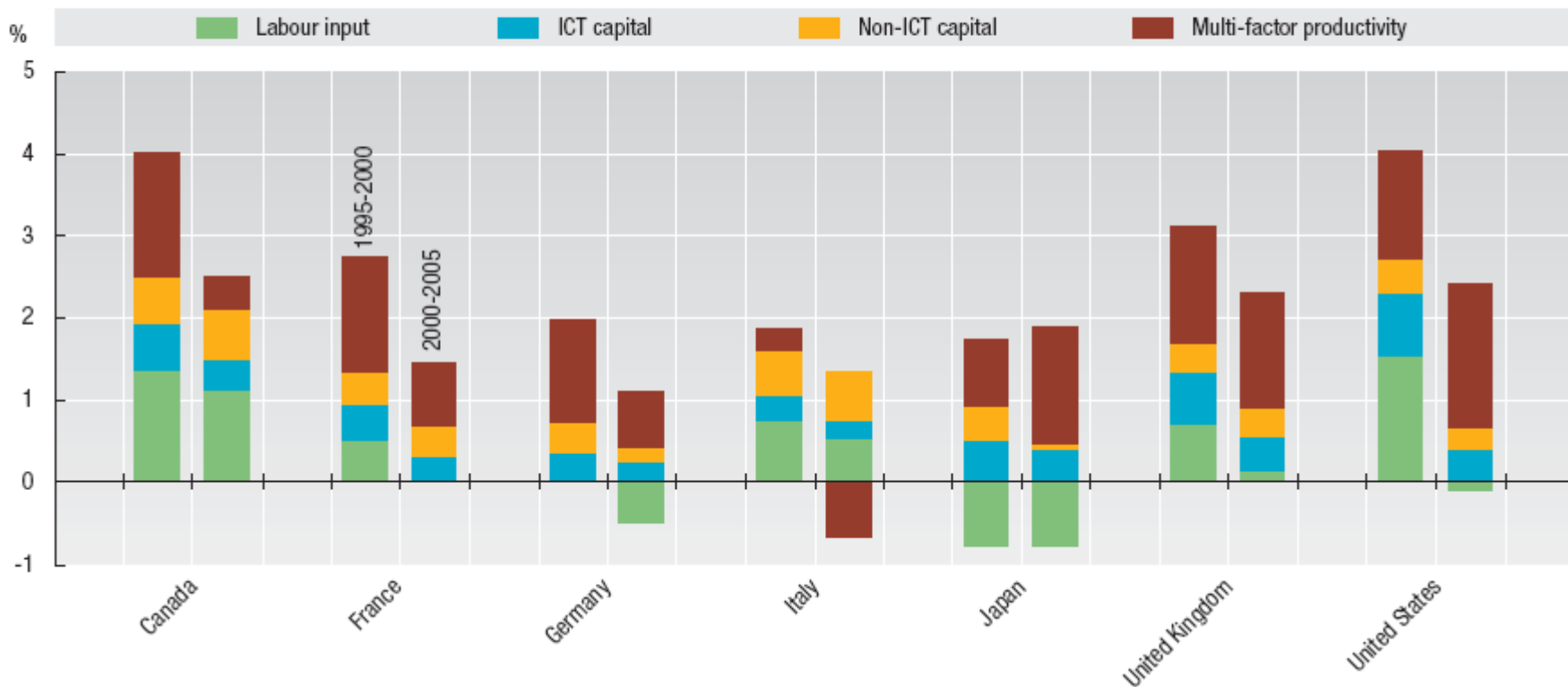
Information:
63% of *End Product*

Products:
17% of
Delivery
Form

Services:
83% of *Delivery Form*

Contributions to GDP growth, G7 countries, 1995-2000 and 2000-05¹

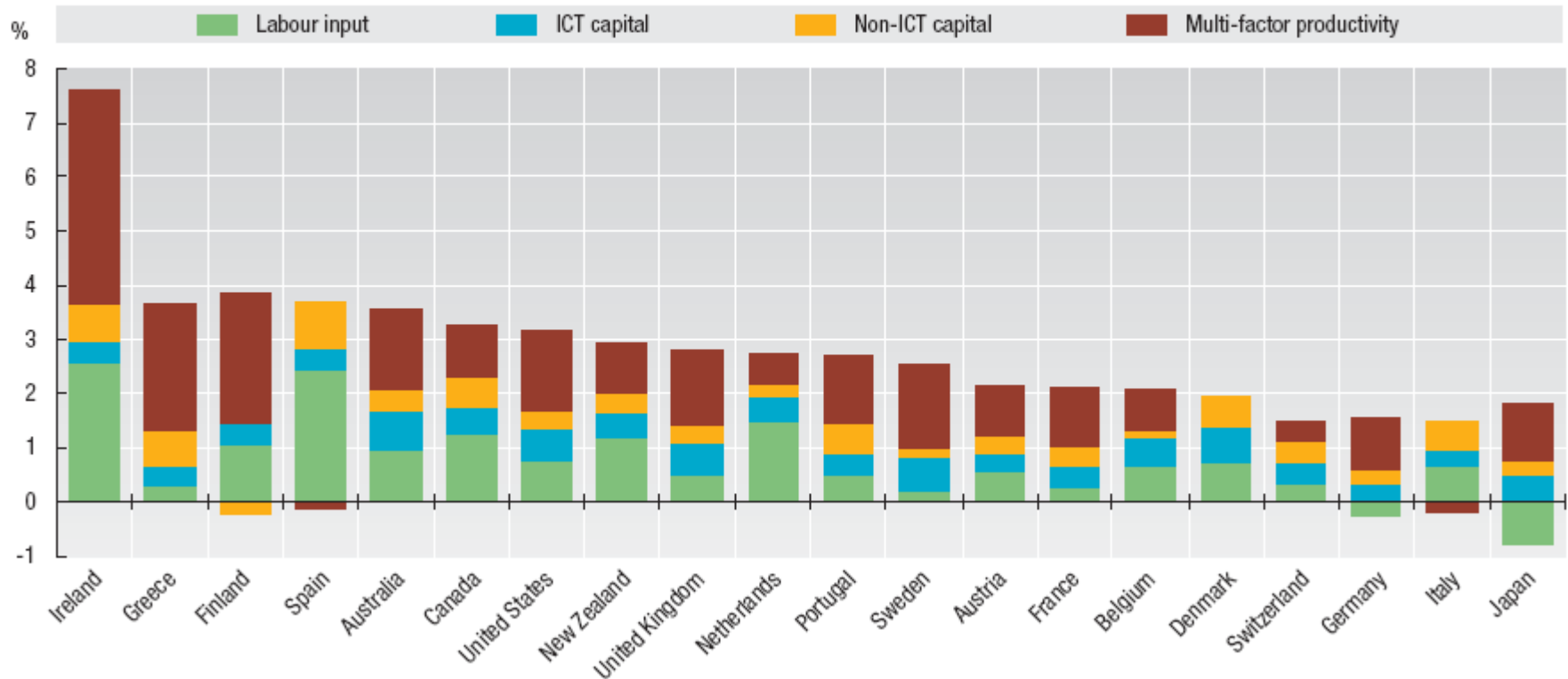
Percentage points



OECD Science, Technology and Industry Scoreboard 2007: Innovation and Performance in the Global Economy, p. 206, available from oecd.org.

Contributions to GDP growth, OECD countries, 1995-2005²

Percentage points



OECD Science, Technology and Industry Scoreboard 2007: Innovation and Performance in the Global Economy, p. 206, available from oecd.org.

Consider three businesses impacted by ICT capital

Financial services

Banking and insurance
“products” in physical branches or local offices



Customer and agents networked on electronic communications (Internet, mobile phone)

Media and entertainment

Tv, radio, newspaper → audio cassette, videotape, CDs, DVDs



Digital content over broadband: Flash video, MP3 audio, blogging

Information technology solutions

Customer and agents networked on electronic communications (Internet, mobile phone)



Distributed personal computers → global service providers / outsourcing → free/libre and open source software

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

WILLIAM ASPRAY
BERNARD O. WILLIAMS

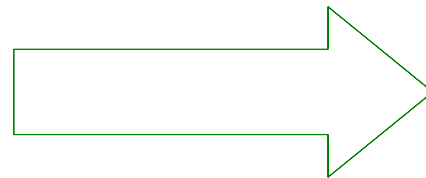
This article discusses the role of the US National Science Foundation in the provision of scientific computing facilities for colleges and universities in the period 1950 to 1973. In this period, the NSF played a major role in establishing computing facilities on American campuses for the purposes of scientific research and science education. By the end of this period, most of these programs at NSF had been disbanded, and the foundation was concentrating its support for computing not on the service of other scientific disciplines, but instead on the establishment of a theoretically oriented discipline of computer science. The primary focus here is on NSF institutional history, with only a few examples of the impact of NSF programs. But it is an important part of a larger story of the role of the federal government in establishing American hegemony in computing in this era.

Physicists

Electrical Engineers

Mathematicians

Philosophers (Boolean Logic)



Computer Science

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.

versity reported — perhaps with some overstatement — that universities, government, and industry were reorganizing to invent and apply new techniques of linear programming, game theory, automata theory, artificial intelligence, adaptive mechanisms, psychometrics, neural psychology, learning machines, information theory, coding theory, statistics, cybernetics, and a wide range of modeling techniques. Fein soberly reported that

W.B. Aspray and B. O. Williams 1994. Arming American scientists: NSF and the provision of scientific computing facilities for universities, 1950-1973. *IEEE Annals of the History of Computing*, 16 (4), 60-74.

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SSMED studies *service systems*; SOA is a *style*

A **service system** can be defined as
a **dynamic** configuration of **resources**
(**people, technology, organisations and shared
information**)
that creates and delivers **value**
between the provider and the customer through
service.

Source: IfM and IBM.
(2008). *Succeeding
through Service
Innovation: A Service
Perspective for
Education, Research,
Business and
Government*. University
of Cambridge Institute
for Manufacturing,
available at [http://
www.ifm.eng.cam.ac.uk/
ssme/](http://www.ifm.eng.cam.ac.uk/ssme/)

Service-Oriented Architecture (SOA)
is an **IT architectural style**
that supports
the **transformation** of your **business** into
a set of **linked services**,
or **repeatable business tasks**,
that can be accessed when needed **over a network**.

Source: [https://
www.ibm.com/
developerworks/
webservices/newto/](https://www.ibm.com/developerworks/webservices/newto/)

Basic questions in SSMED

Science of Service Systems

... to improve understanding, map natural history, validate mechanisms, make predictions.

- Service system entities?
 - Their evolution?
 - Their interactions? Influencing their shape?

Management of Service Systems

... to improve capabilities, define progress measures, optimize investment strategy.

- Invest to create, improve, scale?
- Measures of quality, productivity, compliance, sustainability

SOA

```
graph TD; S[Science of Service Systems] -- "?" --> SOA((SOA)); M[Management of Service Systems] -- "?" --> SOA; E[Engineering of Service Systems] -- "?" --> SOA; D[Design of Service Systems] -- "?" --> SOA;
```

Engineering of Service Systems

... to improve control, optimize resources

- New technologies, environmental infrastructures or reconfiguration of existing?
- Tools?

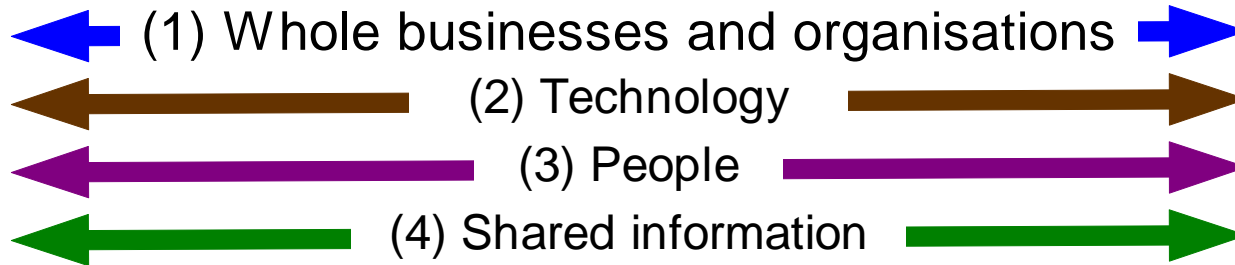
Design of Service Systems

... to improve experience, explore possibilities

- How to improve the experience of people?
- Possible value propositions?
Governance mechanisms?

Reference: Jim Spohrer and Stephen K. Kwan, "Service Science, Management, Engineering, and Design (SSMED): An Emerging Discipline – Outline and Reference", *International Journal of Information Systems in the Service Sector*, forthcoming

Develop T-shaped professionals along 4 resource types



Studied primarily by schools of management (marketing, operations management, operations research and management sciences, supply chain management, innovation management)

Studied primarily by schools of science and engineering (industrial engineering, computer science, statistical control theory)

Studied primarily by schools of information (communications, management information systems, document engineering, process modelling, simulation)

Studied primarily by schools of social sciences and humanities (economics, cognitive science, political science, design, humanities and arts)

Source: IfM and IBM 2008.

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Knowledge of service systems benefits from disciplines

(page 1 of 3)

<i>Academic disciplines</i>	(1) Whole businesses and organizations	(2) Technology	(3) People	(4) Shared information
Architecture and designed systems	x	x	x	x
Behavioral sciences and education			x	x
Cognitive science and psychology	x	x	x	x
Complex adaptive systems theory		x		x
Computer science and AI/web services		x		x
Computer supported cooperative work	x	x	x	x
Economics and law	x		x	x
Engineering economics and management	x	x		x
Experience design, theatre and arts			x	
Financial and value engineering	x	x	x	x
Game theory and mechanism design			x	x
Human resource management	x		x	

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

Knowledge of service systems benefits from disciplines

(page 2 of 3)

<i>Academic disciplines</i>	(1) Whole businesses and organizations	(2) Technology	(3) People	(4) Shared information
Industrial engineering (IE) and systems	x	x	x	x
Industrial and process automation	x	x	x	x
International trade	x			
Knowledge management	x	x	x	x
Management of information systems	x	x	x	x
Management of technology and innovation	x	x	x	x
Marketing and customer knowledge	x	x	x	x
Mathematics and non-linear dynamics	x	x	x	x
Operations management (OM)	x	x	x	x
Operational research (OR)	x	x	x	x
Organisation theory and learning	x	x	x	x
Political science	x		x	

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

Knowledge of service systems benefits from disciplines

(page 3 of 3)

<i>Academic disciplines</i>	(1) Whole businesses and organizations	(2) Technology	(3) People	(4) Shared information
Project management	x	x	x	x
Queuing theory	x	x	x	x
Simulation, modelling visualization	x	x	x	x
Sociology and anthropology	x	x	x	x
Software metrics and development		x		
Statistical control theory		x		x
Strategy and finance	x	x	x	x
Supply chain management	x	x		x
System design and software architecture		x		
Systems dynamics theory and design	x	x	x	x
Total quality management, lean six sigma	x	x	x	x

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

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Recommendations for education

- 1 Enable graduates from various disciplines to become **T-shaped professionals**, who are adaptive innovators with a service mindset and can make early contributions to the service-driven economy.
- 2 Promote **SSME education programmes and qualifications** as a way of developing a **service mindset**, in conjunction with industry recognition and recruitment of SSME qualified graduates.
- 3 Develop a **modular template-based SSME curriculum** in higher education, add new materials and refinements as research develops over time, and then extend to all levels of education.
- 4 Explore **new teaching methods** for SSME related education.

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

Recommendations for research

- 1 Develop an **inclusive interdisciplinary and intercultural approach** to service research.
- 2 **Build bridges** between disciplines through **grand research challenges**.
- 3 Establish **service system** and **value proposition** as **foundational** concepts.
- 4 Work with practitioners to **create data sets** to better understand the nature and behaviour of service systems.
- 5 Create **modelling and simulations tools** for service systems.

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

Recommendations for business

- 1 Establish **employment policies and career paths** for T-shaped professionals.
- 2 Review existing approaches to service innovation and provide **grand challenges** for **service systems research**.
- 3 Provide **funding** for **service systems research**.
- 4 Develop appropriate organisational arrangements to enhance **industry-academic collaboration**.
- 5 Work with stakeholders to include **sustainability measures** and create **actionable service innovation roadmaps**.

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

Recommendations for government

- 1 Promote service innovation for all parts of the economy and provide funding for SSME education and research.
- 2 Demonstrate the value of Service Science to government agencies, and thereby create methods, data sets, and tools to inform and challenge current education and research support.
- 3 Develop relevant measurements and reliable data on knowledge-intensive service activities across sectors to underpin leading practice for service innovation.
- 4 Make government service systems more comprehensive and citizen-responsive.
- 5 Encourage public hearings, workshops, briefings with other stakeholders to develop service innovation roadmaps.

Source: IfM and IBM. (2008). *Succeeding through Service Innovation: A Service Perspective for Education, Research, Business and Government*. University of Cambridge Institute for Manufacturing, available at <http://www.ifm.eng.cam.ac.uk/ssme/>

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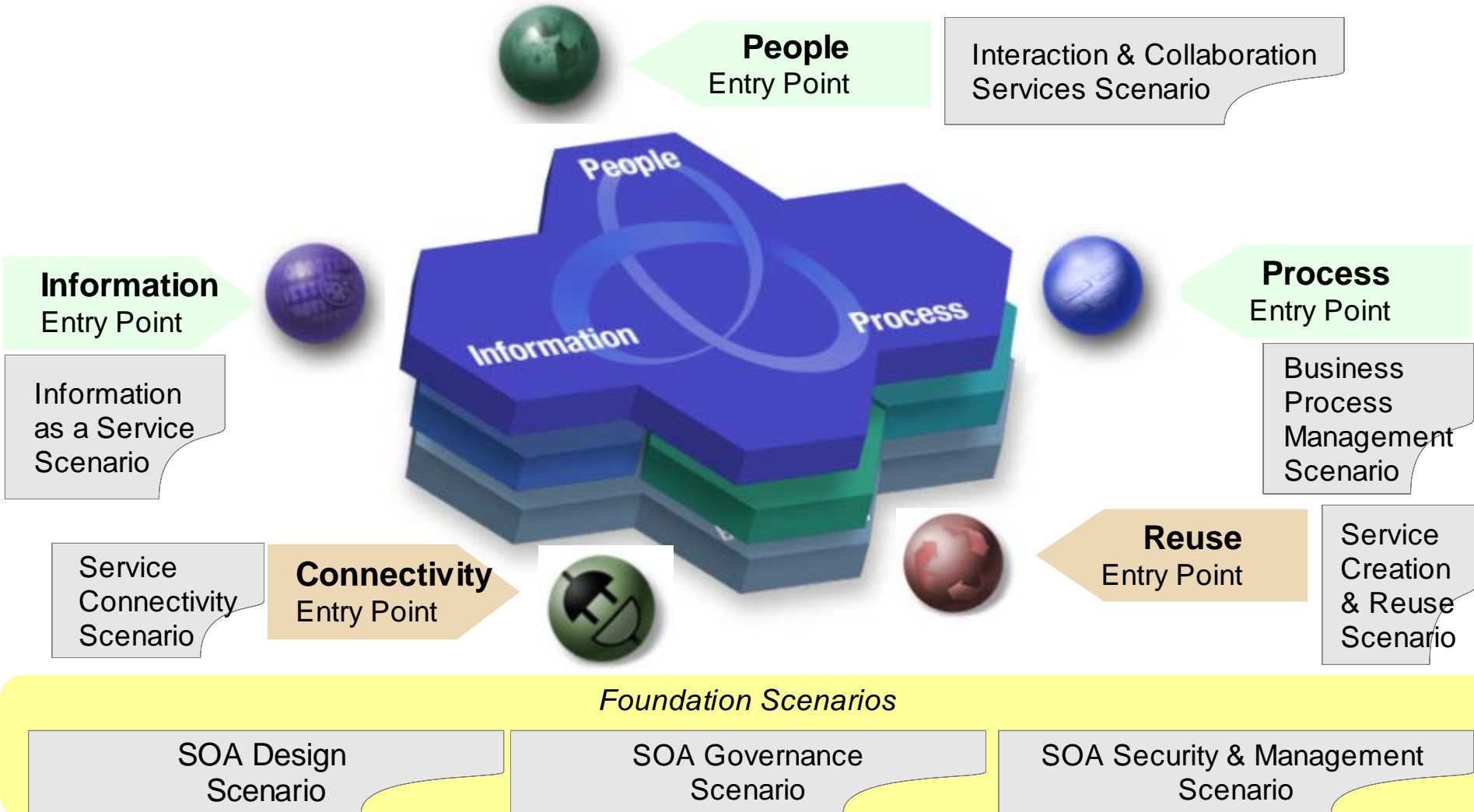
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Entry points

8 scenarios lead to 5 entry points – 3 business-focused and 2 IT-focused



Reference: <https://www.ibm.com/developerworks/webservices/newton/>

A challenge

a
[?]
system

... to ...

a service system

... as ...

[?]
architecture

... to ...

service-oriented
architecture

A challenge: *transition (or transformation)*

The transition from ...

a

[industrial?]
[production?]
system

... to ...

a service system

... is as significant ..

... as ...

[integrated?]
[procedural?]
[object-oriented?]
architecture

... to ...

service-oriented
architecture



Coevolving Innovations

... in Business Organizations and Information Technologies

Innovation as open, collaborative, multidisciplinary, global

Posted by [daviding](#) on June 13, 2008 under [innovation](#) [Edit This](#)

On more than one occasion, I've heard IBM executives assert:

“ The nature of innovation has changed. In the 21st century, innovation is *open, collaborative, multidisciplinary* and *global* .

The ideas of *open, collaborative, multidisciplinary* and *global* appeared in the [Global Innovation Outlook 2.0 report](#) that was published in mid-2006. These words appeared on IBM-internal slides presented by [Nick Donofrio](#) at an *Consulting Leadership Exchange* in September 2005, and at the external-facing conference on [Education for the 21st Century in October 2006](#) ... with lots of other occasions in between. But what do these four words mean?

To make some sense for myself, I've extended these words into phrases and contrasted their contexts in a table .

	<i>Industrial age nature of innovation</i>	<i>21st century nature of innovation</i>
--	--	--

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