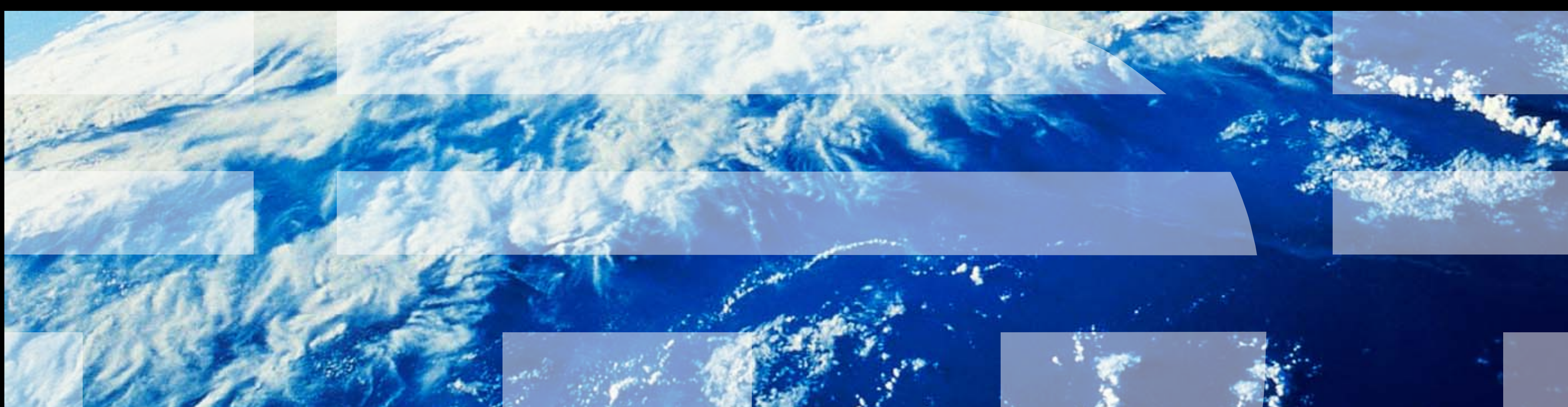
Steve Street
IT Architect, UKI New Business, IBM

Towards a Smarter Planet:

Sensors, Complex Service Systems & Service Science ..



Service Science and Innovation Doctoral Colloquium
22-23 March 2010, Staffordshire University

Goal

- Talk about the ‘Smart Planet’ initiative, what it means and why it’s significant
- Talk about its connections to ‘Service Science’, why Service Science is important
- Discuss the current state of play for ‘Service Science’ ..and how we make the ‘Smarter Planet’ connection

Globally .... Tough Problems …

- 40 - 70 percent of electrical energy is lost due to inefficiencies in the grid.
- In one small business district in Los Angeles alone, cars burned 47,000 gallons of gasoline just looking for parking.
- Consumer products and retail industries lose about $40 billion annually due to inefficient supply chains.
- In a world where 820 million people are undernourished, $48 billion worth of food is thrown away each year in the US.
- Our healthcare “system” can’t link from diagnosis to drug discovery, providers, insurers, employers and patients.
- Financial markets spread risk but can’t track it; this has led to undermined confidence and uncertainty.

Here in UK …

£2.5 Billion

Wasted in energy bills by UK companies due to inefficiencies such as draughty windows and leaving lights and computers switched on

£7-8 Billion

Estimated annual cost of road congestion to the UK economy year

8 months

Reduction in life span for a UK citizen due to poor air quality

1 Third

Amount of purchased food UK consumers throw away

76%

Apples consumed in the UK that come from overseas traveling on average 3700 miles to reach us

‘Human Problems’ – What is Progress ?

‘What is Progress ?’

http://www.youtube.com/watch?v=-IRzfLDmnsA

But at this time something meaningful is happening

The world is
SMALLER.

The world is
FLATTER.

The world is about to get a whole lot
SMARTER.

We now have the ability to measure, sense and monitor the condition of almost everything.

30 billion

By 2010, 30 billion RFID tags will be embedded into our world and across entire ecosystems.

1 billion

By 2010, there will be more than 1 billion camera phones in existence.

85%

Nearly 85% of new automobiles will contain event data recorders by 2010.

Instrumented Interconnected Intelligent

People, systems and objects can communicate and interact with each other in entirely new ways.

2 billion

There will be an estimated 2 billion people on the internet by 2011.

4 billion

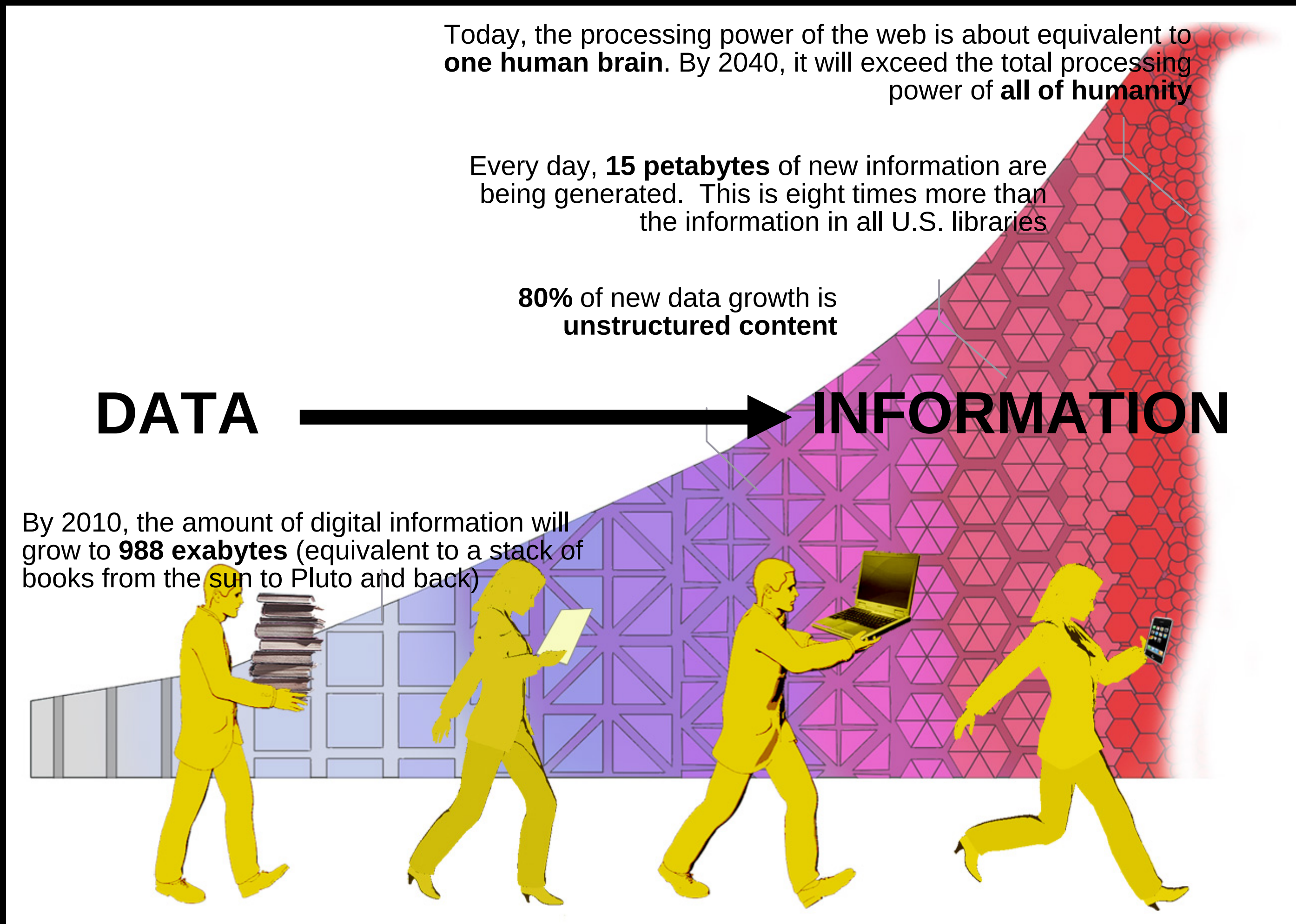
There are an estimated 4 billion mobile phone subscribers worldwide.

1 trillion

Soon, there will be 1 trillion connected devices in the world, constituting an “internet of things.”

Instrumented Interconnected Intelligent

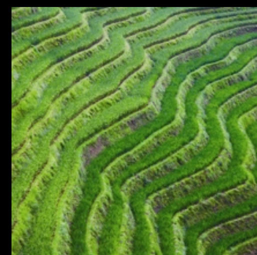
The growing volume, variety, and granularity of information is driving new, unprecedented complexity

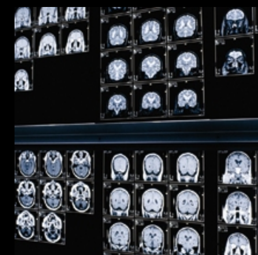


The world is getting smarter: **some examples**


Smart traffic systems

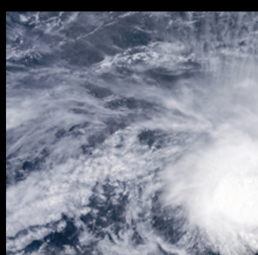

Intelligent oil field technologies


Smart food systems


Smart healthcare

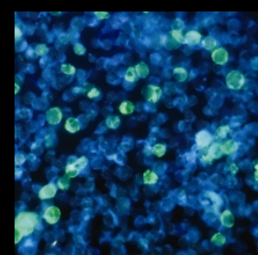

Smart energy grids


Smart retail


Smart water management


Smart supply chains

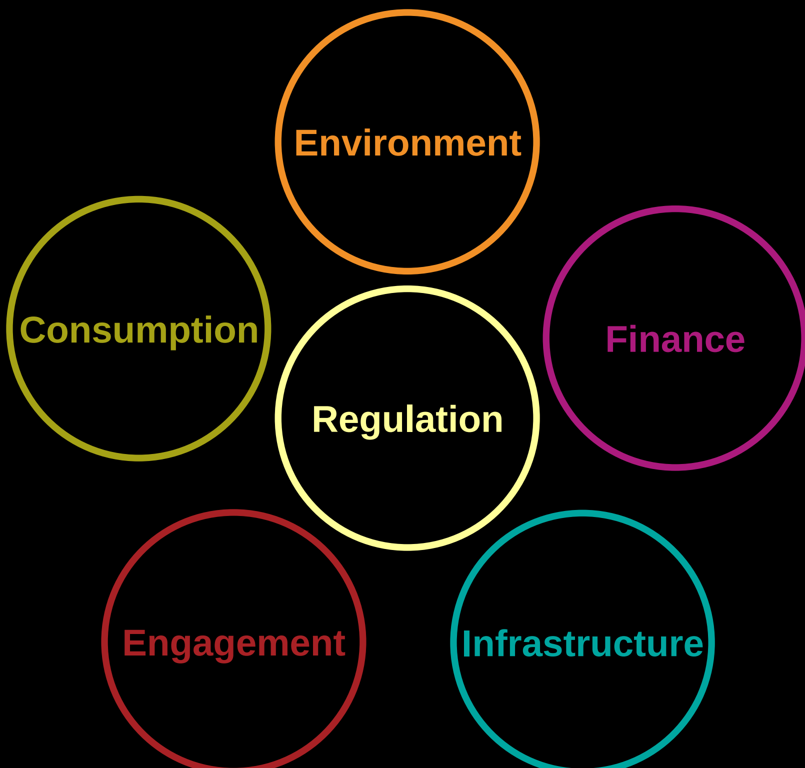

Smart countries


Smart weather


Smart regions


Smart cities

Electricity faces a set of **interrelated challenges** that cannot be addressed one-by one



- Reducing the environmental impact of our energy production and use – CO_2 emissions, particulates and water usage
- Curbing consumption growth and improving energy efficiency whilst increasing production in the face of scarce resources
- Engaging consumers and businesses in playing an active role in managing their energy production and use
- Replacing aging infrastructure and assets and rapidly maturing and scaling clean technologies to build a new, dynamic system
- Changing financial mechanisms governing energy to provide efficiency incentives and improving return on “cleantech”
- Evolving regulation to cater for the changed shape of the industry and its increasing interconnection with other industries

The need, opportunity and mandate for smarter electricity are clear

32%

Proportion of UK electricity to come from renewable sources in 2020 to meet climate change targets.

In 2007, only 5% came from renewable sources.(1)

2016

When UK electricity demand will exceed the capacity of present power stations.

New plants under construction only delay this date until 2020.(2)

47 GW

8 GW of new generation capacity required to meet demand by 2020. 47 GW required to meet demand and meet renewable generation targets.

Presently 9 GW under construction.(3)

£100

The amount, on top of inflation, which an average annual household electricity bill went up by between 2004 and 2008 in England and Wales.

This is a 44% increase in real terms.(4)

47m

The number of smart electricity and gas meters to be installed in Britain's homes by 2020.

Smart metering should help reduce domestic electricity demand by 2.3%.(5)

26%

Increase in generation if half of Britain's passenger cars were powered by electricity.

Meeting this demand through nuclear power would require 10 new reactors.(6)

CEOs understand the challenge facing utilities in UK & Ireland

Lack of investment

66% are not confident that the necessary levels of investment made in water and energy in the next 5-10 years will meet future needs.

Cost of capital

91% believe that the regulator may be over-optimistic in its judgement about the cost of capital in the forthcoming pricing reviews.

Consumer debt

68% are concerned that utilities will themselves be affected by ‘bad debt’ increasing among cash-strapped consumers.

Reducing demand peaks

60% believe smart networks would help smooth peaks in demand and 55% believe it would help allocate network capacity more effectively.

Smarter technology

89% would like to see the ‘agenda set’ for smart technologies, including smart metering.

Government led

74% would like to see the UK adopt the kind of Government-led investment now being made in the US.

Reference: Market Force Survey for IBM, 2009

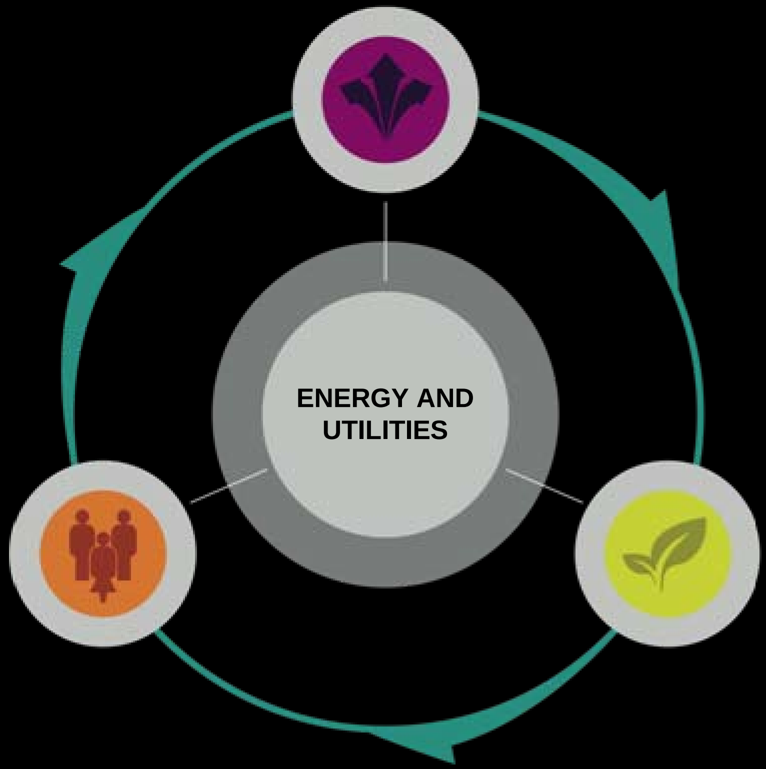
To deliver power more responsibly and more efficiently, energy and utilities organizations are working toward a smarter energy value chain.

TRANSFORMATION OF THE GRID

Transforming the grid from a rigid analog system to a dynamic and automated energy delivery system.

EMPOWERMENT OF CONSUMERS

Empowering consumers by providing them with near real-time, detailed information about their energy usage.



REDUCTION OF GREENHOUSE GAS EMISSIONS

Meeting stringent greenhouse gas emissions targets while maintaining sufficient, cost-effective power supply.

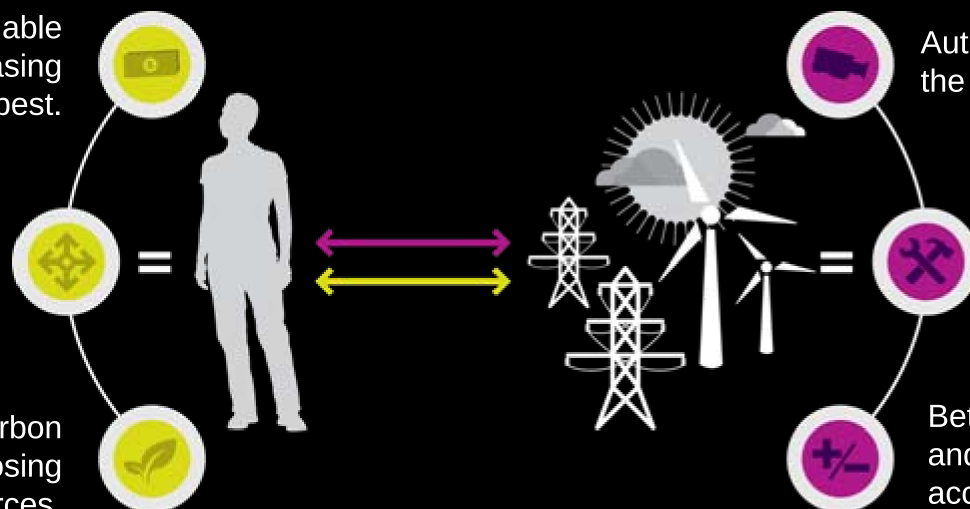
Having access to real-time information about the flow of energy in the grid enables utilities and consumers to make smarter, more responsible choices.

CONSUMERS

Take advantage of variable pricing by purchasing electricity when it's cheapest.

Generate their own electricity and sell it back to the grid.

Decrease carbon emissions by choosing clean electricity sources.



UTILITIES

Automatically monitor the health of the grid.

Remotely sense damage to grid assets and dispatch repair crews.

Better predict demand and manage supply accordingly.

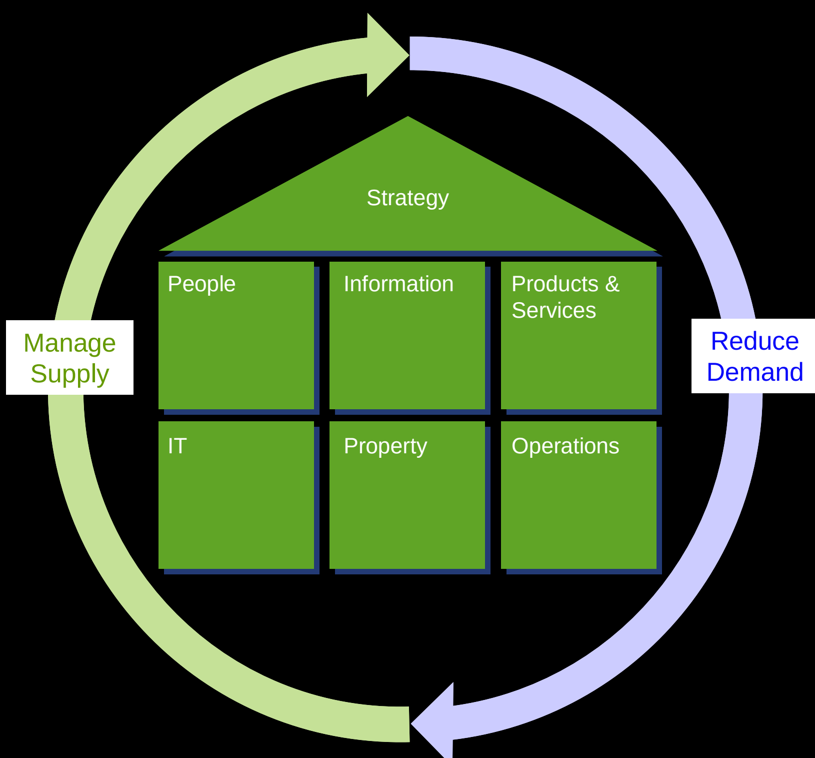
Energy Flow

Information Flow

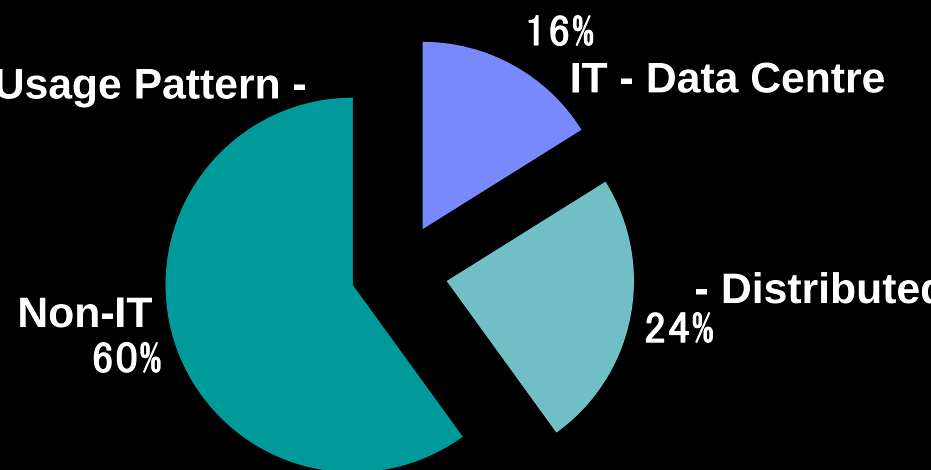
Smarter Electricity - REDUCTION OF GREENHOUSE GAS EMISSIONS

Meeting stringent greenhouse gas emissions targets while maintaining sufficient, cost-effective power supply

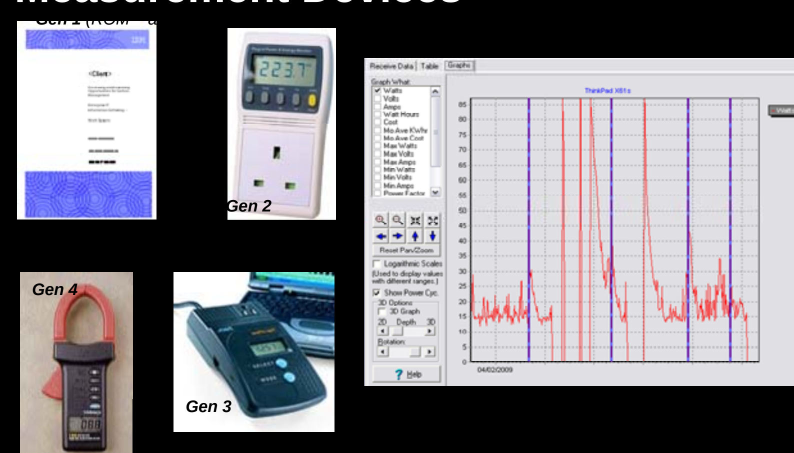
Energy Efficiency Framework -



Usage Pattern -



Measurement Devices -

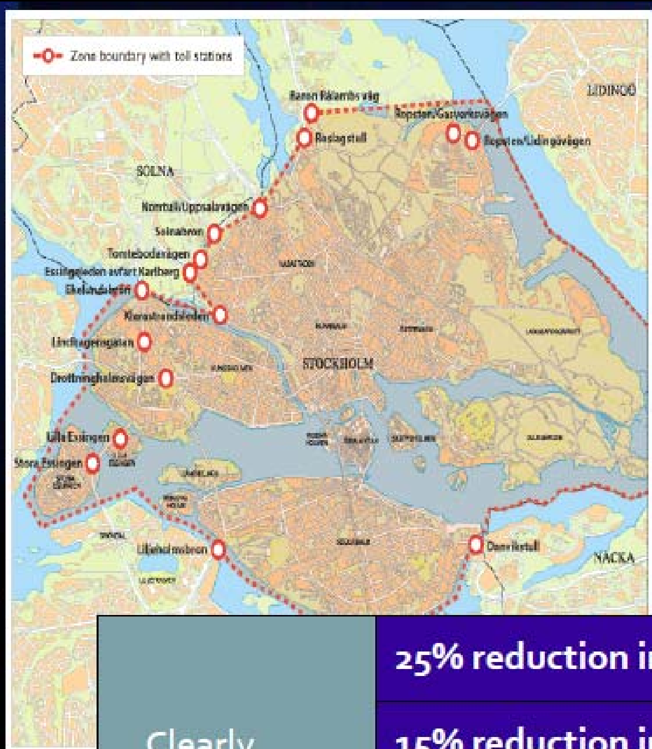


Smarter transportation: Client transformations

Stockholm implemented an intelligent toll system in the city center, which resulted in 20% less traffic, 40% lower emissions and 40,000 additional users of the public transportation system.

To encourage citizens to use multiple modes of transportation and make it easier to align the cost of transit with its impact on the environment, the **Singapore Land Transport Authority** implemented fare management with smart cards that can be used to pay for buses, trains, taxis, road-use charging and parking.

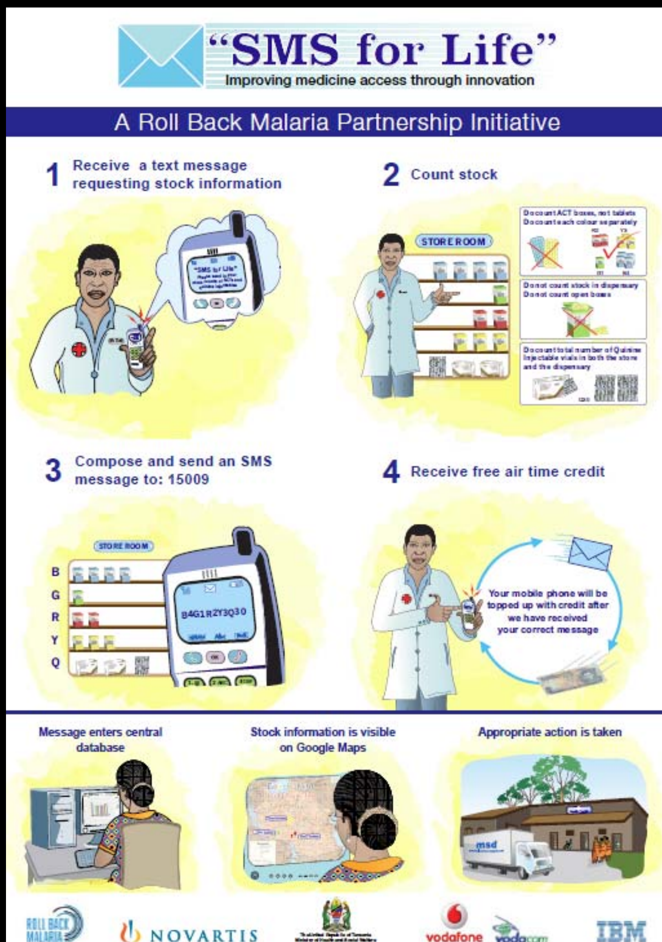
Stockholm Congestion Tax Project (SCTP) - Case Study -



Clearly Measurable Results	25% reduction in traffic entering cordon
	15% reduction in CO_2 emissions
	$120M/yr in revenue to City of Stockholm; payback in 4 years
	Congestion charges will fund transit improvements

Source: www.stockholmsforsoket.se

Smarter healthcare: Client transformations

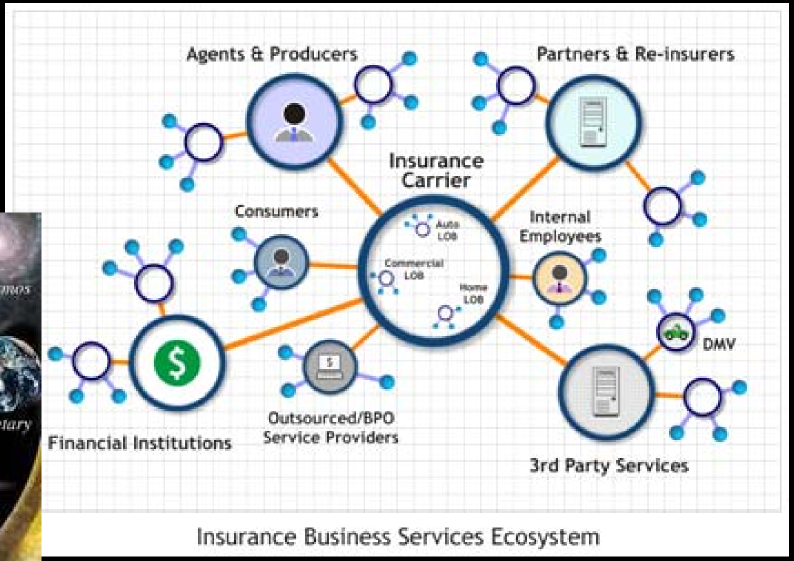


'SMS for Life' – a pilot program in Tanzania under the 'Rollback Malaria' umbrella - is using simple – SMS based - technology to provide Medical Districts with accurate information *for the first time* re: stocks of necessary drugs

So what's the Connection to Service Science.. ?

At their heart the majority of these challenges are dependent on complex, engineered, service systems

Unravelling and understanding complex systems is a foundation stone for SSME, from which better services concepts, implementation and management models and tools can be developed.



"People-Oriented, Services-Intensive, Market-Facing Complex Systems – *complex systems* and *services* – are very similar areas around which we are framing the very complicated problems of business and societal systems that we are trying to understand."
– Irving Wladawsky-Berger, IBM VP Innovation (Oct. 9, 2006)

..subject matter

So what's the Connection to Service Science ?

'Smart Planet' is ..

- **Real**
- **Non-Transient**
- **Problems of**
- **Direct Interest to Business**
- **That force a 'multi-dimensional' approach to solve them**
- **That need new 'integrative' Skills**
- **& offer the opportunity for new / 'transdisciplinary' techniques**

- **New Problems**
  - New Connections to new Value Systems /
    Expanding the 'Problem Space'…
- **New Solutions**
  - Expanding the 'Innovation Space'
- **New Approaches**
  - Across the Board / Collaborative
- **New Techniques**
  - Business Analytics..

..the opportunity to make a difference ..

Summary

- **The changing economic, political and business landscape makes service innovation an imperative.**

- **Service innovation requires a better understanding of service systems, but the knowledge and skills required are not readily available.**

- **Business, government and academia need to work together towards an interdisciplinary approach to research and education.**

So where is Service Science Today ?

- **SSME is an urgent call to action to get more systematic about service innovation**
- **SSME is also a proposed academic discipline and the basis for a proposed new profession – the service scientist**
- **SSME is also a proposed research area, the study of service systems**
- **SSME is highly multidisciplinary and spans areas of science, engineering, and management**
- **To oversimplify:**
  - Science is a way to transform data about service systems into knowledge
  - Engineering transforms the knowledge into new value
  - Management continuously improves the end-to-end value creation process and directs investment

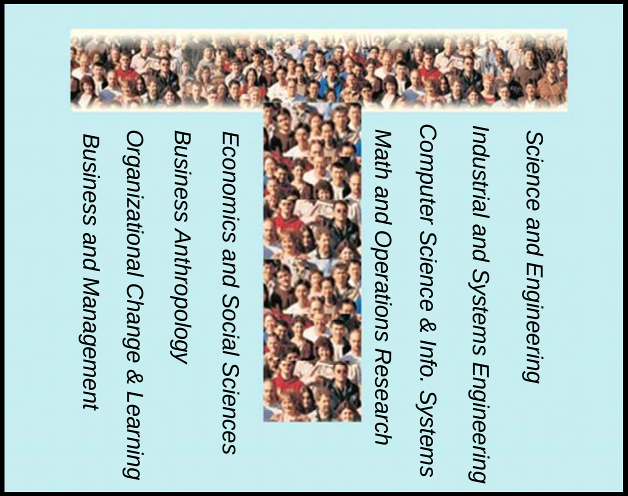
..opportunity to build on success..

Service Science Today:

The 21st Century Demands Uniquely-Skilled People

- Cross-disciplinary programs and degrees
- Fusing technical competency with industry-specific knowledge and business-process expertise
- Success requires open collaboration among academia, government and industry
- To transform how the pipeline of future skills is built

Service Scientists: Adaptive Innovators



"Need I-shaped, T-Shaped people …" Stuart Feldman (Oct 6, 2006)

So where is Service Science going ? One Theme ..

Changing Nature of STEM Education – 2 initiatives -

STEM
Science
Technology
Engineering
Mathematics

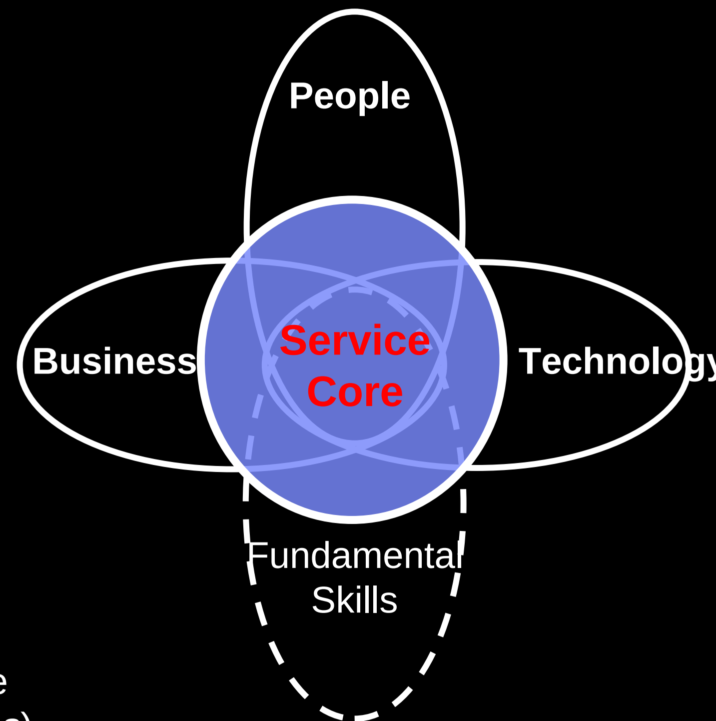
Teach as
Four disciplines

→

STEM^{2D}	
Natural Sciences	Social Sciences
Technology (physical)	Technology (social)
Engineering	Environment, Economics & Law
Mathematics	Management

Teach as a single integrated transdiscipline
(2D = 2-Design *improved SP service systems*)

'STEM2D'



'A Framework for Service Science Curricula'

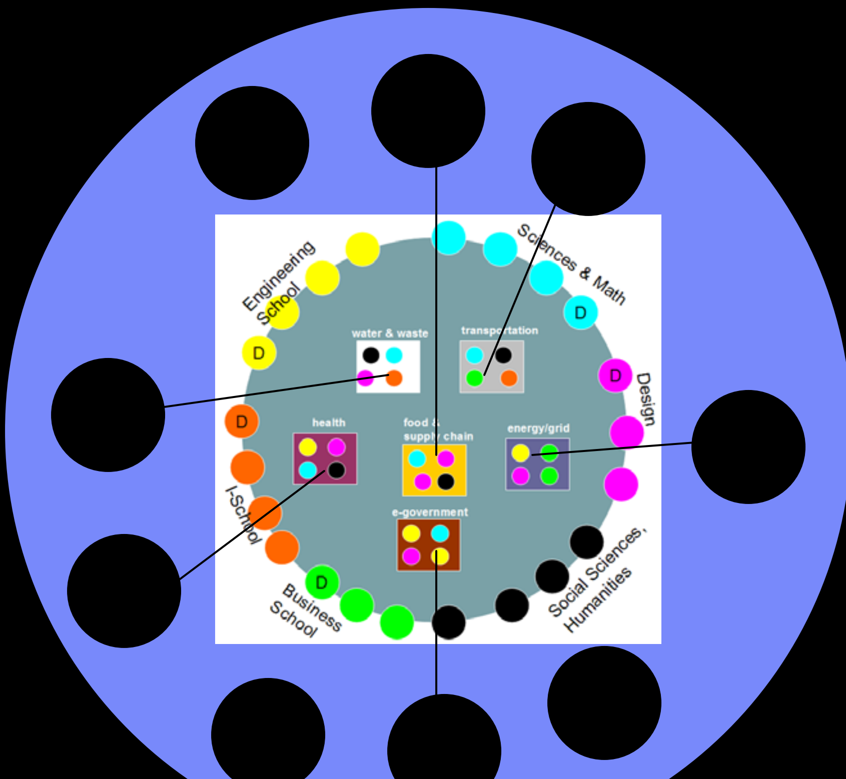
.. need for new skills

So where is Service Science going ?

.. Collaboratories

Universities as “~~Living Labs~~” / Connection Points – Industry / Academia …

Urban serving research university “tries out” innovations that could improve the host city



Run | Transform | Innovate

connect
and
share
innovations

Other cities with urban serving research universities inside

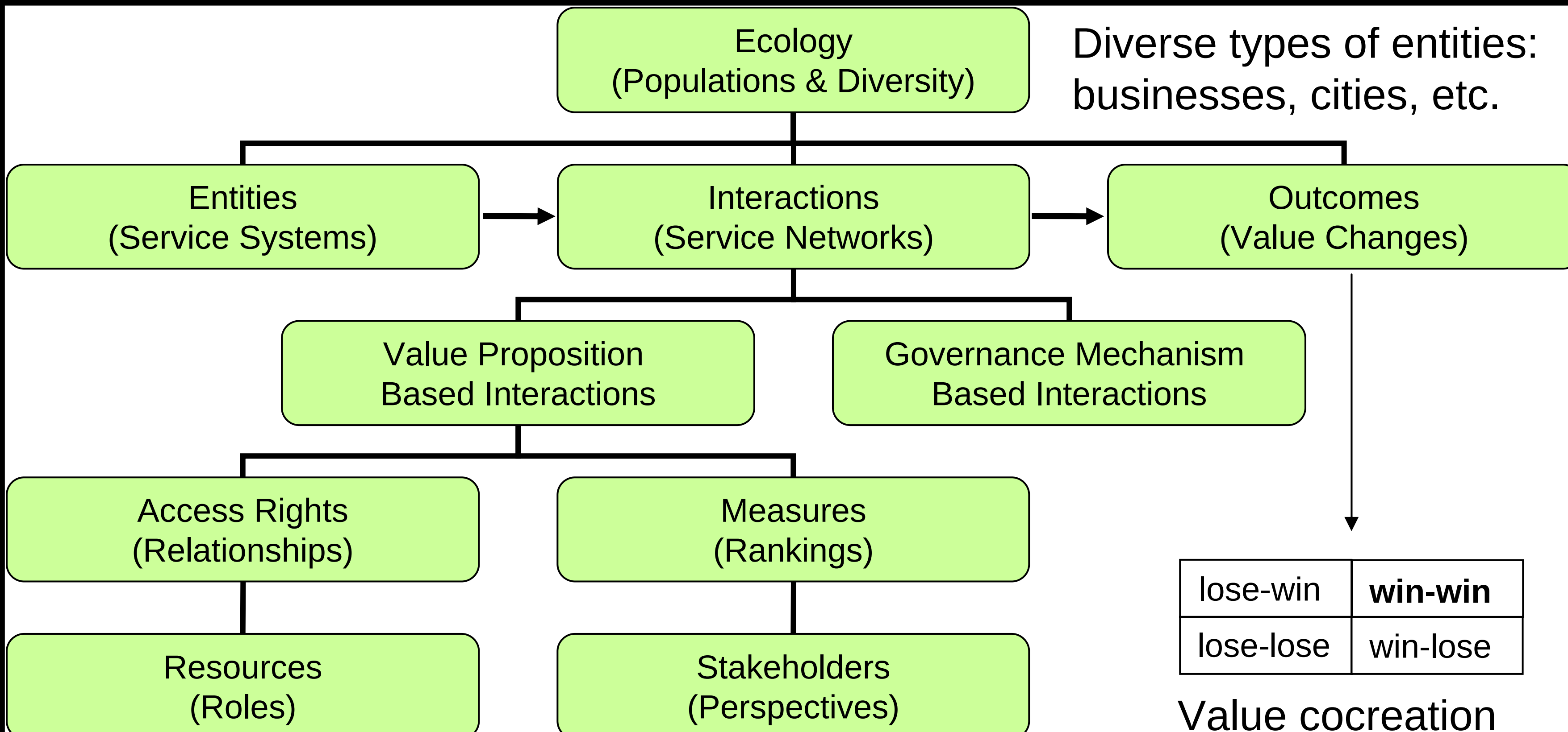
CityCountry	World Rank	2008 estimate	Area extent (sq km)
TOKYO, Japan	1	34,400,000	7,835
JAKARTA, Indonesia	2	21,800,000	2,720
New York (NY), United States	3	20,090,000	11,264
SEOUL, South Korea	4	20,010,000	1,943
MANILA, Philippines	5	19,550,000	1,425
Mumbai (Bombay), India	6	19,530,000	777
Sao Paulo, Brazil	7	19,140,000	2,590
MEXICO CITY, Mexico	8	18,430,000	2,137
Delhi, India	9	18,000,000	1,425
Osaka, Japan	10	17,270,000	2,720
CAIRO, Egypt	11	16,750,000	1,269
Kolkata (Calcutta), India	12	15,010,000	984
Los Angeles (CA), United States	13	14,730,000	5,812
Shanghai, China	14	14,460,000	2,396
MOSCOW, Russia	15	13,260,000	4,533
BEIJING (PEKING), China	16	12,770,000	2,616
BUENOS AIRES, Argentina	17	12,390,000	2,590
Guangzhou, China	18	11,810,000	2,590
Shenzhen, China	19	11,710,000	1,295
Istanbul, Turkey	20	11,220,000	1,256

.. need to collaborate

So where is Service Science going ?

IBM

Attempts to define Foundational Concepts -



Value cocreation
is a possible outcome

Spohrer, J. & Maglio, P. P. (2009). Service science: Toward a smarter planet
in W. Karwowski & G. Salvendy (Eds.), *Introduction to service engineering*.

..become a science

Service Science Emerging:

Resources: Building blocks of entities

First foundational premise of service science:

Service system entities dynamically configure (access) four types of resources.

The named resource is
either
Physical
or
Not-Physical
(physicists resolve disputes)

The named resource has
either
Rights
or
No-Rights
(judges resolve disputes within their jurisdictions)

	Physical	**Not-Physical**
Rights	1. People	2. Organizations
No Rights	3. Technology/ Environment	4. Shared Information

Formal service systems can contract
Informal service systems can promise/commit

Trends & Countertrends (evolve/augment):
(feelings/patterns) Informal <> Formal (language/symbols)
(unmonitored) Social <> Economic (monitored)
(leaders/personal) Political <> Legal (laws/impersonal)
(human) Cognitive Labor <> Computation (machine)
(human) Physical Labor <> Technology (machine)
(atoms) Transportation <> Communication (bits)
(tacit) Qualitative <> Quantitative (explicit)

Service Science Emerging:

Value Propositions: Building blocks of interaction networks

Second foundational premise of service science:

Service system entities calculate value from multiple stakeholder perspectives

A value propositions can be viewed as a request from one service system to another to run an algorithm (the value proposition) from the perspectives of multiple stakeholders according to culturally determined value principles.
The four primary stakeholder perspectives are: customer, provider, authority, and competitor

Value propositions coordinate & motivate resource access

Stakeholder Perspective (the players)	Measure Impacted	Pricing Decision	Basic Questions	Value Proposition Reasoning
1.Customer	Quality (Revenue)	Value Based	Should we? (offer it)	Model of customer: Do customers want it? Is there a market? How large? Growth rate?
2.Provider	Productivity (Profit)	Cost Plus	Can we? (deliver it)	Model of self: Does it play to our strengths? Can we deliver it profitably to customers? Can we continue to improve?
3.Authority	Compliance (Taxes and Fines)	Regulated	May we? (offer and deliver it)	Model of authority: Is it legal? Does it compromise our integrity in any way? Does it create a moral hazard?
4.Competitor (Substitute)	Sustainable Innovation (Market share)	Strategic	Will we? (invest to make it so)	Model of competitor: Does it put us ahead? Can we stay ahead? Does it differentiate us from the competition?

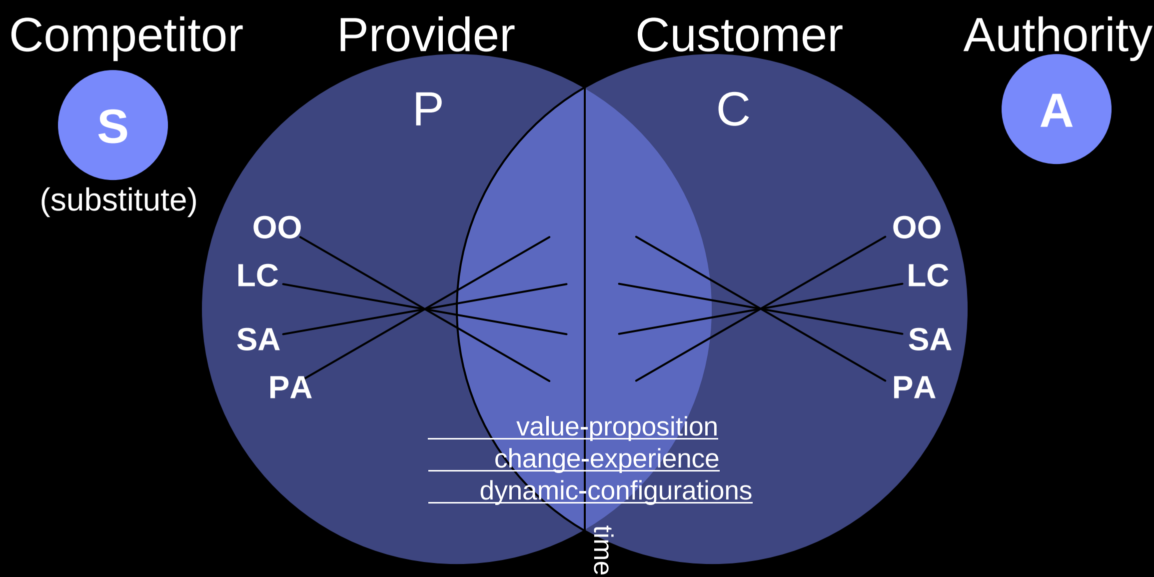
Service Science Emerging:

Access Rights: Building blocks of value propositions

Third foundational premise of service science:

The access rights associated with resources (customer's and provider's) are reconfigured by mutually agreed to value proposition relationships

- Access rights
  - Access to resources that are owned outright (i.e., property)
  - Access to resource that are leased/contracted for (i.e., rental car, home ownership via mortgage, insurance policies, etc.)
  - Shared access (i.e., roads, web information, air, etc.)
  - Privileged access (i.e., personal thoughts, inalienable kinship relationships, etc.)



service = value cocreation

B2B
B2C
B2G
G2C
G2B
G2G
C2C
C2B
C2G
***

provider resources
Owned Outright
Leased/Contract
Shared Access
Privileged Access

customer resources
Owned Outright
Leased/Contract
Shared Access
Privileged Access

Service Science **Emerging:**

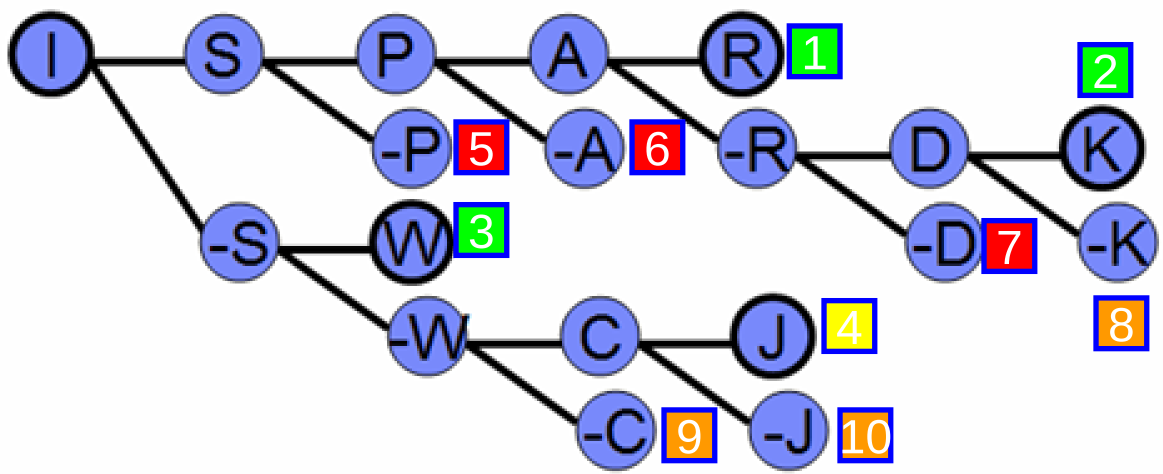
Outcomes (ISPAR*): Results of entities interacting

- Four possible outcomes from a two player game

Provider	Customer: Lose	Customer: Win
Win	lose-win (coercion)	win-win (value-cocreation)
Lose	lose-lose (co-destruction)	win-lose (loss-lead)

- ISPAR generalizes to ten possible outcomes
  - win-win: 1,2,3
  - lose-lose: 5,6, 7, maybe 4,8,10
  - lose-win: 9, maybe 8, 10
  - win-lose: maybe 4

ISPAR descriptive model



I = Interaction
S = Service interaction
-S = Not a service interaction
P = Proposal communicated
-P = Proposal not communicated
A = Agreement
-A = Agreement not reached
R = Realized value co-creation
-R = Not realized value co-creation
(as judged by one or both service systems, or another interested service system stakeholder)

D = Dispute
- D = Not disputed
K = OK resolution for all interested
-K = Not OK resolution for interested
W = Welcome non-service interaction
-W = Not welcome non-service interaction
C = Criminal (illegal) interaction
-C = Not criminal interaction
J = Justice realized
-J = No justice realized

* = Interact-Service-Propose-Agree-Realize (ISPAR)

So what should we do now ? Opportunity -

‘A Smarter Planet ‘ – Implications for Service Science

A focus on Key Real World Problems that **need** an **understanding** of **Service Systems**

- An Opportunity
- A Driver
- A Challenge

The body of Practical Knowledge about Complex Service Systems will be enhanced..

So what should we do now ? Key Next Steps -

Service Science for the Smarter Planet

- **Continue ..**
  – 'Call to Arms'
  – Focus on Service Skills (Development & Curricula)

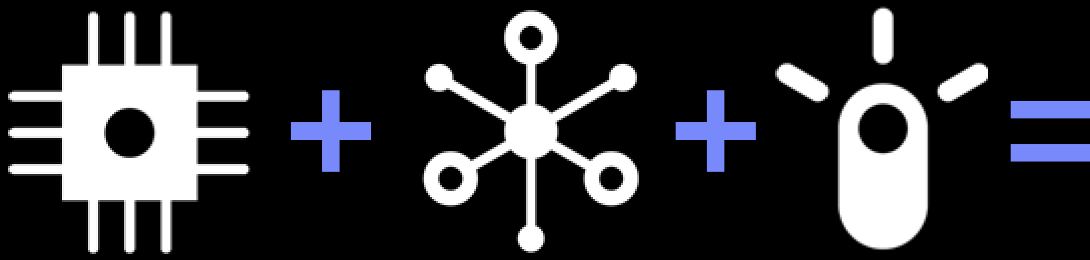
- **Build..**
  – Attempts to build Foundational Paradigms

- **Focus on..**
  – Making Practical Connections between Industry and Academia to exploit emerging Knowledge to help solve real world problems
  – 'Collaboratories'
  – Knowledge Networks …
  – …

For the Smarter Planet -

Success requires new thinking (innovative business models, real-time insights)

instrumented, interconnected and intelligent.



Through collaboration and co-creation building on the emerging Science of ‘Service Science’ we can start to address some of the core challenges in complex service systems

We've only just begun to uncover what is possible on a smarter planet.

The world will continue to become smaller, flatter and smarter. We are moving into the age of the globally integrated and intelligent economy, society and planet.

The question is,
what will we do with it?

And what part will **Service Science** play ?

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- JBS Podcast -
  - http://www.jbs.cam.ac.uk/interactive/mba/2009/podcast_street_services.html

7 Principles of The Way The World Works

1.
MOVING THINGS FROM HERE TO THERE

The science of moving things from here to there - cargo, components in a supply chain, inventory, money, digital bits, policies, even ideas - is the backbone of economic progress, and quality of everyday life.

2.
MAKING THE MOST OF WHAT WE HAVE

A system of any scale - a team, a company, a data center, a city, a nation - contributes most, when it's optimized. An ability to make more from the same elements serves as a vital imperative.

3.
RECOGNIZING PATTERNS

We understand that which we can see and then act on what we can envision. Recognizing patterns in a mountain of data gives you new power to see what is truly going on - from there, you can model what is likely to happen next. Do we want the pattern to continue? Change?

4.
MAKING DECISIONS

As the planet becomes instrumented, interconnected, and intelligent, more and more insight is made available. Rather than guessing or acting on a hunch, this (often) real-time insight gives us the choice of how to make decisions - and when to make them.

5.
CONSERVING TIME AND ENERGY

Ambition is greater than the resources available. The planet now requires that we conserve energy of all types - human energy, use of time, natural resources. We must take waste and inefficiency out of our systems.

6.
PREVAILING OVER OPPOSING FORCES

The world is filled with opposing forces, and virtually every system has opposing forces that keeps it vital. These forces cause the tensions that help any system evolve. That said, prevailing over these forces can be complex.

7.
PARTICIPATING IN SYSTEMS of SYSTEMS

The success of virtually any endeavour of scale requires understanding how these systems interconnect and interplay. Your place, your role, your contribution depends on how clearly you see those systems.

**Note:*

These principles are a first articulation. They will, and should, evolve by tapping into IBM's community of experts on these topics.