

Cloud Computing: Demand-driven Utilities and Business Opportunities in the Hands of Many

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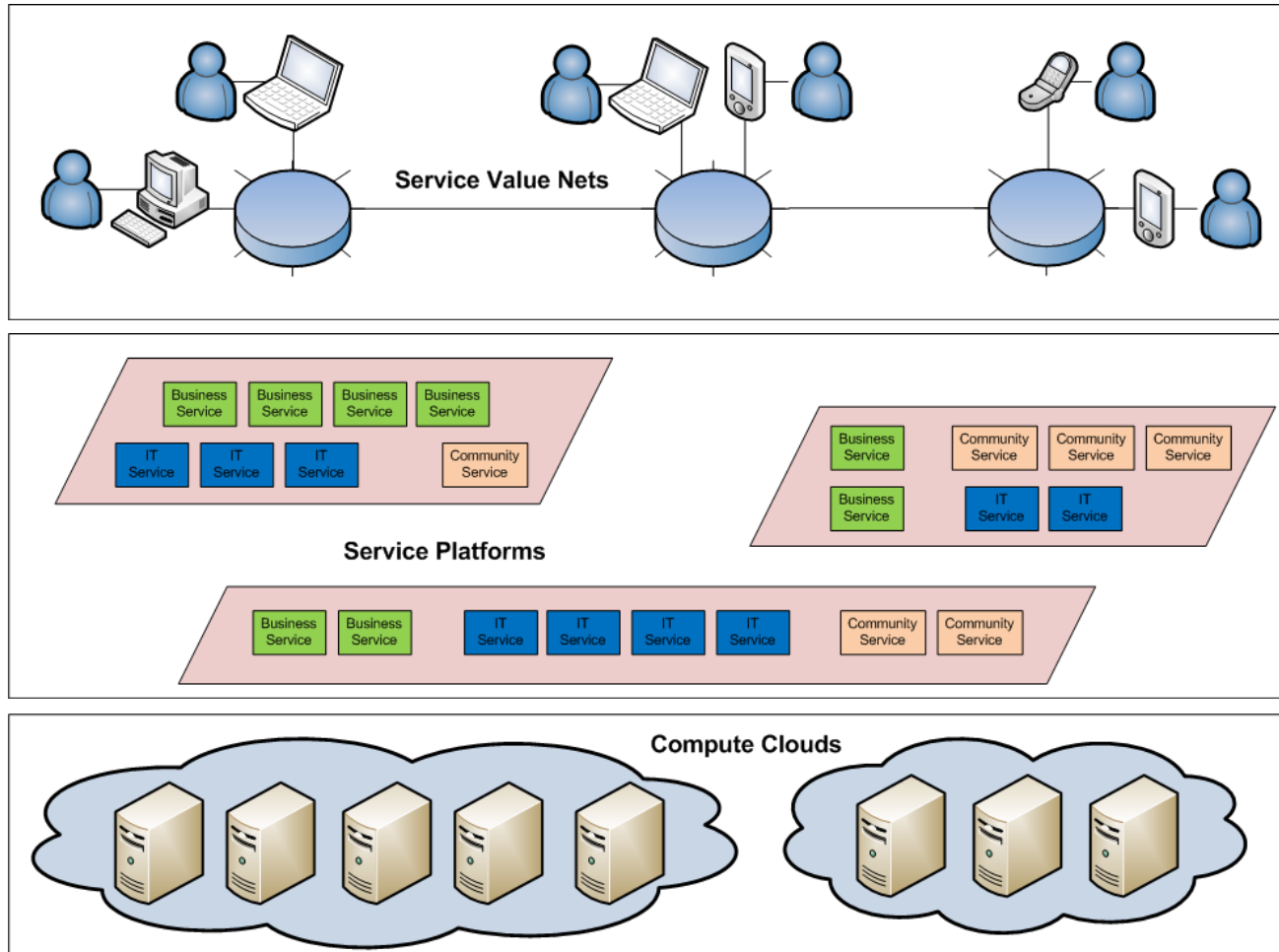
Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft



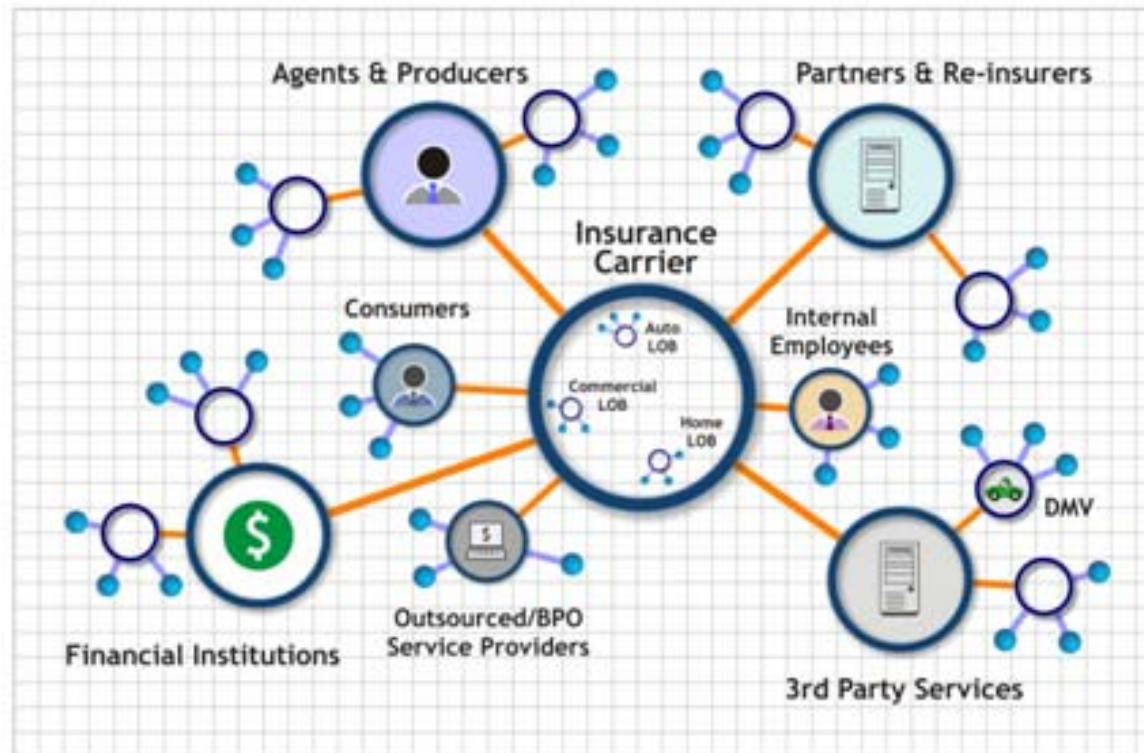
Universität Karlsruhe (TH)
Research University · founded 1825



eOrganization Research

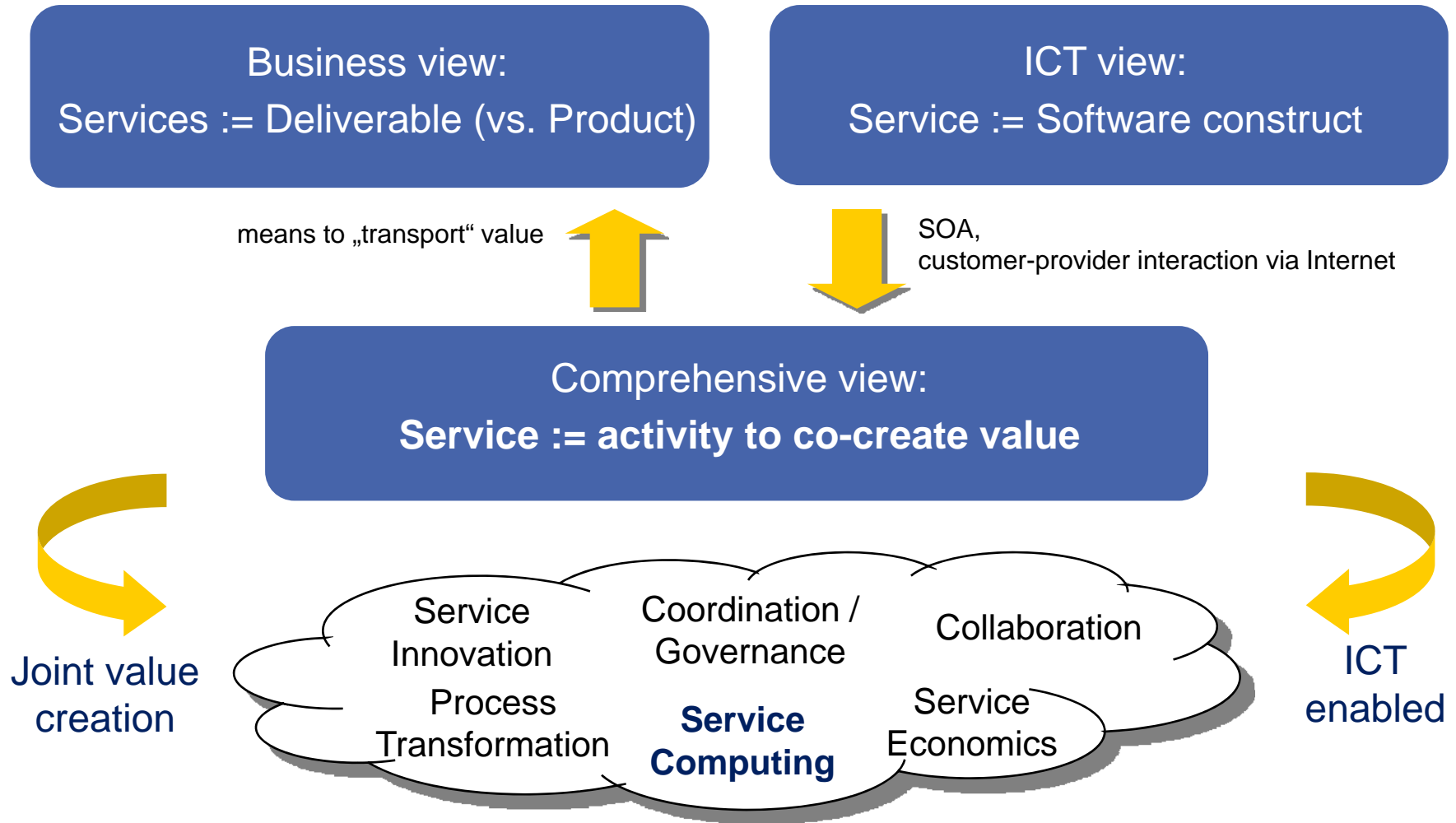


Service Systems are configurations of people, technology and information – connected via value propositions



Insurance Business Services Ecosystem

An Inter-disciplinary Perspective



Agenda

1. Introduction: Cloud Computing
2. Understanding the **Cloud Ecosystem**; understanding business and technical (architectural) challenges
3. Understanding when (and when not) Clouds „compute“ (**TCO** – Total Cost of Ownership)

Why Cloud Computing?

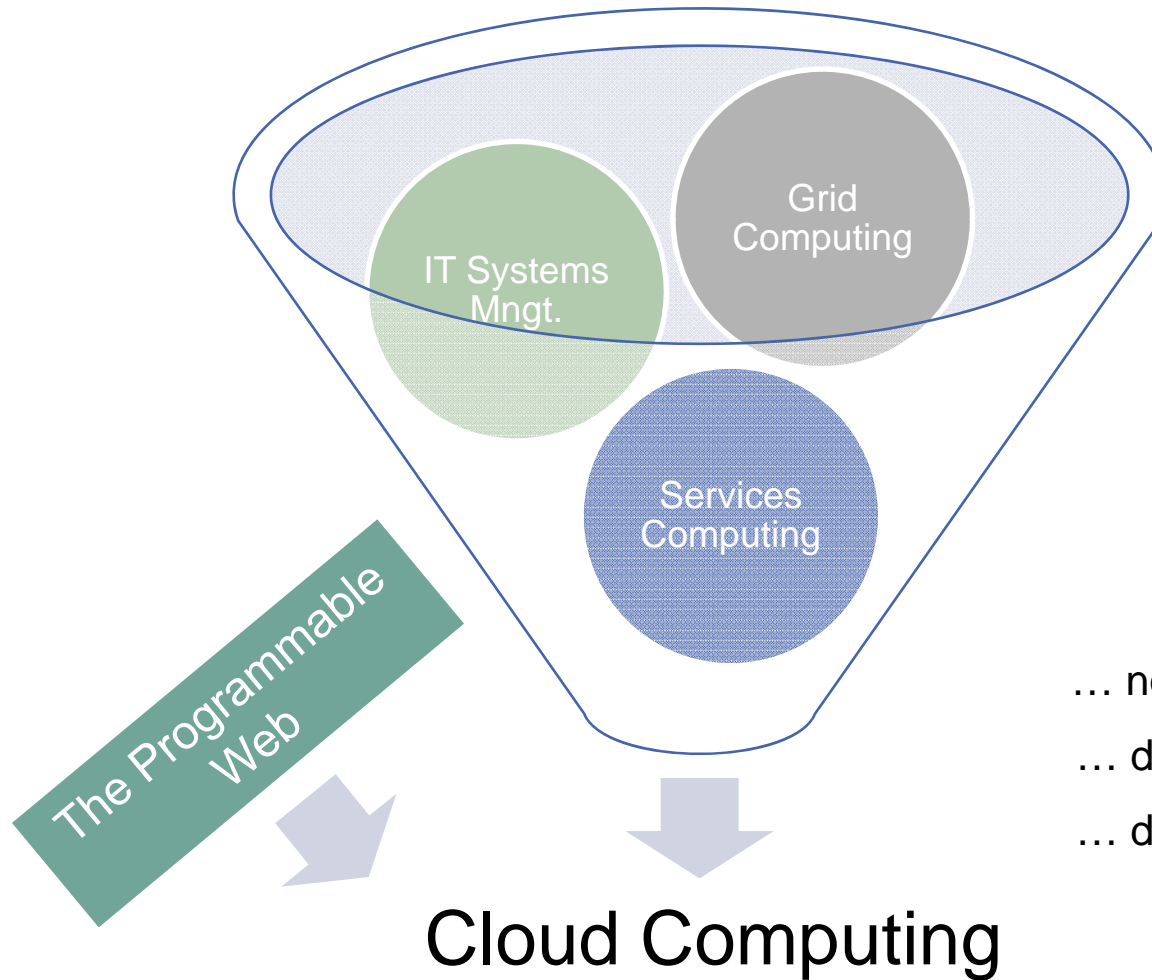
- The **classical** problem
 - Under-utilized server resources waste computing power (and energy)
 - Over-utilized servers cause interruption or degradation of service levels
- The **emerging** problem
 - Highly dynamic scalability demands
 - Time to market
 - Affordable pricing
- Leveraging the **modern Web**
 - Sophisticated infrastructure is available as Services
 - Sufficient bandwidth makes Services a feasible option
 - New mass market for computing utilities

The Economist, October 23 Issue

- **Cloud Computing lowers market barriers, thus enforcing competition and specialisation...**
- **The next wave of business process outsourcing is yet to come...**
- **Hardware is going to be a winner (with declining margins over time), business application vendors will lose, unless they manage to change their business model ...**
- **Netbooks, smartphones and other electronic devices with built-in Internet access are going to be even more successful, allowing users to tap into the cloud wherever they are...**
- **Headlines:**
 - **The long nimbus**
 - **Clouds and judgment**
 - **Computers without borders**
 - **Highs and lows**
 - **On the periphery**
 - **Creating the cumulus**
 - **Where the cloud meets the ground**
 - **Let it rise**



What is Cloud Computing?



- ... no single scientific community
- ... different research foci
- ... different business implications

A Definition

- Building on compute and storage virtualization, and leveraging the modern Web, **cloud computing** provides scalable and affordable compute utilities as on-demand services with variable pricing schemes, enabling a new consumer mass market

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Cloud Computing Players

- Cloud **providers** – raw cloud resources; IaaS (infrastructure-as-a-service)
- Cloud **platform providers** – resources + frameworks; PaaS (platform-as-a-service)
- Cloud **brokers** – help broker some aspect of raw resources and frameworks, e.g.,
 - server managers
 - application assemblers
 - application hosting
- Cloud **application providers** (SaaS)
- Cloud **consumers** – users of any of the above

Players: Providers

- Programmatic access via Web Services and/or Web APIs
- “Pure” virtualized resources
 - CPU, memory, storage, and bandwidth
 - Data store

OR



- Virtualized resources plus application framework (e.g., RoR, Python, .NET)
 - Imposes an application and data architecture
 - Constrains how application is built



Google App Engine



Players: Cloud Brokers







- Resells (aspects of) raw cloud resources, with added value propositions
 - Packaging resources as bundles
 - Facilitating cloud resource management, e.g., setup, updates, backup, load balancing, etc.
 - Providing tools and dashboards
- Enabler of a cloud ecosystem



Players: Application Providers

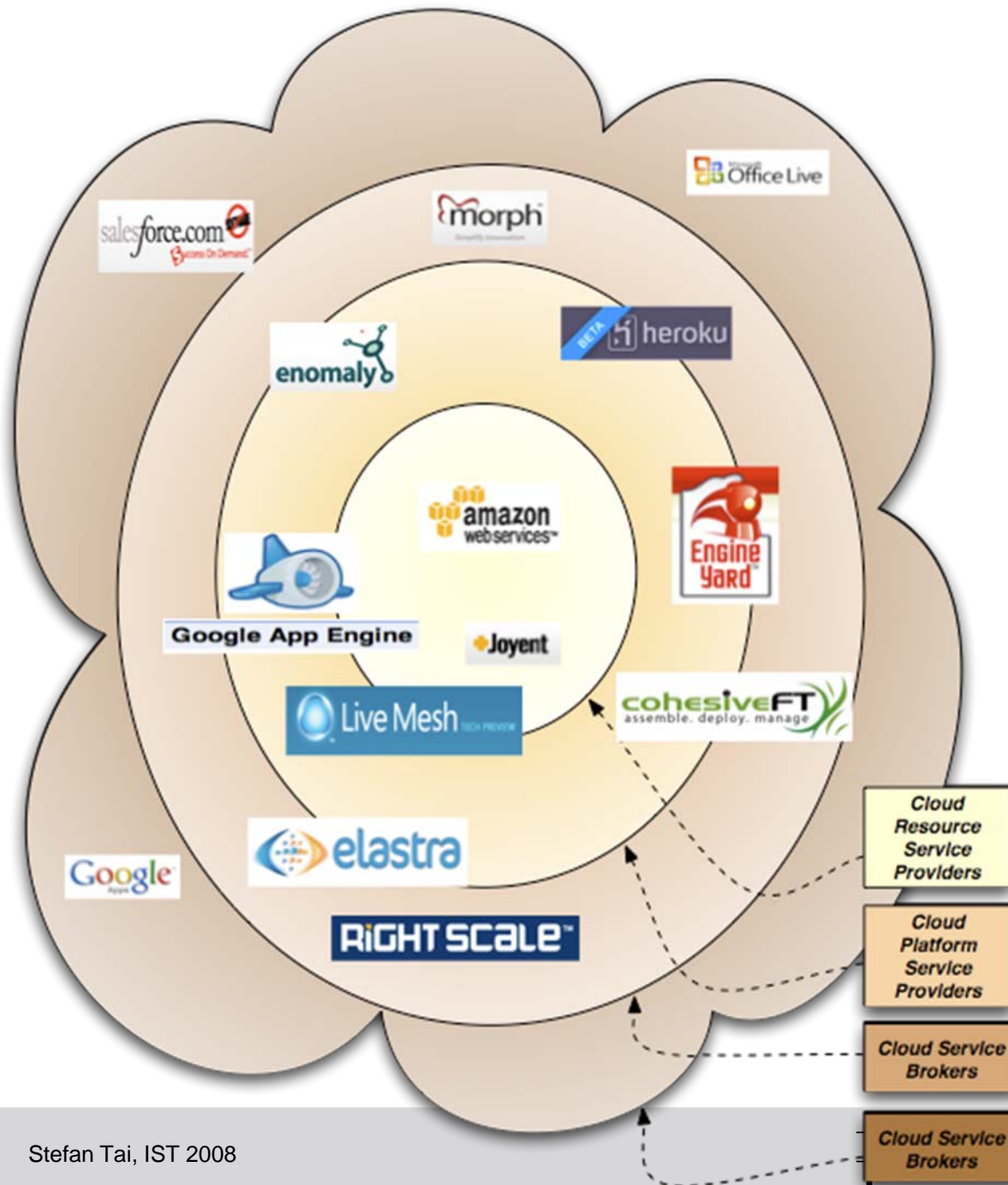
- **Software as a Service (SaaS): Applications provided and consumed over the Web**
- **Cloud usage (mostly) hidden**



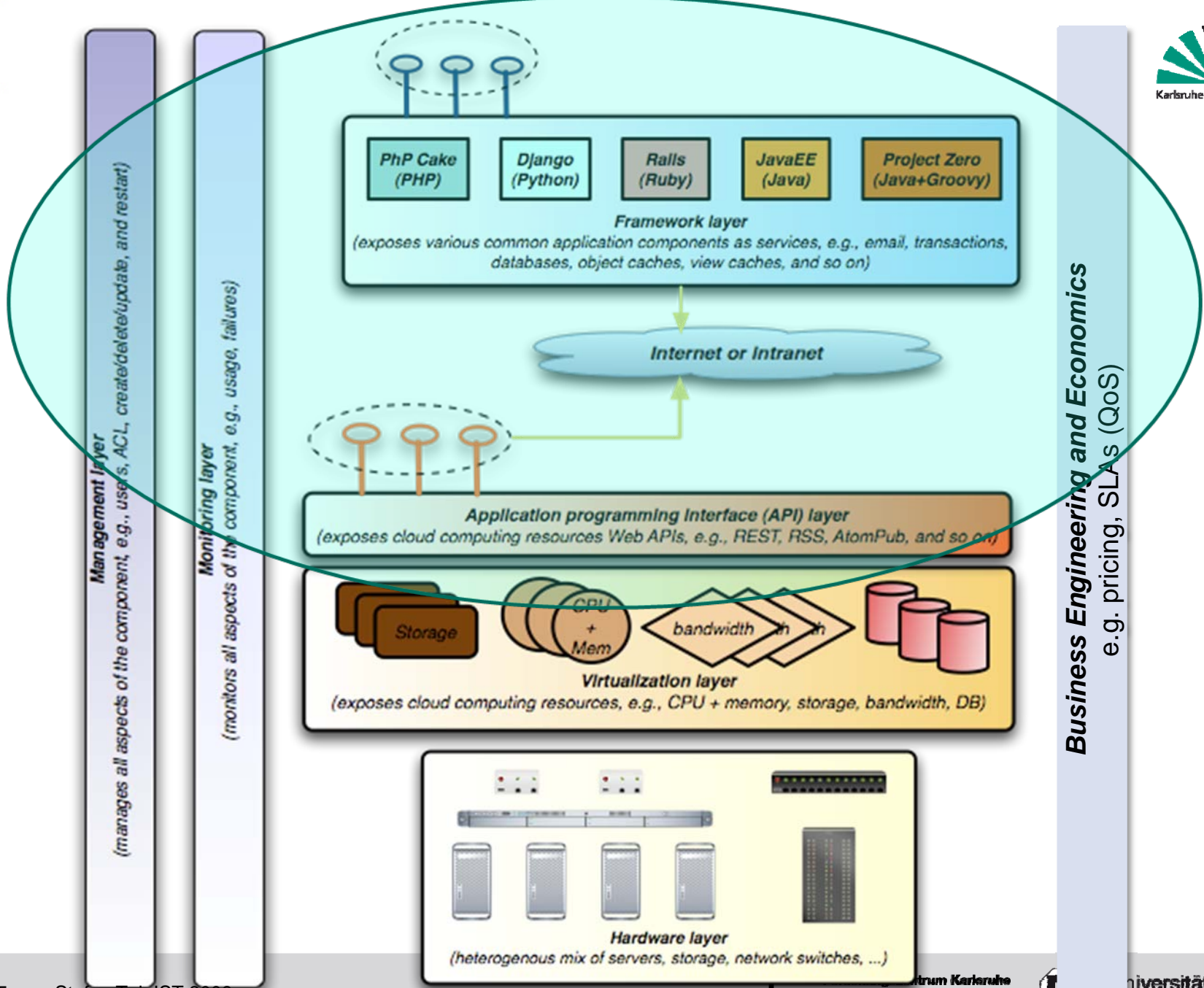
-  **Gmail**
Email with up to 25 GB of storage per custom email address, mail search tools and integrated chat.
-  **Google Docs**
Create, share and collaborate on documents in real-time.
-  **Google Calendar**
Coordinate meetings and company events with sharable calendars.
-  **Google Sites**
One-stop sharing for team information.
-  **Google Talk**
Free text and voice calling around the world.
-  **Security and compliance**
Set email policies and recover deleted messages.



Evolving Cloud Ecosystem

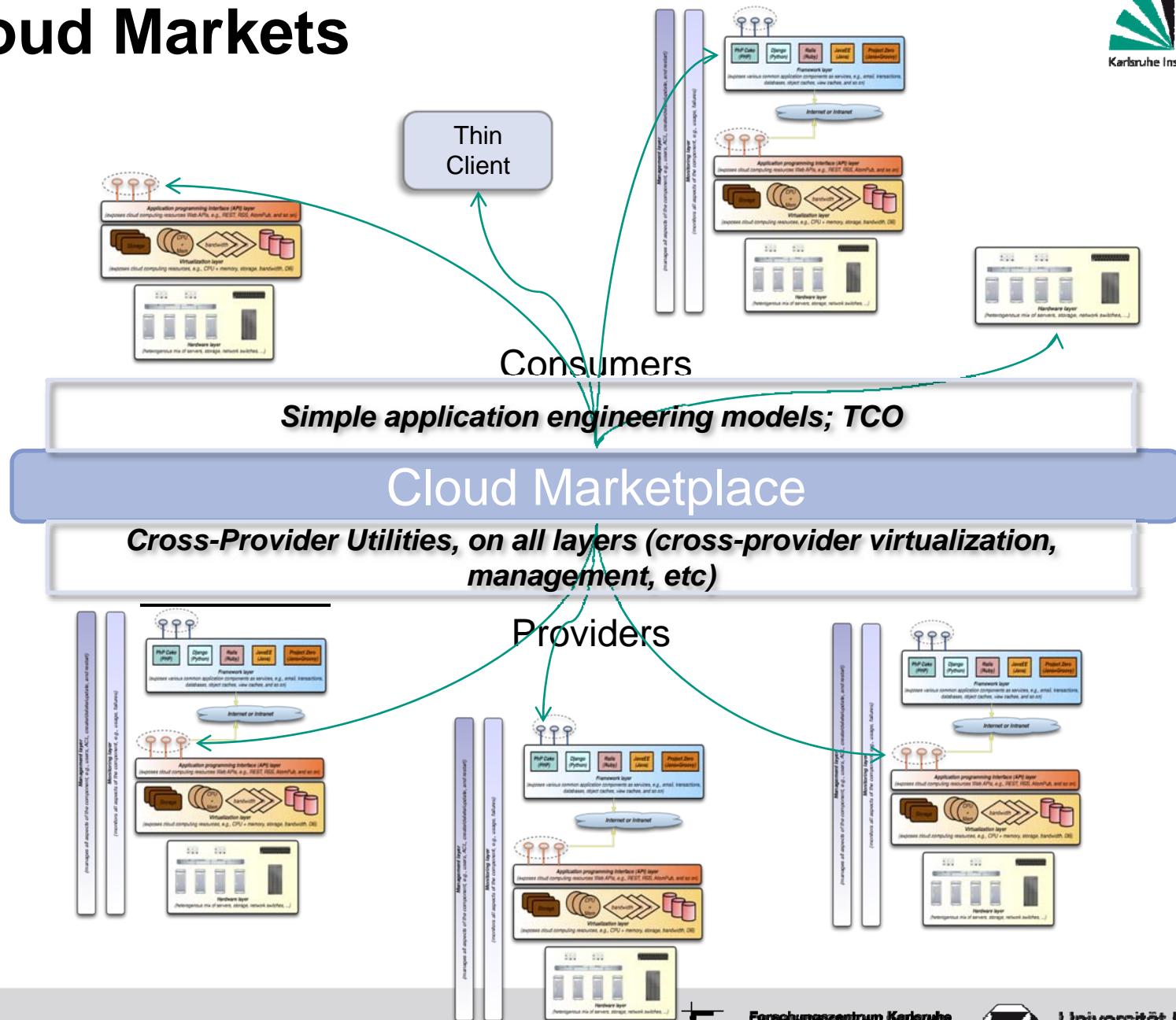


- Cloud Resource Service Providers
- Cloud Platform Service Providers
- Cloud Service Brokers
- Cloud Service Brokers



Adapted from E. Michael Maximilien, IBM

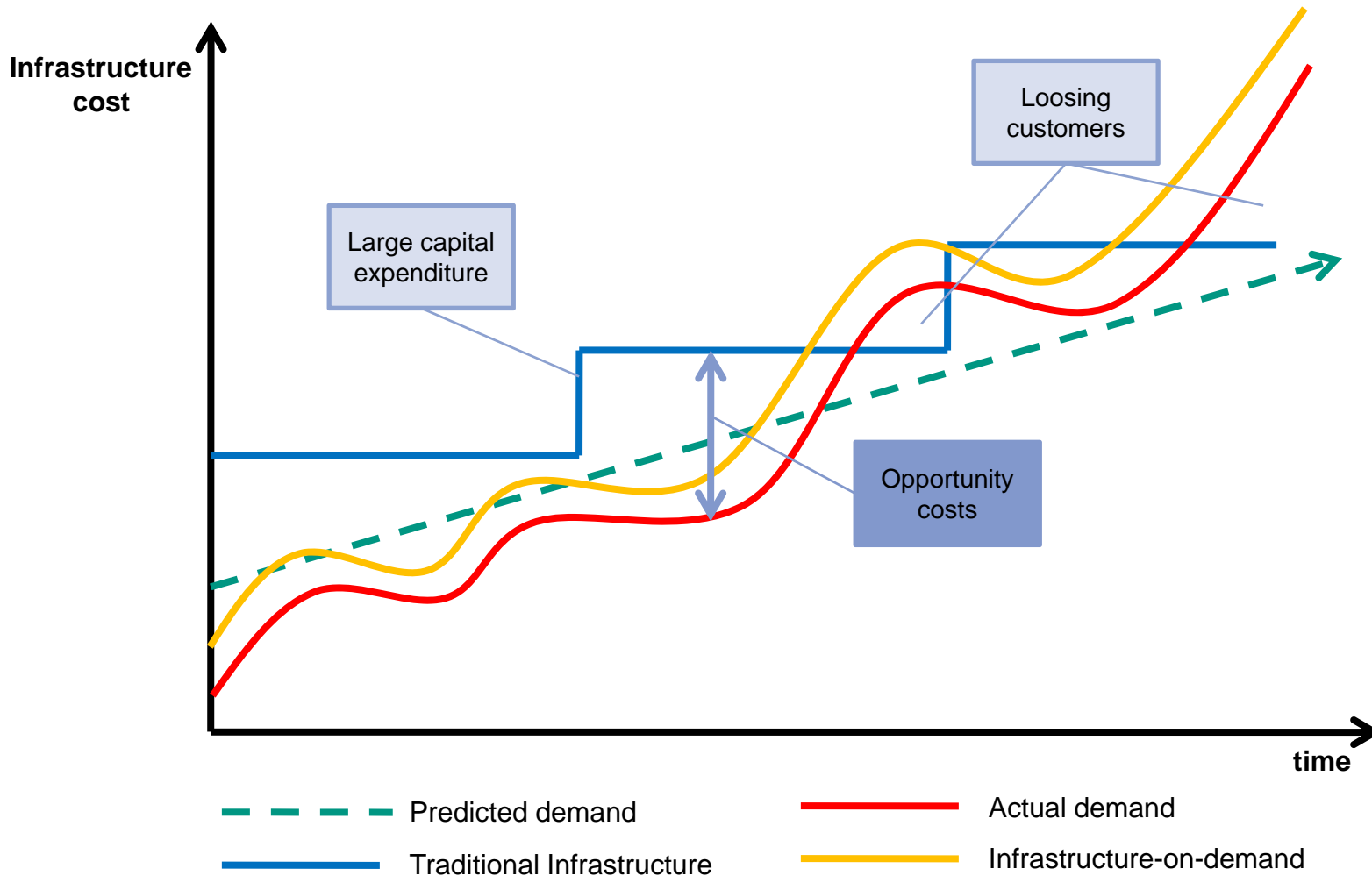
Cloud Markets



Agenda

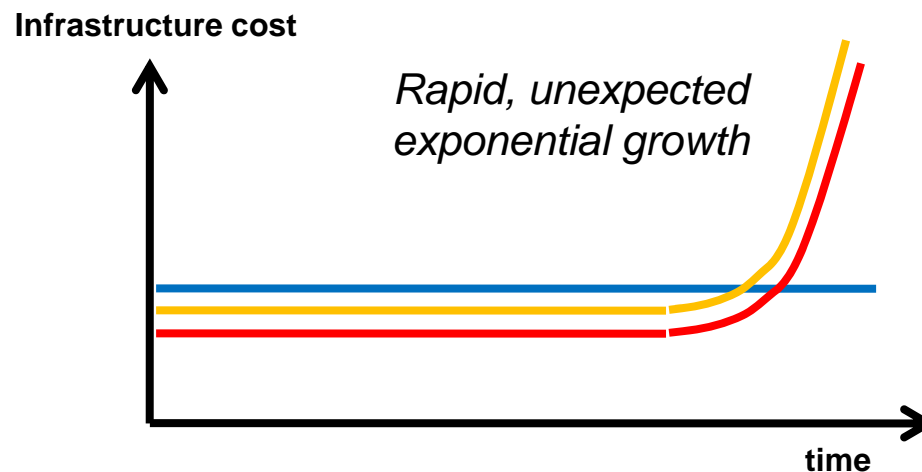
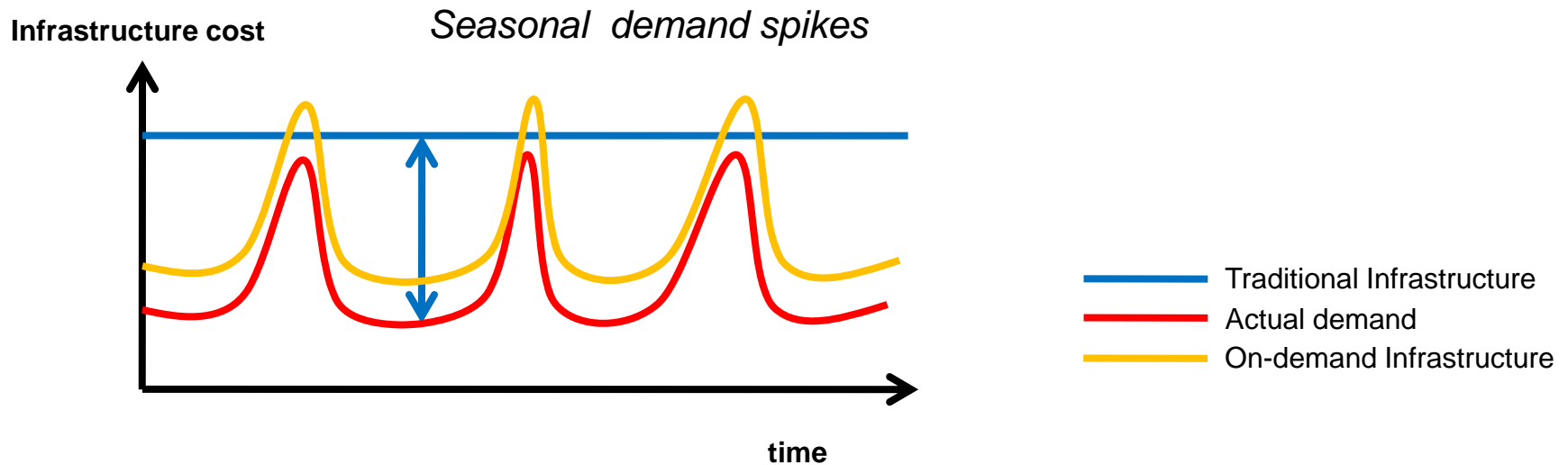
1. Introduction: Cloud Computing
2. Understanding the Cloud Ecosystem; understanding business and technical (architectural) challenges
3. **Understanding when (and when not) Clouds „compute“ (TCO – Total Cost of Ownership)**

Demand predictions cost money



Adapted from Mike Culver, amazon.com

Diverse demand patterns exist



Cloud Computing TCO

Collect real-world use cases and identify typical scenarios



Examine key aspects from business and IT perspective

Business objectives

- foster innovation
- rapid prototyping
- leverage Web as platform

Demand behavior

- seasonal
- temporary spikes
- unpredictable

IT requirements

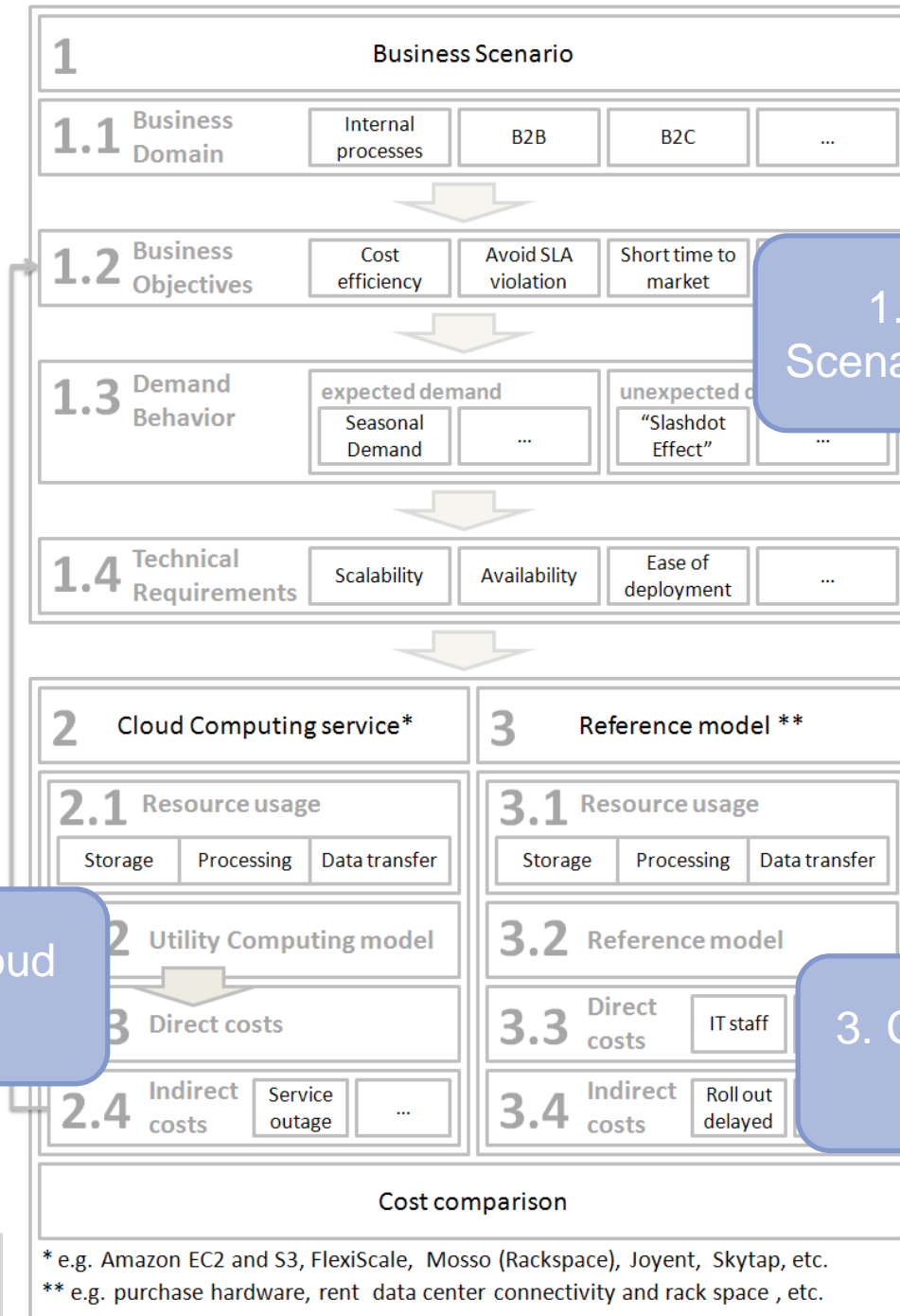
- scalability
- reliable and stable platform
- high availability

Understand and value benefits from cloud computing

Strategic evaluation

- understanding the cloud ecosystem
- **discovering new markets**
- **project-specific decision support**
- **provider lock-in problems**
- **SLAs, policies, and compliance**
- **Cost estimation & comparison**
- TCO comparison
- utility computing modeling
- application of valuation tools

TCO Framework



1. Model the Scenario/Application

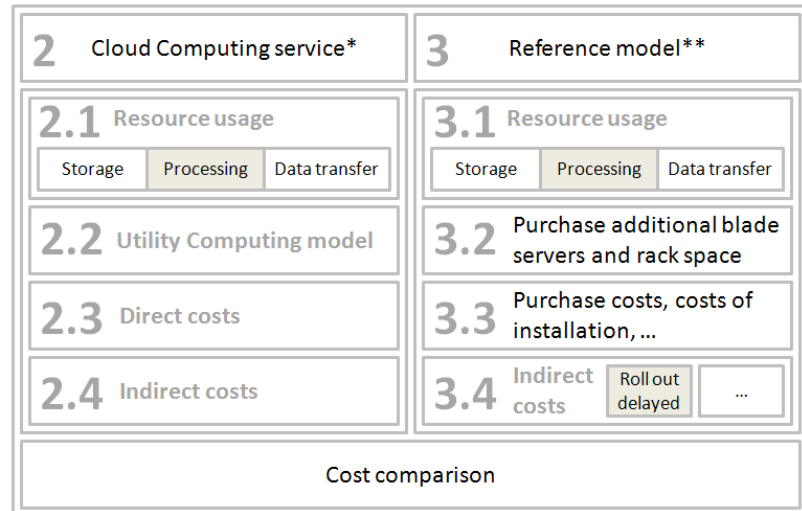
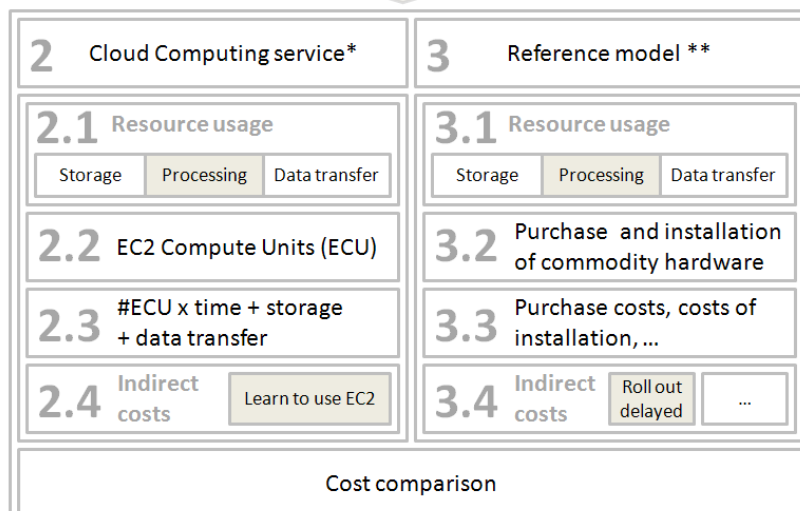
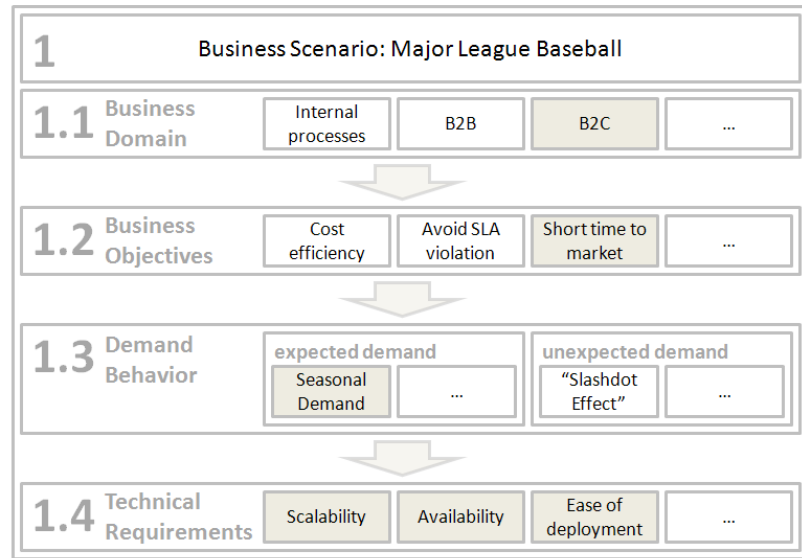
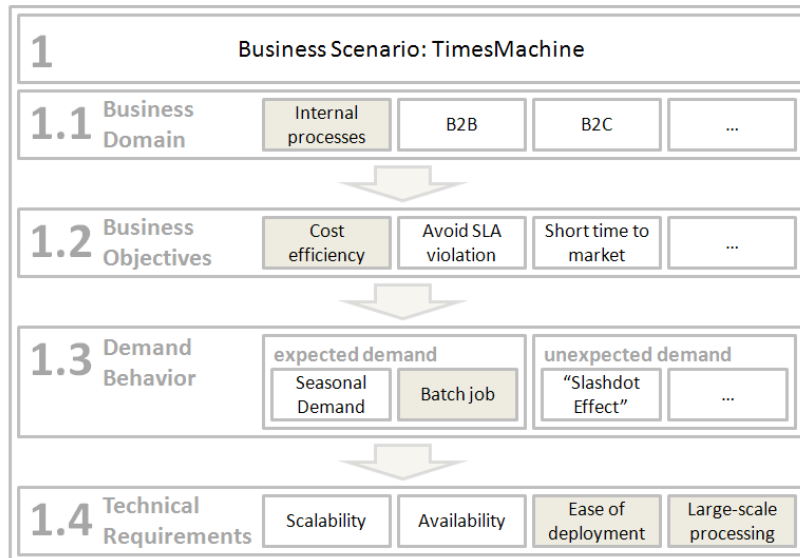
2. Calculate Cloud TCO

3. Calculate TCO of alternatives

Source:
M. Klems, J. Nimis, S. Tai:
„Do Clouds Compute?“, 2008

* e.g. Amazon EC2 and S3, FlexiScale, Mosso (Rackspace), Joyent, Skytap, etc.
** e.g. purchase hardware, rent data center connectivity and rack space, etc.

Sample Applications



* Amazon EC2 and S3

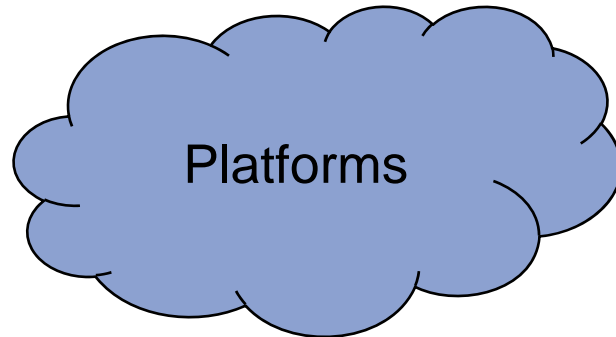
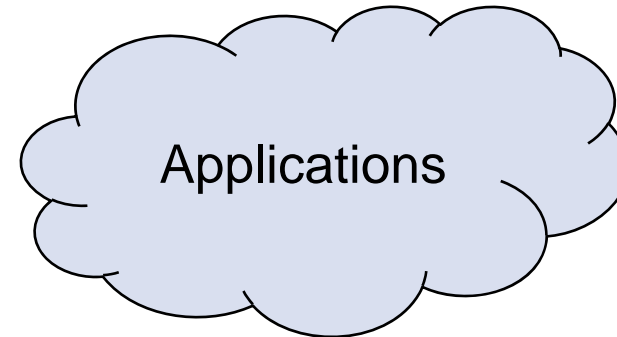
** Purchase commodity hardware, in-house installation and configuration

* Joyent

** Purchase additional data center rack space and servers

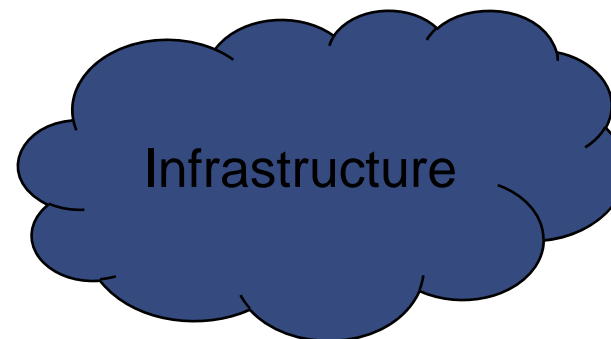
Summary: There are many Clouds...

Enterprise applications
(e.g., salesforce.com)
Consumer applications
(e.g., Google desktop apps)
Social networking applications

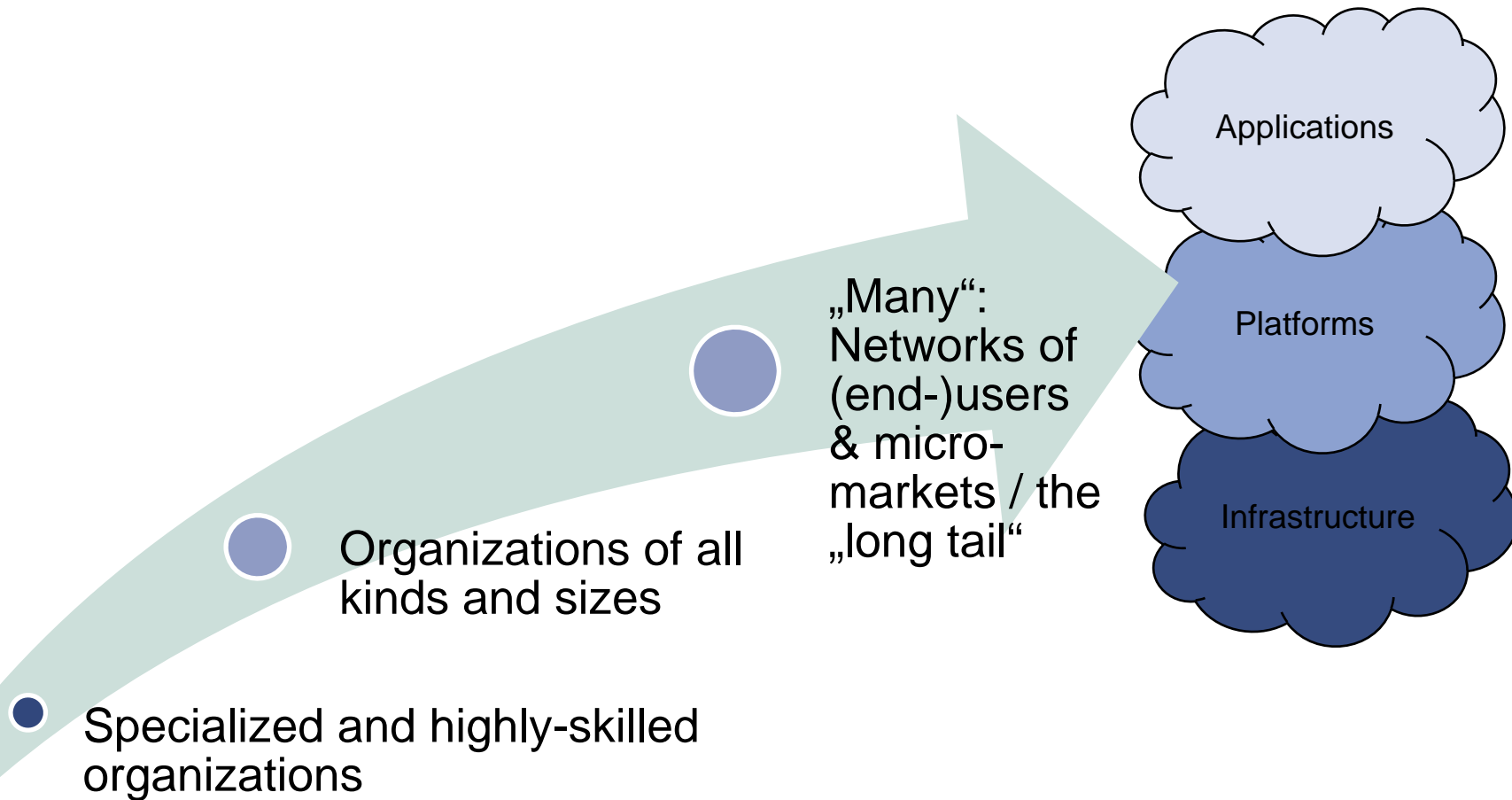


Frameworks and runtimes
(e.g., Google App Engine)
Workforce services
(e.g., Amazon's Mechanical Turk)

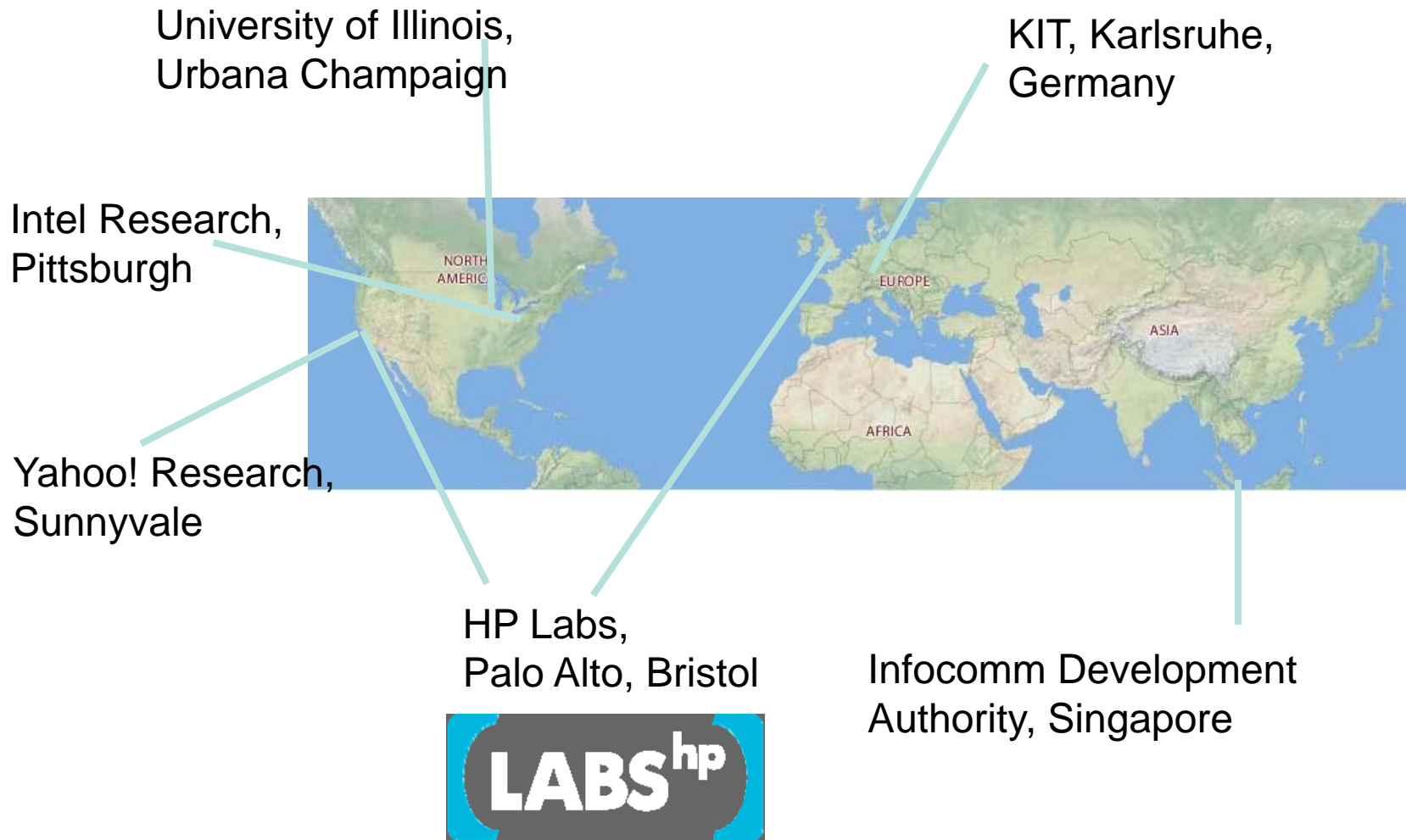
Compute power
(e.g., Amazon's EC2)
Storage
(e.g., Amazon's S3)



Opportunities in the hands of many



...and in Karlsruhe



■ Promote

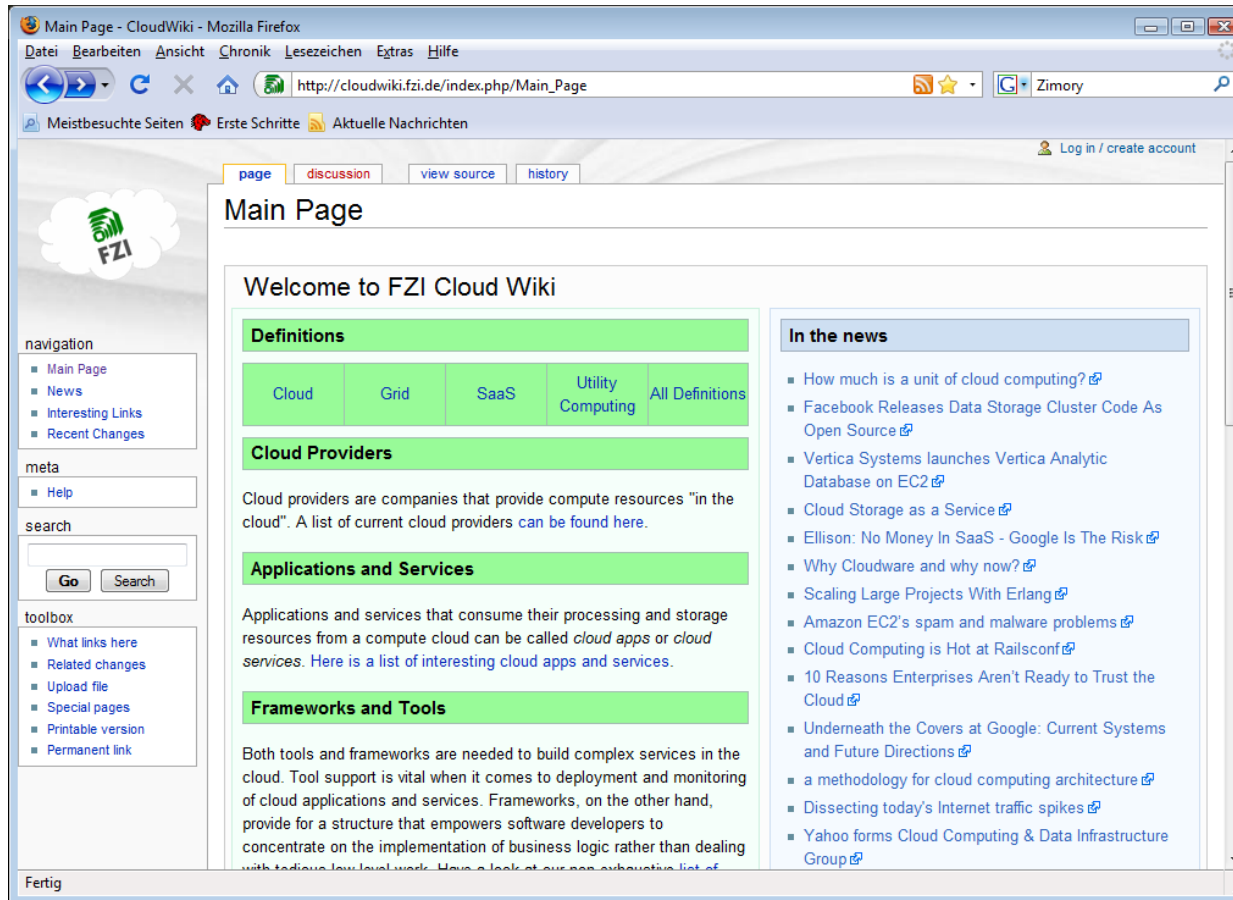
- collaborative cloud computing research among industry, academia and government on
- cloud computing software,
- data-center management infrastructure and hardware at an
- Internet scale
- **Availability by end of 2008**

■ Technical Benefits

- Allow federated cluster experiments/benchmarks
- Allow innovation at all levels of the cloud computing infrastructure stack
- Commitment to openness in sharing software, tools, best practices
- Collection of usage statistics
- **Diversity of research areas**

Cloud Computing Resources

<http://cloudwiki.fzi.de>



The screenshot shows the main page of the FZI Cloud Wiki in a Mozilla Firefox browser window. The page title is "Main Page - CloudWiki - Mozilla Firefox". The address bar shows the URL "http://cloudwiki.fzi.de/index.php/Main_Page". The page content includes a navigation menu on the left, a main content area with sections for "Definitions", "Cloud Providers", "Applications and Services", and "Frameworks and Tools", and a right sidebar with "In the news" section. The "Definitions" section has a table with columns for "Cloud", "Grid", "SaaS", "Utility Computing", and "All Definitions". The "Cloud Providers" section contains a paragraph about cloud providers. The "Applications and Services" section contains a paragraph about cloud apps and services. The "Frameworks and Tools" section contains a paragraph about tools and frameworks. The "In the news" section contains a list of news items with links.

Main Page - CloudWiki - Mozilla Firefox

http://cloudwiki.fzi.de/index.php/Main_Page

Meistbesuchte Seiten Erste Schritte Aktuelle Nachrichten

Log in / create account

page discussion view source history

Main Page

Welcome to FZI Cloud Wiki

Definitions

Cloud	Grid	SaaS	Utility Computing	All Definitions
-------	------	------	-------------------	-----------------

Cloud Providers

Cloud providers are companies that provide compute resources "in the cloud". A list of current cloud providers can be found [here](#).

Applications and Services

Applications and services that consume their processing and storage resources from a compute cloud can be called *cloud apps* or *cloud services*. Here is a list of interesting cloud apps and services.

Frameworks and Tools

Both tools and frameworks are needed to build complex services in the cloud. Tool support is vital when it comes to deployment and monitoring of cloud applications and services. Frameworks, on the other hand, provide for a structure that empowers software developers to concentrate on the implementation of business logic rather than dealing with tedious low-level work. Have a look at our non-exhaustive list of

In the news

- How much is a unit of cloud computing? [↗](#)
- Facebook Releases Data Storage Cluster Code As Open Source [↗](#)
- Vertica Systems launches Vertica Analytic Database on EC2 [↗](#)
- Cloud Storage as a Service [↗](#)
- Ellison: No Money In SaaS - Google Is The Risk [↗](#)
- Why Cloudware and why now? [↗](#)
- Scaling Large Projects With Erlang [↗](#)
- Amazon EC2's spam and malware problems [↗](#)
- Cloud Computing is Hot at Railsconf [↗](#)
- 10 Reasons Enterprises Aren't Ready to Trust the Cloud [↗](#)
- Underneath the Covers at Google: Current Systems and Future Directions [↗](#)
- a methodology for cloud computing architecture [↗](#)
- Dissecting today's Internet traffic spikes [↗](#)
- Yahoo forms Cloud Computing & Data Infrastructure Group [↗](#)

Fertig



The screenshot shows a Mozilla Firefox browser window displaying the website <http://eorganization.appspot.com/>. The browser's address bar shows the URL, and the page title is "eOrganization". The website has a navigation menu with "Overview", "People", "Research", and "Teaching". The "Overview" page is active, showing contact information for KIT and FZI, a description of the eOrganization research group, and a grid of research group members. A "powered by Google App Engine" logo is visible at the bottom left of the page content, and a "Fertig" button is at the bottom right. The browser window also shows a search bar with "Google" and a "Meistbesuchte Seiten" (Most visited sites) section.

Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe
http://eorganization.appspot.com/
Meistbesuchte Seiten Erste Schritte Aktuelle Nachrichten

eOrganization

[Overview](#) [People](#) [Research](#) [Teaching](#)

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D-76131 Karlsruhe
Germany
Tel: +49 (721) 0054701
Fax: +49 (721) 0054700

Shortcuts
[Teaching winter 2008](#)
[Thesis offers](#)
[Job offers](#)

Latest news
[archive](#)
There are currently no news

eOrganisation research group

The eOrganization research group explores challenging research problems in the field of service computing. Our research aims to contribute to a better understanding, design, use, and impact analysis of modern information and communication technology, in particular Web technology, in support of business and people networks in an increasingly services-led economy. Our research is set in the multi-disciplinary context of leveraging the Internet as a combined computing platform, a business platform, and a collaboration platform.

The research group consists of two teams: the "Economics and Technology of eOrganization" team at the KIT (Karlsruhe Institute of Technology, University of Karlsruhe), and the "Dynamic Service Nets" team at the FZI (Forschungszentrum Informatik). At the KIT, the team is part of the Institute AIFB and the KSRI (Karlsruhe Service Research Institute). At the FZI, the team is part of the IPE (Information and Process Engineering) department.

Research Group eOrganization

Head: *Prof. Dr. Stefan Tai*

 Karlsruhe Institute of Technology Economics and Technology of eOrganizations Lead: <i>Dr. Christian Zirpins</i>	 Dynamic Service Nets Lead: <i>Mr. Jens Nimis</i>	
 eOrg @ Institute AIFB	 eOrg @ Institute KSRI	 DSN @ Information Process Engineering

You are currently not logged in - Login

powered by Google App Engine

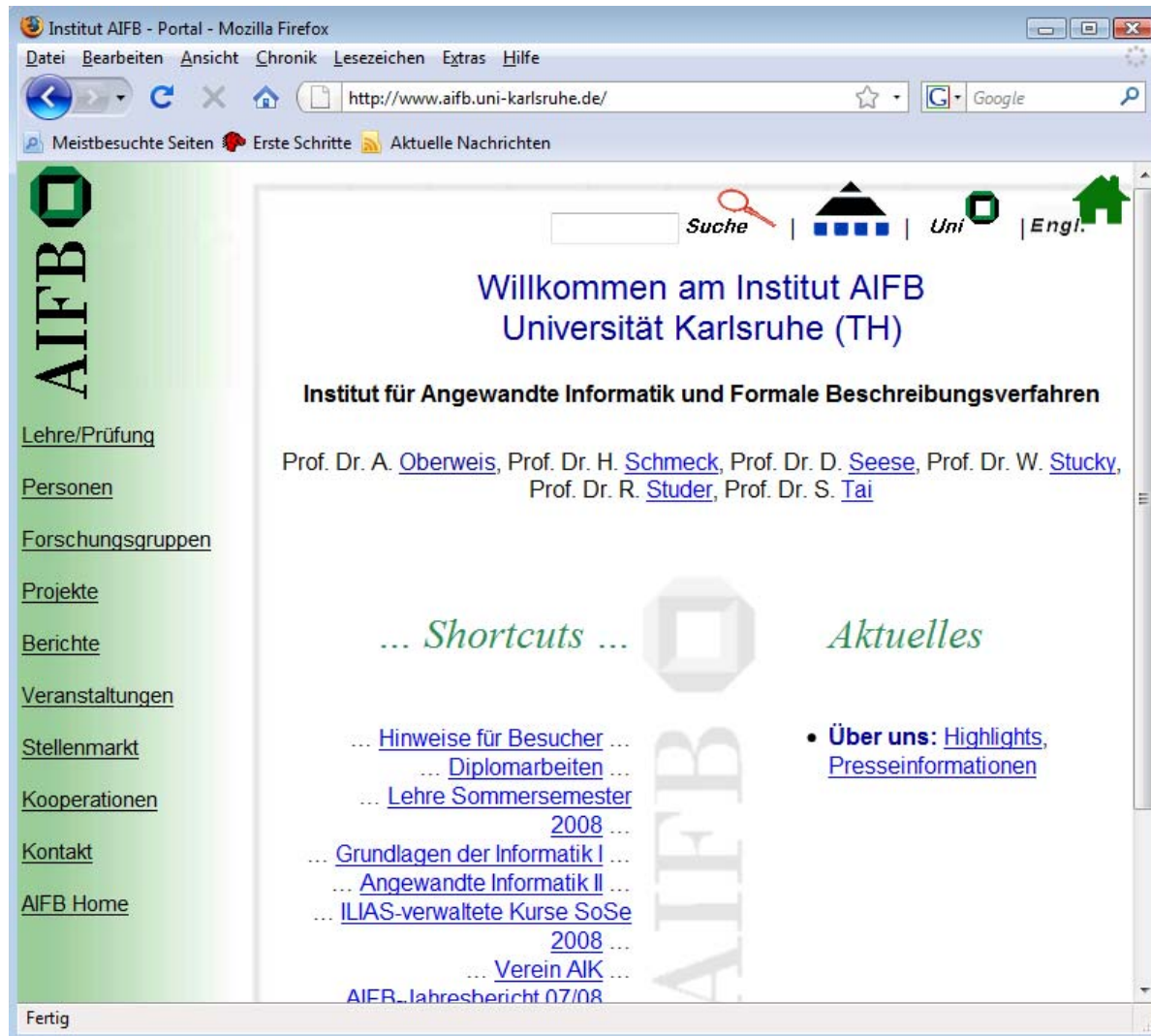
Fertig

Thank You!

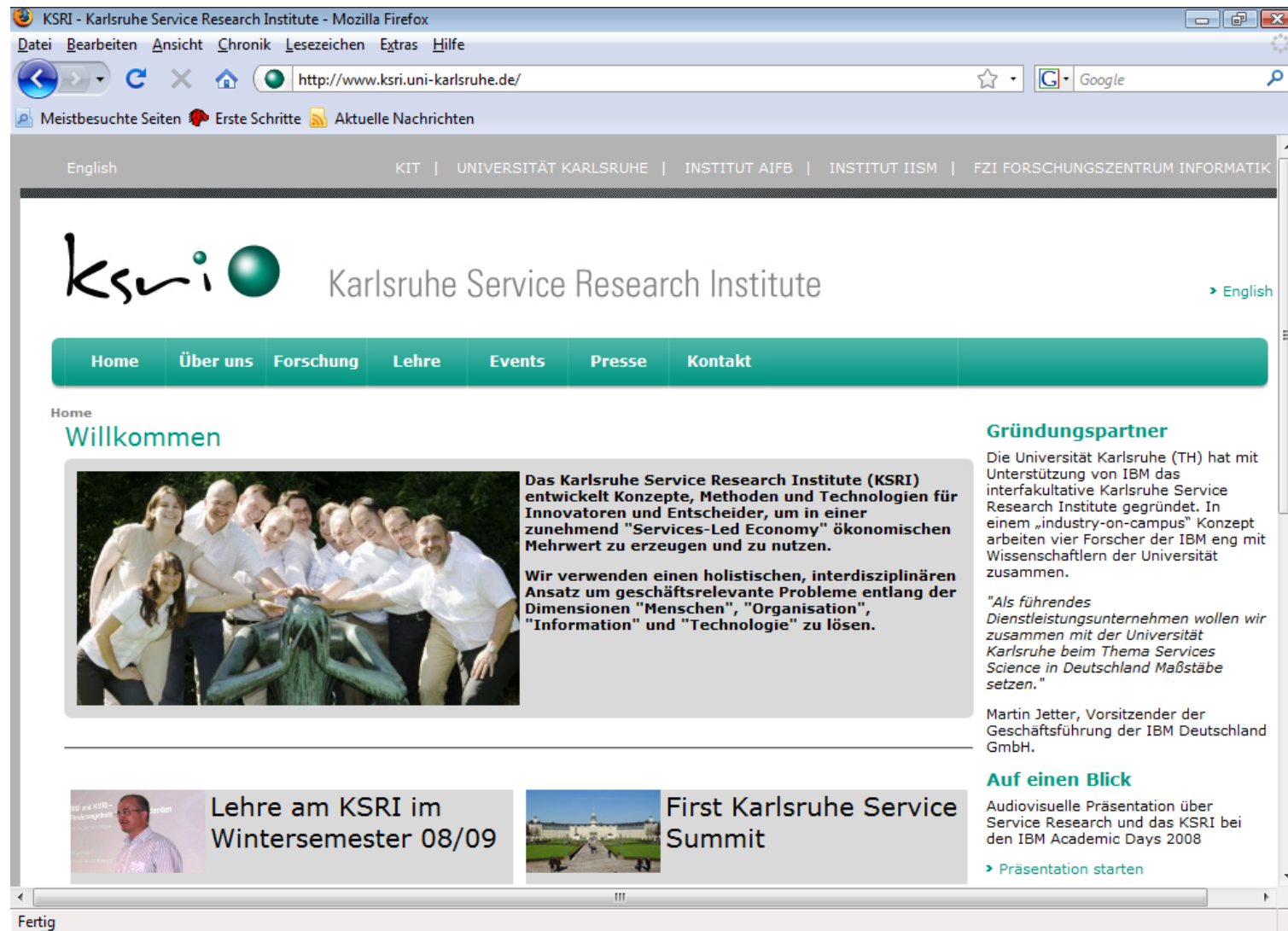


Acknowledgments & Collaborators

- Markus Klems, FZI eOrganization
- Marcel Kunze, KIT SCC
- E. Michael Maximilien, IBM Almaden RC
- Jens Nimis, FZI eOrganization
- Thomas Sandholm, HP Labs Palo Alto
- Gerhard Satzger, IBM & KSRI
- Christian Zirpins, KIT eOrganization



The screenshot shows a Mozilla Firefox browser window displaying the AIFB website. The browser's address bar shows the URL <http://www.aifb.uni-karlsruhe.de/>. The website has a green and white color scheme. On the left is a vertical navigation menu with the AIFB logo and links for 'Lehre/Prüfung', 'Personen', 'Forschungsgruppen', 'Projekte', 'Berichte', 'Veranstaltungen', 'Stellenmarkt', 'Kooperationen', 'Kontakt', and 'AIFB Home'. The main content area features a search bar, navigation icons for 'Suche', 'Uni', and 'Engl.', and a large 'AIFB' watermark. The main heading reads 'Willkommen am Institut AIFB Universität Karlsruhe (TH)'. Below this is the full name of the institute: 'Institut für Angewandte Informatik und Formale Beschreibungsverfahren'. A list of faculty members is provided: Prof. Dr. A. Oberweis, Prof. Dr. H. Schmeck, Prof. Dr. D. Seese, Prof. Dr. W. Stucky, Prof. Dr. R. Studer, and Prof. Dr. S. Tai. There are two columns of links: 'Shortcuts' and 'Aktuelles'. The 'Aktuelles' column includes a link for 'Über uns: Highlights, Presseinformationen'. The status bar at the bottom of the browser window shows 'Fertig'.




The screenshot shows a Mozilla Firefox browser window displaying the website <http://www.ksri.uni-karlsruhe.de/>. The browser's address bar and search engine (Google) are visible. The website header includes navigation links for English, KIT, UNIVERSITÄT KARLSRUHE, INSTITUT AIFB, INSTITUT IISM, and FZI FORSCHUNGSZENTRUM INFORMATIK. The main content area features the KSRI logo and the text "Karlsruhe Service Research Institute". A green navigation bar contains links for Home, Über uns, Forschung, Lehre, Events, Presse, and Kontakt. The "Home" section is titled "Willkommen" and includes a group photo of staff, a text block about the institute's mission, and a quote from Martin Jetter. Below this, there are two featured content blocks: "Lehre am KSRI im Wintersemester 08/09" and "First Karlsruhe Service Summit". A "Gründungspartner" section highlights the partnership with IBM, including a quote and a link to start a presentation.

English | KIT | UNIVERSITÄT KARLSRUHE | INSTITUT AIFB | INSTITUT IISM | FZI FORSCHUNGSZENTRUM INFORMATIK

ksri Karlsruhe Service Research Institute

Home Über uns Forschung Lehre Events Presse Kontakt

Home
Willkommen



Das Karlsruhe Service Research Institute (KSRI) entwickelt Konzepte, Methoden und Technologien für Innovatoren und Entscheider, um in einer zunehmend "Services-Led Economy" ökonomischen Mehrwert zu erzeugen und zu nutzen.

Wir verwenden einen holistischen, interdisziplinären Ansatz um geschäftsrelevante Probleme entlang der Dimensionen "Menschen", "Organisation", "Information" und "Technologie" zu lösen.

Gründungspartner

Die Universität Karlsruhe (TH) hat mit Unterstützung von IBM das interfakultative Karlsruhe Service Research Institute gegründet. In einem „industry-on-campus“ Konzept arbeiten vier Forscher der IBM eng mit Wissenschaftlern der Universität zusammen.

"Als führendes Dienstleistungsunternehmen wollen wir zusammen mit der Universität Karlsruhe beim Thema Services Science in Deutschland Maßstäbe setzen."

Martin Jetter, Vorsitzender der Geschäftsführung der IBM Deutschland GmbH.

Auf einen Blick

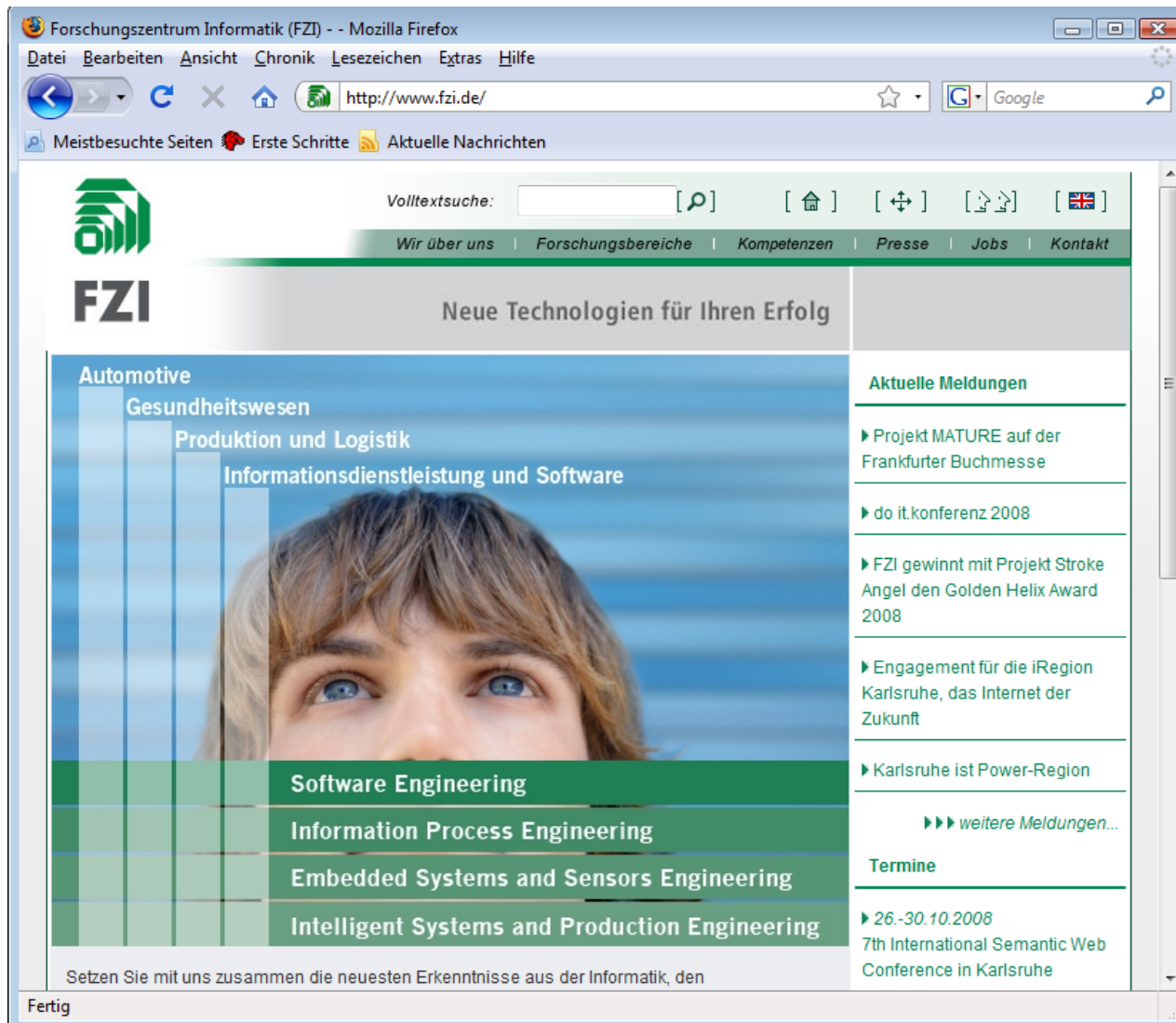
Audiovisuelle Präsentation über Service Research und das KSRI bei den IBM Academic Days 2008

[Präsentation starten](#)

Lehre am KSRI im Wintersemester 08/09

First Karlsruhe Service Summit

Fertig



The screenshot shows a Mozilla Firefox browser window displaying the FZI website. The browser title is "Forschungszentrum Informatik (FZI) - - Mozilla Firefox". The address bar shows "http://www.fzi.de/". The website header includes the FZI logo, a search bar, and navigation links: "Wir über uns", "Forschungsbereiche", "Kompetenzen", "Presse", "Jobs", and "Kontakt". The main content area features a large image of a woman's face looking up, overlaid with a bar chart and text: "Automotive", "Gesundheitswesen", "Produktion und Logistik", and "Informationsdienstleistung und Software". Below this, there are four green buttons: "Software Engineering", "Information Process Engineering", "Embedded Systems and Sensors Engineering", and "Intelligent Systems and Production Engineering". A sidebar on the right contains "Aktuelle Meldungen" with several news items and "Termine" with an event listing.

Forschungszentrum Informatik (FZI) - - Mozilla Firefox

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

http://www.fzi.de/

Meistbesuchte Seiten Erste Schritte Aktuelle Nachrichten

Volltextsuche: [] [] [] [] []

Wir über uns | Forschungsbereiche | Kompetenzen | Presse | Jobs | Kontakt

FZI Neue Technologien für Ihren Erfolg

Automotive
Gesundheitswesen
Produktion und Logistik
Informationsdienstleistung und Software

Software Engineering
Information Process Engineering
Embedded Systems and Sensors Engineering
Intelligent Systems and Production Engineering

Aktuelle Meldungen

- Projekt MATURE auf der Frankfurter Buchmesse
- do it.konferenz 2008
- FZI gewinnt mit Projekt Stroke Angel den Golden Helix Award 2008
- Engagement für die iRegion Karlsruhe, das Internet der Zukunft
- Karlsruhe ist Power-Region

►►► weitere Meldungen...

Termine

- 26.-30.10.2008
7th International Semantic Web Conference in Karlsruhe

Setzen Sie mit uns zusammen die neuesten Erkenntnisse aus der Informatik, den

Fertig