SAP Research Americas and China

Future Technologies for the Connected Enterprise

MCETECH, Montreal, January 2008

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Deliver “IT-Powered Business Innovation” for Customers
- Differentiate from competition through business innovation
- Boost productivity through best industry practices
- Ensure business integrity and compliance

Enterprise Service-Oriented Architecture
- Business Process Platform
- Enterprise Services
- Composite Applications

Trusted Ecosystem of Partners
- Alliance of “Gorillas”
- Many ISVs
- Collaborative innovation
Summary of SAP Today

SAP AG in 2007 revenues: $ 15 billion
- More than 43,000 companies run SAP software
- Providing more than 30 industry solutions
- 40,494 SAP employees (March, 2007)

12 million users in 120+ countries team with us to...
- Integrate their business processes
- Extend their competitive capabilities
- Get a better return on investment at a lower total cost of ownership

Unique partner ecosystem
- More than 3,850 industry partners
- Overall more than 180,000 SAP partner certifications
SAP is Well Positioned for Growth

- **Trusted business partner** for 43,000+ companies – the largest installed base in the enterprise software sector

- **Deep vertical expertise** with strategic solutions for more than 30 industries

- **Great innovation power** with 15,000+ developers

- **Largest ecosystem in the industry** system integrators, ISVs, OEMs, resellers, partners

- **One of the top brands globally** #34 according to *BusinessWeek*
>40% of SAP’s developers are located across the globe in 8 SAP Labs.
Mission

SAP RESEARCH prepares the groundwork for future growth by

- Acting as a key SAP IT trend scout
- Researching and developing in strategically important SAP business areas
- Be an entry point for new talent from university

Research Americas and China

Develop new processes and technologies for enterprise software research for the 21st Century

Internal Strategy

- Identify industry trends that need research and advanced development
- Work with various product groups to begin the technology transfer process as early as possible
- Be a resource as reviewers and advisors for various product groups

External Strategy

- Work with external industry and university research collaborators to gain insights on technology research trends, and customer requirements
- Leverage North American Universities: Stanford, Berkeley, CMU, MIT
- Leverage North American Partners and Lab Locations: Intel Research, HP Labs Research, Nokia Research
- Work with key startup companies and venture capital firms to identify cutting edge developments
The Global Research- & Development Network of SAP

- Bangalore
- Tokyo
- Budapest
- Tel Aviv
- Sofia
- Montreal
- Pretoria
- Shanghai
- Sofia Antipolis
- Walldorf
- Darmstadt
- Dresden
- Karlsruhe
- Belfast
- Sofia
- St Gallen
- Zurich
- Chelsea
- Palo Alto
- Walldorf
- Shanghai
- Pretoria
- Walldorf
- Shanghai
- Pretoria

SAP Labs

SAP Research

SAP Research NA and China
SAP Portfolio of North American Universities and Academic Research Centers
University Collaborations (30 active projects)

- MIT – Auto-ID Lab Distributed Data Management, CS Water Monitoring, Engineering Department SCRisk, Sloan School Harrahs Productivity and IT, MIT Industry Liaison Program
- Stanford – AI Lab Policy Oriented Enterprise Management (Semantics and Business Rules), CHIMe Lab at Department of Communication Carweaver, 1.5 way Communication, Media-X
- CMU – API Usability, Security Surface Attacks, Cylab Secure joints, Optimal Store Location, Cylab Obfuscation & ERP
- Cornell – Game Theory for maintenance crew allocation at Canadian Rail
- UCSC – Cluster File Systems for DB, Smart Search
- NYU Stern – SME – Productivity, Pricing and SaaS
- University of Arizona – UI and Data Provenance, Transformation from 4GL to Web Services
- CRIM Montréal – TAO (Adaptive Test Accelerator; automatic testing using state machines)
- University of Colorado at Boulder – End User Design (Meta Design)
- University of Toronto – Partsweaver
- Concordia University Montreal – Defect Detection Modeling for CRM development
- HEC Montréal – Epidemiology for ERP purchase decisions, Mobile Infrastructure, HEC ERP Simulation
- Penn State – Commanders Intent & Real Time Supply Chain, SME Research
- École Polytechnique de Montréal – Lean Scheduling for Manufacturing
- University of Trento – Reuse of UI for integration of presentation layer
- University of Texas at Dallas – Transforming ABAP into SOA
- IEEE ICWS and SC conference 2007 at Salt Lake City, keynote by Ike Nassi
Market and Technology Trends
IT Market Trends (1)

Worldwide IT Spending **Growth Lower**
- IT global market growth in 2008 some 6%, in US down to possibly 3%

**Strong Increase in Emerging Markets**
- IT vendors will accelerate investments in the hyper-growth “BRIC+9” economies, collectively growing at 16%
- SMB initiatives will also accelerate, with spending growing at 8-10%

**Market Makers (& Ecosystems) Jump Feet-First Into Everything-as-a-Service (IDC)**
- SAP Business By Design, MS Dynamics CRM Live, Google and salesfroce.com, Cisco might extend Webex to online platform, Web 2.0 apps in the cloud (Google and IBM), BI as a service – Acxiom with ConnectionPointX for real-time customer data matching and demographics, LexisNexis, Experian, ACNielsen, Thomson Financial,…

**Application Appliances** Solutionization high-volume development of targeted solutions (IDC)
- AppPods – prepackaged, out of the box, easy to use
A Flood of “Web Gadgets” Extend the (Mobile) Internet Computing

- iPod, Kindle, … MS, Apple, Asus, Qisda (BenQ)

All MNO Will Join the Open Internet

- Google Open Handset Alliance and Android platform.

Telecom operators will promote VoIP

Social Networking Cacophony Will Drive “Eureka 2.0” Software Sites (IDC)

- How to make sense of the wisdom of the crowd?
- Leverage text analytics, sentiment extraction and related technologies, including semantic search for brand/reputation monitoring, customer satisfaction, and new product ideas - Lexalytics, Clear Forest, Connexor, Cymfony, Biz360, Attensity, Attenex, and Recommind
- IDC predicts that one or more of these Eureka 2.0 companies will host a portal to predict U.S. presidential election winner
2 million personal robots were in use worldwide in 2004 and another 7 million will be installed by 2008 (International Federation of Robotics)

Social technologies dominate the hype cycle


SAP RESEARCH
Technology Trends most relevant for SAP (1)

High Performance Computing
- In 2010 10-100 core per server with 100 TByte memory will be available for biz apps
- Web-scale architectures like Google, Amazon and IBM using clusters
- VMware for ERP will become mainstream, SaaS will grow faster than SW revenue

Pervasive Connectivity Ubiquitous device to device connectivity
- 1.4 B Mobile users worldwide, i.e. more than 20% of the world’s population
- Wireless & embedded computing - Hand held, wearable systems, appliances, cars, medical implants, water monitoring
- Huge amount of data – 300 Exabyte over internet in 2010
- 1990, one optical fiber could transmit 1 Gbps - 2000, increase to 1 Tbps

Exponential Data Growth
- 161 Exabyte are created by IT in 2007
- In 2007 creation will surpass for the first time storage capacity
- Moore’s law for data creation
- Amount of data is doubling every 18-24 month, 980 Exabyte generated 2010
- Biggest contribution from digital cam and video
Technology Trends most relevant for SAP (2)

Green Technology
- Market place for energy trading – power companies, factories, households, etc.
- Carbon trading and tracking, carbon footprint for consumer goods
- Carbon neutral factories and houses

SOA, Web Services, E-commerce Web Services, Semantics
- SOA is becoming mainstream, satisfaction rate is 90% and 86% respectively, CIO Insight
- Amazon runs biz processes for Target, Animoto, etc.
- Semantics (meaning) for the Semantic Web, widely used in Web 2.0 and for ERP

Business Networks are organizations’ new primary source of differentiation
- Operational Excellence, Customer for Life, Product Services and Leadership, High Performing Assets, Responsive Supply Networks
- SW that responds to events in real time can help organizations
  - To offer new products and services,
  - Maximize utilization and profit from big and long-term investments in assets based on realtime available information, …
- Accelerated change across those networks triggers the need for evolved IT platforms
  - A Business Process Platform combines composition and integration technology with ready-to-use Enterprise Services into a powerful platform
Challenges for Biz SW
Enterprise software platforms need broad coverage

Frontend Characteristics
- Highly Distributed, anywhere anytime usage
- User-centric, Collaborative
- Implicit, Unstructured
- Exception Driven, Ad hoc, Dynamic

Backend Characteristics
- Structured, well-defined flows
- Process-driven, Transactional
- Reliable, Efficient, Scalable
- Mature, slower rate of change
- Centralized Core, ERP based
Technologies Needed
Technologies for the Connected Enterprise

Taking advantage of the massive amounts of new computing power

**Multi core, multi thread and grid computing**

Partition complex apps via web services, parallelizing service execution by detecting scope for parallelism, hide implementation detail from programmer, …

**Error tolerant SW, recovery oriented computing**

Manageability, fault tolerant computing (Amazon, NYSE, …)

**Data base**

Performance scalability, file clusters for DB, Partitioning, Security, Streaming DB, networked Data, smart data caching, Networked data management, flexible schemas (Freebase – graph describes data), ODB, …

**Lean consumption, SaaS**

SW is outsourced instead of on premise, implementing & managing HW & SW stack, e.g. NETSUITE (ERP&CRM), Salesforce (CRM), Webex, MCA Solutions (Service Planning and Optimization (SPO)). BI as a service, Service Market Places. Develop Services like open source SW.

Workday by Dave Duffield: in-memory, ODB and SaaS
Technologies for the Connected Enterprise

Extending Business Processes & Enterprise Services to other Networks

Real World Awareness and Internet of Things

Sensor networks, smart items, wearable computing, business logic operating on edge devices. Make real world data available from all kinds of sources (manufacturing systems, web, moving objects like cars, water companies, etc.) and connect to business apps.

Events - Biz Event Network, event bus, complex event processing, tracking

Capture and control basic events from Internet, DB, services, tasks. Aggregate, relate and identify events. Make meaningful biz events enterprise wide and beyond available, connect to analytics, financials, etc. Establish pervasive traceability over all apps (RFID, retail, utilities, spare parts, ...)

Robotics

MS CCR, LINQ, PFX – C# with SQL and lambda calculus, process (thread) agile
Collaboration and Simulation at the Center of Transactions and Processes

**Web Services & Mash Ups**

Remixing in new context, mix successful web applications with SAP applications (Duet, interactive forms, NRX), smart clients, Ajax, hybrid apps that can work offline (Google Gears, Adobe Air)

**Open Source & Social Networking**

Collaborative development, risk mitigation, develop on demand with virtual team. New biz models - revenue from service, long tail, blur between private & biz life, social networks, semantic search, Eureka 2.0, Freebase, recommendation engines,…

**Real time analysis and decision making, augmented reality (SL), gaming for ERP**

Automatically anticipate and adapt to needs of users. Retrieval and analysis of data from the web and ERP, diagnostics and analytics (statistics, machine learning, etc.) for biz data, real time virtual rich media (second life, etc.), multi party real time gaming, corporate strategy simulation., visible intelligence
Rebalancing User Centricity with Business Process Centricity

**Usability Ups**

- Computers are evolving to more natural interfaces – speech, handwriting & image recognition
- Usability is key when moving to model driven programming (e.g. service orchestration) and the “internet” (e.g. Web 2.0, SW as a Service, mash-ups, etc.)
- User-centered design methodologies

**Multichannel access including mobility**

- MS table computer, iPhone, Skype (ubiquitous video conferencing), location based services, …
Technologies for the Connected Enterprise

Improve Productivity and Reduce Cost of Software Development

Use dynamic programming language to tape into massive amounts of developer communities outside of the traditional ERP communities

E.g., Ruby, connect to rules, constraints for biz processes, light weight debuggers that handle concurrency

Service Orchestration & Composite Applications

Discover and orchestrate services & UI to new services and composites for cognitive non-routine applications, semantics, rule engines

Security

Security of distributed Services, Privacy, Compliance, Risk Management

Address the Complexity of ERP Software

Define universal metadata, reverse engineering, ontologies, self describing data

Interoperability, convert between internal and external formats like CCTS, Rosetta Net, etc
Define universal product ID beyond enterprise boundaries (EPCIS, DoD, ..), Transform and structure complex applications
Technologies for the Connected Enterprise

Miscellaneous

Mathematical approaches to Biz SW

Algorithms in the attic (HBR mega trend), Google, DARPA Cougaar Agents, Khmetrics OR, financial OR, game theory, risk propagation in planning systems, productivity functions,

Green Technology

Energy distribution (market places), carbon tracking, hazardous material tracking, efficiency, hydrolysis, alternative fuel and energy generation
What’s for Sure
Some Predictions

SMB SW market will show strong growth
- ERP is mature, IT spending in big corporations is slow (possibly even a recession)
- Future growth will come from BRIC+9 (16%), SMB are especially important

“Horizontal” offerings will account for near future revenue increase for SAP
- Apps on top of ERP enabled by SOA: BPM, Biz User Intelligence (GRC, CPM, ...)

Enterprise IT players will move into consumer (end user) market
- ERP vendors need new seats, SMB user is not the expert user
- AppPhone to close gap between notebook and smart phone
  - Web connected, consumer priced, simple to use, out of the box “utility”
  - Consumer and enterprise players will collide with SMB at ground zero
    - IBM, SAP, .. versus Google, eBay, Yahoo, Apple,...
Some Predictions

Mobile will cause the furthest reaching changes
- Mobile connectivity will bring innovative biz models to developing countries and BRIC+9
  - 1.4 B Mobile users worldwide, i.e. more than 20% of the worlds population
  - Mobile connectivity will create new biz models also in developing countries
- Location based services
  - 20% of mobiles have already GPS with a growth rate of 25% for the coming years
- Web 2.0 on mobile
  - Your cell phone will be your wallet, your ticket broker, your concierge, your bank, your shopping buddy, and more…
  - (IBM: Five Innovations that Will Change Our Lives Over the Next Five Years)

SaaS will grow faster than total SW market
- Scale economies and SMB are a big driver
- Virtualization is the enabler
- Enables on demand analytics, Acxiom offers ConnectionPoint for retail, Experian, Thomson Finance,…
Thank You - Merci Beaucoup
An Interlude - IBM: Five Innovations that Will Change Our Lives Over the Next Five Years

It will be easy for you to be green and save money doing it: A range of "smart energy" technologies will make it easier for you to manage your personal "carbon footprint". As data begins to run through our electrical wires, dishwashers, air conditioners, house lights, and more will be connected directly to a "smart" electric grid, making it possible to turn them on and off using your cell phone or any Web browser. In addition to alerting you about leaving appliances on when they could be off to conserve energy, technology will also provide you with up-to-date reports of electrical usage, so you can monitor how much you are spending and how much energy you are putting out, just like you can track your cell phone minute usage today. Intelligent energy grids will also enable utilities to provide you with the option to use green energy sources, like solar and wind, to fuel your home, and innovations in solar and wind technology will bring cost-efficient options to a utility near you.

The way you drive will be completely different: In the next five years, a coming wave of connectivity between cars and the road is going to change the way you drive, help keep you safe, and even keep you out of traffic jams. Technology is poised to keep traffic moving, cut pollution, curb accidents, and make it easier for you to get from point A to B, without the stress. The cities you live in will find a cure for congestion using intelligent traffic systems that can make real-time adjustments to traffic lights and divert traffic to alternate routes with ease. Your car will have driver-assist technologies that will make it possible for automobiles to communicate with each other and with sensors along the road -- allowing them to behave as if they have 'reflexes' so they can take preventive actions under dangerous conditions. Your car will automatically tell you where traffic is jammed up and find you an alternative route to take.

You are what you eat, so you will know what you eat: We've all heard the saying 'you are what you eat', but with foods being sourced across international borders, the need to 'know exactly what you eat' has never been so important. In the next five years, new technology systems will enable you to know the exact source and make-up of the products you buy and consume. Advancements in computer software and wireless radio sensor technologies will give you access to much more detailed information about the food you are buying and eating. You will know everything from the climate and soil the food was grown in, to the pesticides and pollution it was exposed to, to the energy consumed to create the product, to the temperature and air quality of the shipping containers it traveled through on the way to your dinner table. Advanced sensor and tracing systems will tell you what you eat, before you eat it.

Your cell phone will be your wallet, your ticket broker, your concierge, your bank, your shopping buddy, and more: In the next five years, your mobile phone will be a trusted guide to shopping, banking, touring a new city, and more. New technology will allow you to snap a picture of someone wearing an outfit you want and will automatically search the web to find the designer and the nearest shops that carry that outfit. You can then see what that outfit would look like on your personal avatar – a 3-D representation of you – right on your phone, and ask your friends, in different locations, to check it out online and give their opinion. Your phone will also guide you through visiting a city. When you turn on your phone in a city you are visiting, it automatically provides you with local entertainment options, activities, and dining options that match your preferences, and then make reservations and purchases tickets for you – like a personal concierge.

Doctors will get enhanced “super-senses” to better diagnose and treat you: In the next five years, your doctor will be able to see, hear and understand your medical records in entirely new ways. In effect, doctor’s will gain superpowers – technologies will allow them to gain x-ray like vision to view medical images; super sensitive hearing to find tiniest audio clue in your heart beat; and ways to organize information in the same way they treat a patient. An avatar – a 3D representation of your body – will allow doctors to visualize your medical records in an entirely new way, so they can click with the computer mouse on a particular part of the avatar, to trigger a search of your medical records and retrieve information relevant to that part of your body, instead of leafing through pages of notes. The computer will automatically compare those visual and audio clues to thousands or hundreds of thousands of other patient records, and be able to be much more precise in diagnosing and also treating you, based on people with similar issues and makeup.