# Distributed & Outsourced

# Software Engineering

Bertrand Meyer, Martin Nordio
ETH Zurich

Peter Kolb
Red Expel

Christian Estler, Julian Tschannen (ETH, assistant)

ETH course, Fall 2014

# Course page

http://se.inf.ethz.ch/courses/2014b_fall/dsl/

Also see project description:
http://se.inf.ethz.ch/research/dose/

# Our goal in this course

We want you to:

- Understand the fundamental issues and techniques of software engineering
- Understand the specificities and technical challenges of distributed software development, including in an outsourcing context
- Know how to organize, participate in and manage an distributed project
- Understand the effect of the outsourcing phenomenon on the industry and manage your own career accordingly

# Topics (partial)

- Challenges of distributed software development
- The outsourcing phenomenon and its evolution
- Organizing a distributed project
- Requirements
- Process models
- Negotiating with suppliers: Service Level Agreements
- Quality assurance & testing

# A profound transformation

Massive transfer of development towards specialized suppliers, largely in low-wage countries

Outsourcing is not new; offshore development is a major new trend, affecting everyone in the information technology

# A profound transformation

Started with manufacturing

Then electronic design

Then low-level service jobs

Then call centers, customer support…

Then implementation-level programming

Then…

# Why we are doing this

Distributed Software Engineering raises new challenges

Techniques exist, but the skills must be taught

You should understand the issues quickly and find solutions

This is also a great way to learn by example the benefits of software engineering principles, e.g. abstraction, API design, documentation, requirements…

# Project principles and roles

Emulate industrial setting, but only where it makes sense

- A university is not a company (e.g. money not a factor)
- Benefits of a controlled setting
- Goal #1 is to learn

All groups created equal

- We do not want e.g. one university to specify & another implement

Clear management structure

- Central management role, currently at ETH
- Technology choices imposed; currently Eiffel (as a language and method), Web tools, any others that may be necessary
- Universities invited to contribute, e.g. broadcast own lectures

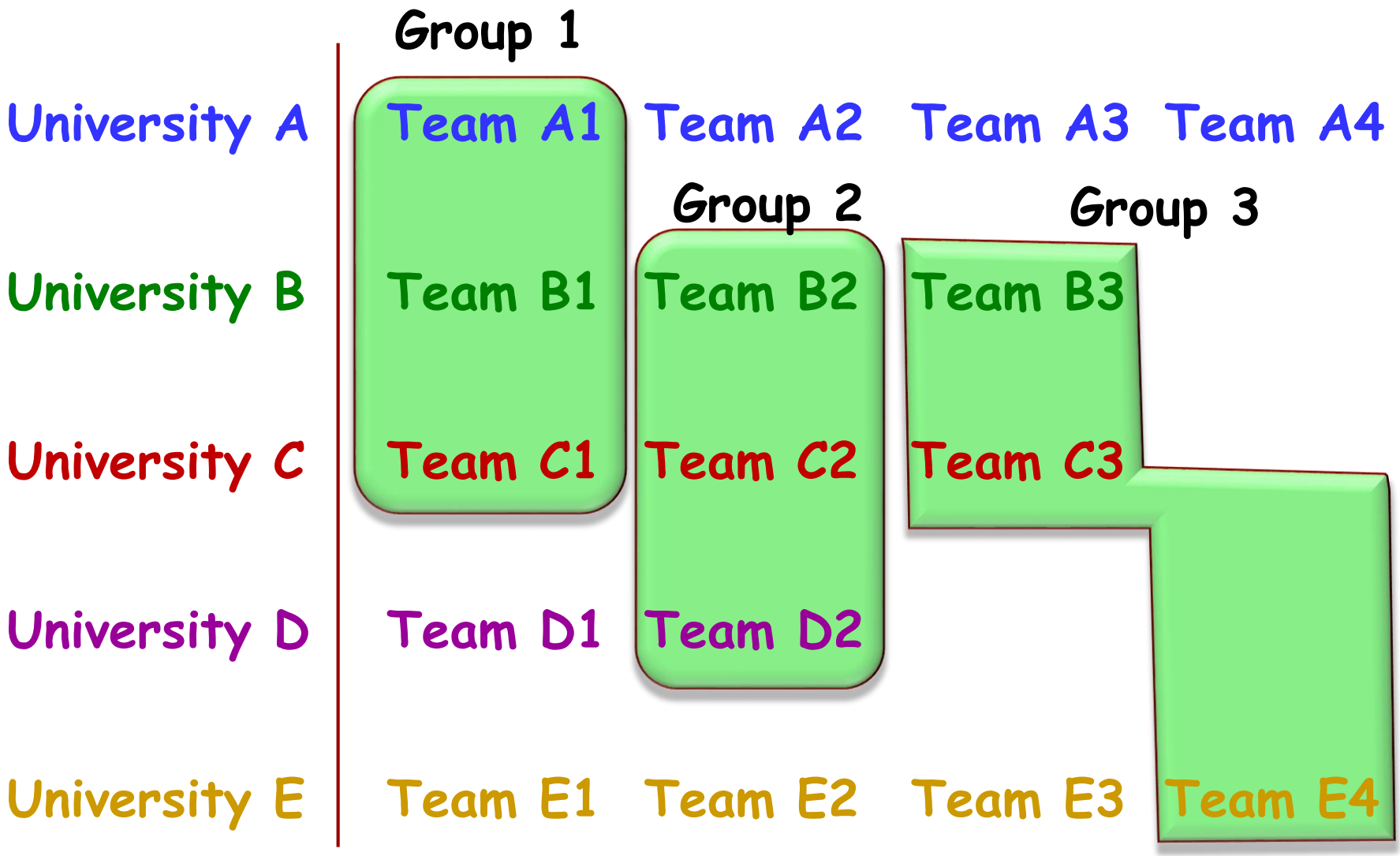
# Evolution of this course

- Since 2004 and until 2007: "*Software Engineering for Outsourced and Offshore Development*"
- First of its kind (as far as we know)
- Since 2007 year: project participation from other universities
- Since 2008 year: Distributed and Outsourced Software Engineering
- Project in cooperation with several universities

# The DOSE Course

| | | |
|---|---|---|
| 1. | ETH Zurich | 2007 |
| 2. | University of Zurich | |
| 3. | Odessa National Polytechnic (Ukraine) | |
| 4. | University of Nizhny Novgorod (Russia) | |
| 5. | Politecnico di Milano (Italy) | 2008 |
| 6. | University of Debrecen (Hungary) | |
| 7. | Hanoi University of Technology (Vietnam) | 2009 |
| 8. | University of Rio Cuarto (Argentina) | |
| 9. | KAIST (Korea) | |
| 10. | Wuhan University (China) | 2010 |
| 11. | University of Delhi (India) | |

# Teams and groups



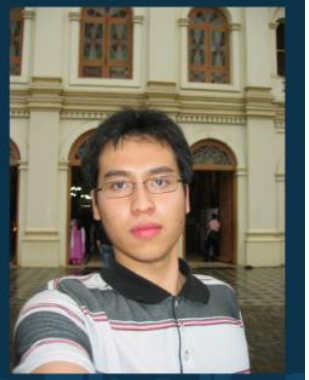
# DOSE 2007-2012

# Groups' presentation

## Shenji Schäppi

Computer Science MSc Student at ETH Zurich

- Eiffel Exp.: good
- SRS Exp: good
- Work Exp: Internship at Accenture India (Bangalore)
- O-O languages: Good Knowledge of Java, basic knowledge of C#,C++,C
- Languages spoken: English, German, French



## Minh Le Do

Computer Science BSc Student at HUT

- Eiffel Exp.: none
- SRS Exp: basic
- Work Exp: Internship at LINC - HUT (Hanoi, Vietnam)
- Biggest project: 1'000 lines of code
- O-O languages: Basic Knowledge of Java, basic knowledge of C#
- Languages spoken: English, Vietnamese, German

## Conrado Plano

Computer Science MSc Student at ETH Zurich

- Eiffel Exp.: good
- SRS Exp: good
- Work Exp: Assistant for lecture Introduction to Programming, Internship at Accenture India (Bangalore) and Lotus Notes Consultant at ATEGRA AG
- O-O languages: Good Knowledge of Java, basic knowledge of C#
- Languages spoken: Spanish, English, German, Italian

## Duc Hoang Bui

Computer Science MSc Student at HUT

- Eiffel Exp.: basic
- SRS Exp: good
- Work Exp: Internship at ATNAVN (Hanoi)
- Biggest project: 12'000 lines of code(a web application on Struts2)
- O-O languages: Good Knowledge of Java, basic knowledge of C#
- Languages spoken: English, Vietnamese, French

# Project presentation (2007)

Attended by students from all universities involved

(through Skype)

# Demos

DOSE 2009:

http://youtu.be/ajAAdEJlnk8

http://youtu.be/10XWBFIQFh8

DOSE 2011:

http://youtu.be/UOLq77YykyA

http://youtu.be/_tA70IKm9GY

http://youtu.be/cWtVvOe2OBM

http://youtu.be/SfIYBv9j78M

http://youtu.be/JJdwYP58hgI

DOSE 2012:

http://youtu.be/ly86S4dMIrs

http://youtu.be/BEqc0drq3fc

http://youtu.be/99umLjQ8RUA

# ETH: Grading

Project: 100%

# ETH course

Exercise sessions

Tuesday 9am-10am

Project presentation, December 17, 2013

Assignment 0: Set up

Deadline: Tuesday. September 24th

# Four key elements

Strategy

Process

Technology

Communication

# Today

Challenges of distributed development: an industrial experience

The outsourcing proposition (part 1)

# Reference for this first lecture

Bertrand Meyer, "Design and Code Reviews in the Age of the Internet", *Communications of the ACM*, September 2008.

# The context

Gone are the days of one-company, one-team, one-location projects

Today's ecosystems are multipolar!

- Distributed team
- Flexible assignment of tasks
- Outsourcing, insourcing, backsourcing
- Flexibility is key: the world belongs to the nimble
- Lots of ideas, proven and unproven, e.g. agile methods
- What happens in the absence of direct contact?
- Universities do not prepare for this!

# An industrial experience

Lessons and challenges from experience with the ecosystems of a distributed development at Eiffel Software

# Eiffel Software

Technology company

Focused on O-O tools, Eiffel approach, Design by Contract

Serving the needs of very demanding customers in finance, defense, aerospace, health care, education…

Actively involved in standardization (ECMA, ISO)

"Eiffel ecosystem"

# EiffelStudio development

Eiffel Software, in Santa Barbara (Calif.), since 1985

Two-million line code base (almost all Eiffel, a bit of C)

Major industry customers, mission-critical applications

Open-source license, same code, vigilant user community

6-month release schedule since 2006

My role: more active in past two years

Developer group ecosystem:

- Small group (core is about 10 people)
- Most young (25-35)
- Highly skilled
- Know Eiffel,O-O, Design by Contract
- Strong company culture, shared values
- Know environment, can work on many aspects
- Distributed
- Mostly, we live in a glass house

# Rule 1

The first principle of distributed development:

I would not try unless people have previously worked together in a common location

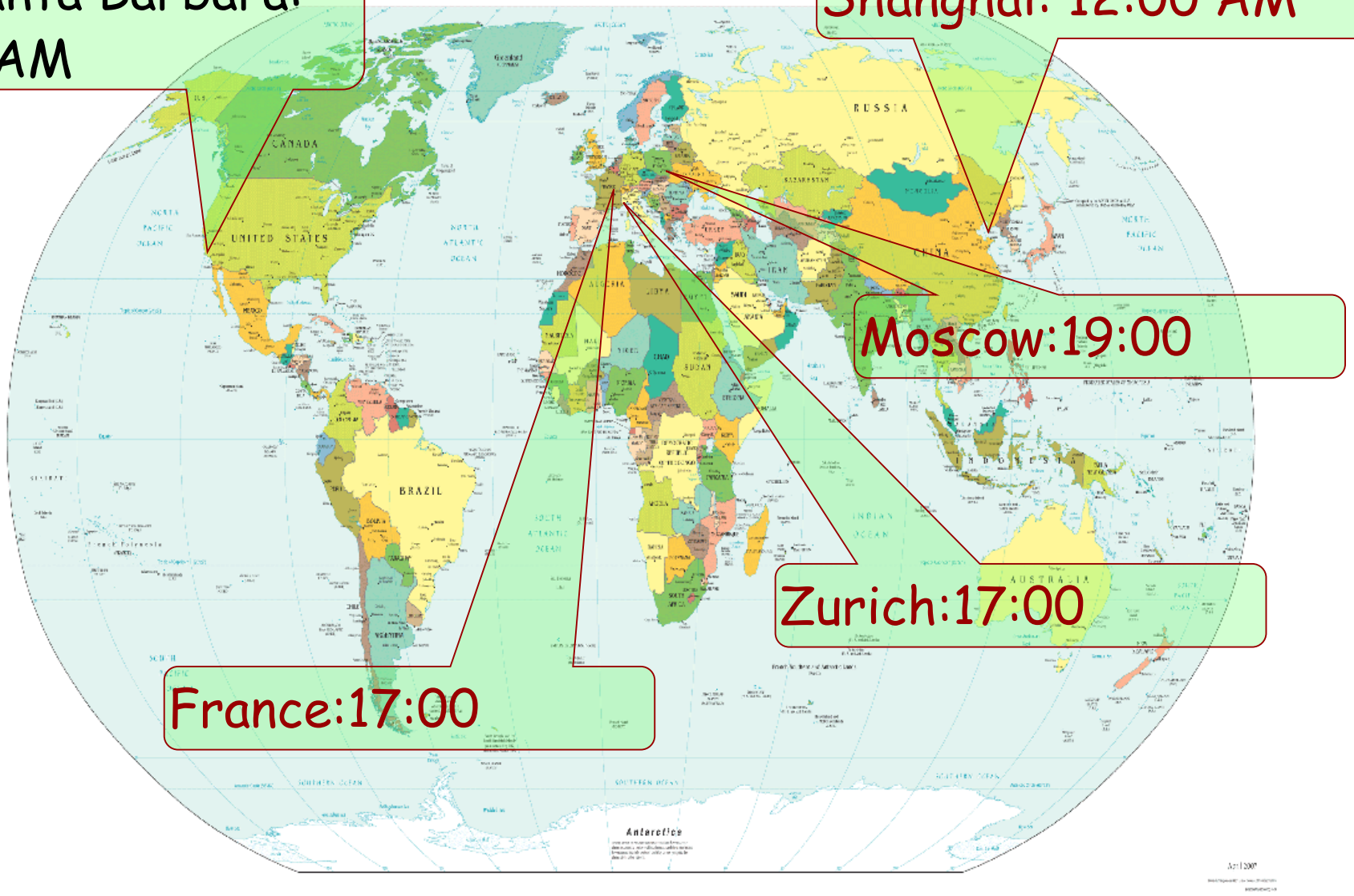
# Rule 2

Email is great, but every team needs contact

Our solution: the weekly one-hour meeting

Replaced a SB-only meeting (every Friday, until 2005)

# How do we organize a meeting?



# Meeting properties

Top goal: ensure that we meet the release deadline

Tasks: check progress, identify problem, discuss questions of general interest

Not a substitute for other forms of communication

Time is strictly limited: one hour come rain or shine

(The meeting challenge: see E. Northcote Parkinson)

# Meeting tools: originally

Skype (conference call, limited to 9 people)

Skype chat window

Google docs

# Lessons

Basically it works, but still far from perfect

Still too many non-semantic communication (see Roman Jakobson)

Audio communication heightens problems, e.g. accents

Ability to edit a common document in real time is a critical advantage

Need to work after the meeting

Documents are key: mix of verbal and written word

# Infrastructure matters

Connection problems are not fun after the third time

# Meeting tools: now

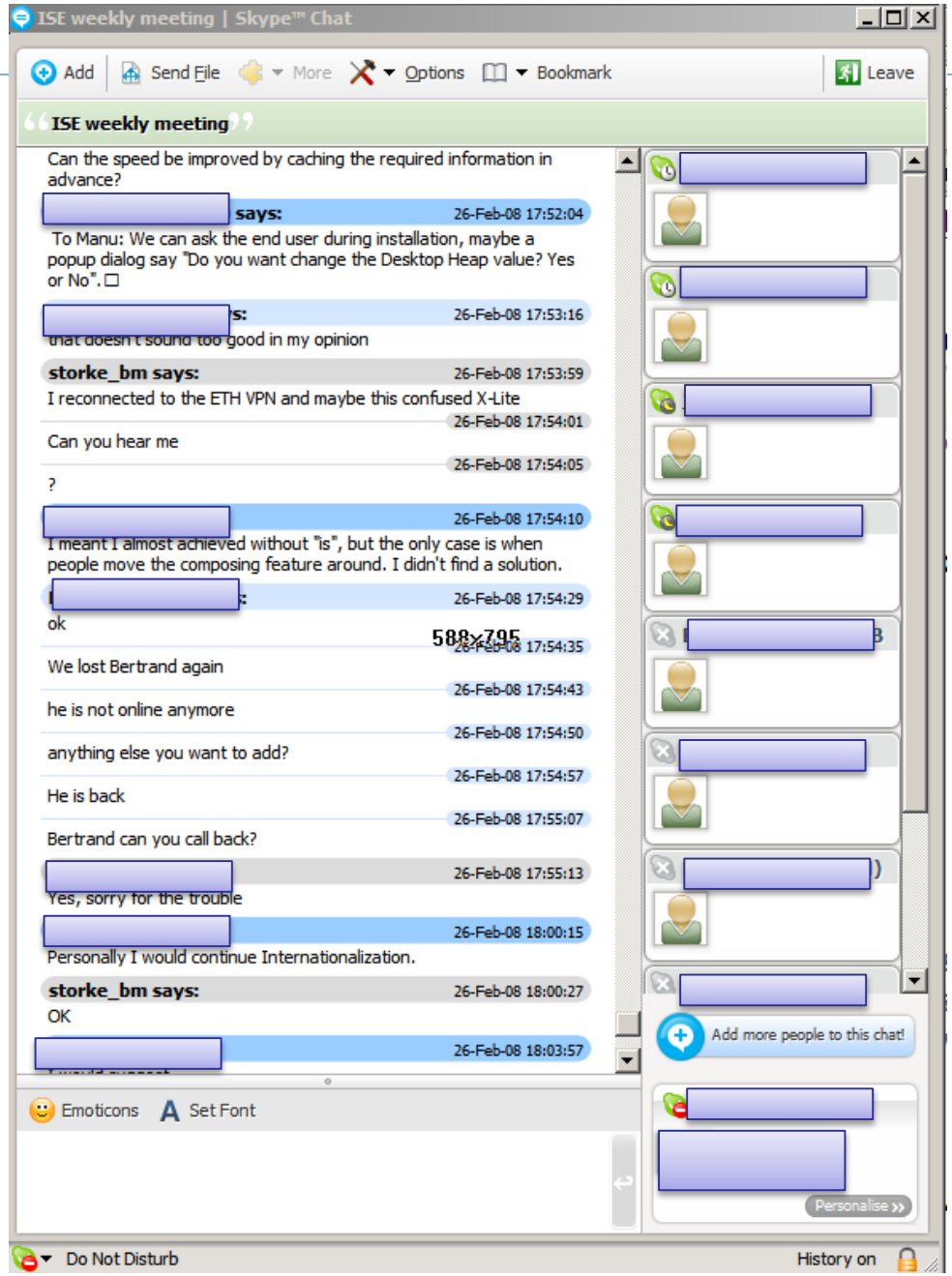
Webex for conference call management

X-Lite as a replacement for Skype

Google Docs

Wiki site (http://dev.eiffel.com)

Skype: chat window only


ISE weekly meeting | Skype™ Chat
Add
Send File
More
Options
Bookmark
Leave
ISE weekly meeting
Can the speed be improved by caching the required information in advance?
says: 26-Feb-08 17:52:04
To Manu: We can ask the end user during installation, maybe a popup dialog say "Do you want change the Desktop Heap value? Yes or No". ☐
26-Feb-08 17:53:16
that doesn't sound too good in my opinion
storke_bm says: 26-Feb-08 17:53:59
I reconnected to the ETH VPN and maybe this confused X-Lite
26-Feb-08 17:54:01
Can you hear me
26-Feb-08 17:54:05
?
26-Feb-08 17:54:10
I meant I almost achieved without "is", but the only case is when people move the composing feature around. I didn't find a solution.
26-Feb-08 17:54:29
ok
588×795
26-Feb-08 17:54:35
We lost Bertrand again
26-Feb-08 17:54:43
he is not online anymore
26-Feb-08 17:54:50
anything else you want to add?
26-Feb-08 17:54:57
He is back
26-Feb-08 17:55:07
Bertrand can you call back?
26-Feb-08 17:55:13
Yes, sorry for the trouble
26-Feb-08 18:00:15
Personally I would continue Internationalization.
storke_bm says: 26-Feb-08 18:00:27
OK
26-Feb-08 18:03:57
Add more people to this chat!
Personalise
Emoticons
Set Font
Do Not Disturb
History on

# Scripta manent

(Or: talk is cheap)  (Not a Skype advertising slogan)

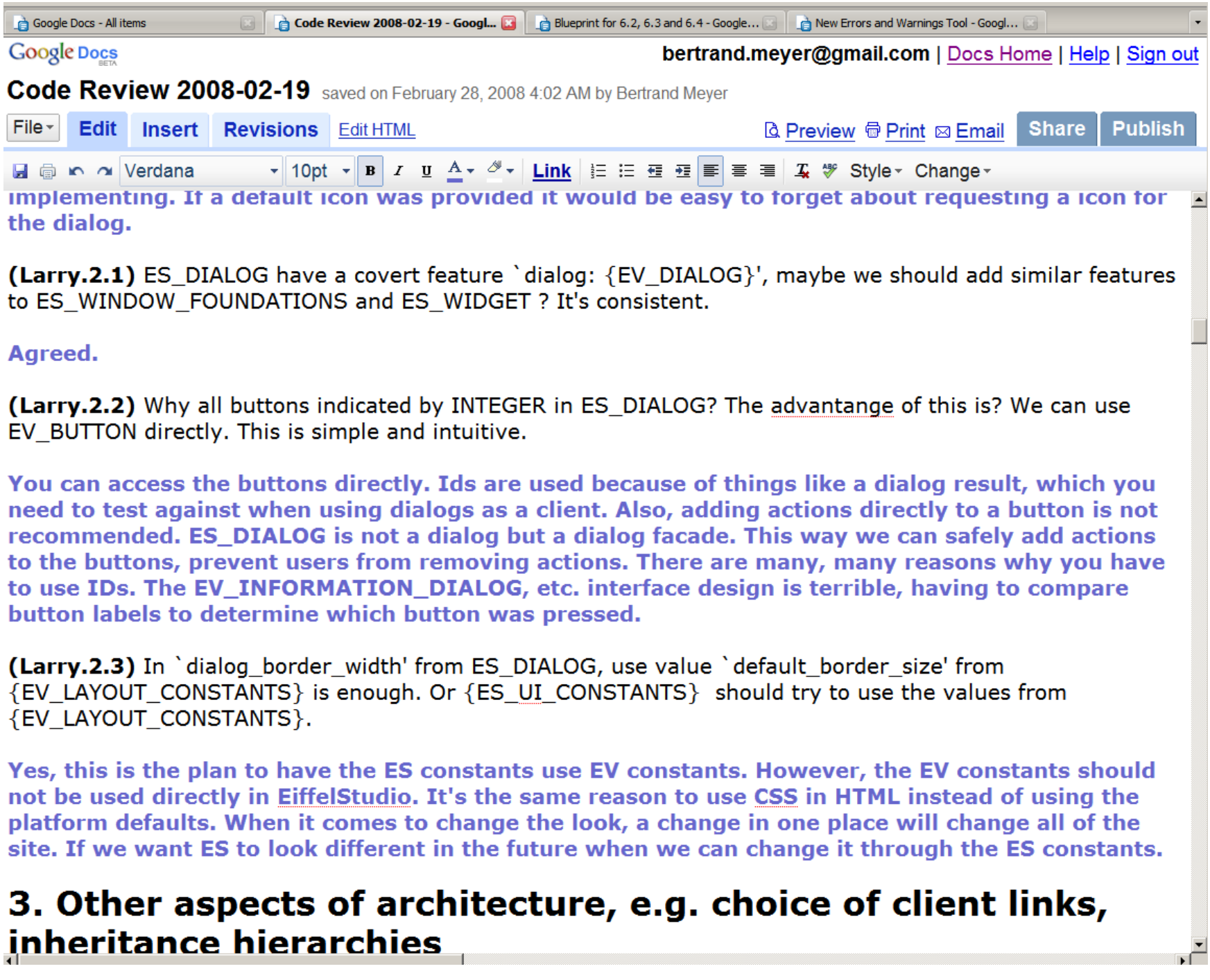
# Recent addition

Code review

Traditional: time-consuming, tedious, value often questioned as compared to e.g. static analysis tools

With the Web it becomes much more interesting!

- Classes circulated three weeks in advance
- Comment categories: choice of abstractions, other aspects of API design,architecture choices, algorithms & data structures, implementation, programming style, comments & documentation
- Comments in writing on Google Doc page, starting one week ahead
- Author of code responds on same page
- Meeting is devoted to unresolved issues


Google Docs - All items
Code Review 2008-02-19 - Googl...
Blueprint for 6.2, 6.3 and 6.4 - Google...
New Errors and Warnings Tool - Googl...
Google Docs
bertrand.meyer@gmail.com | Docs Home | Help | Sign out
Code Review 2008-02-19 saved on February 28, 2008 4:02 AM by Bertrand Meyer
File Edit Insert Revisions Edit HTML
Preview Print Email Share Publish
Verdana 10pt Link Style Change
implementing. If a default icon was provided it would be easy to forget about requesting a icon for the dialog.
(Larry.2.1) ES_DIALOG have a covert feature `dialog: {EV_DIALOG}', maybe we should add similar features to ES_WINDOW_FOUNDATIONS and ES_WIDGET ? It's consistent.
Agreed.
(Larry.2.2) Why all buttons indicated by INTEGER in ES_DIALOG? The advantange of this is? We can use EV_BUTTON directly. This is simple and intuitive.
You can access the buttons directly. Ids are used because of things like a dialog result, which you need to test against when using dialogs as a client. Also, adding actions directly to a button is not recommended. ES_DIALOG is not a dialog but a dialog facade. This way we can safely add actions to the buttons, prevent users from removing actions. There are many, many reasons why you have to use IDs. The EV_INFORMATION_DIALOG, etc. interface design is terrible, having to compare button labels to determine which button was pressed.
(Larry.2.3) In `dialog_border_width' from ES_DIALOG, use value `default_border_size' from {EV_LAYOUT_CONSTANTS} is enough. Or {ES_UI_CONSTANTS} should try to use the values from {EV_LAYOUT_CONSTANTS}.
Yes, this is the plan to have the ES constants use EV constants. However, the EV constants should not be used directly in EiffelStudio. It's the same reason to use CSS in HTML instead of using the platform defaults. When it comes to change the look, a change in one place will change all of the site. If we want ES to look different in the future when we can change it through the ES constants.
3. Other aspects of architecture, e.g. choice of client links, inheritance hierarchies

# Lessons

The world has gone global, so has the software world

Many difficult issues, failure always possible

Solutions exist

Many software engineering lessons apply, made even more relevant

Communication is the core issue

Infrastructure (network, tools…) is critical

# The software engineering ecosystem

The human factor is at the center of it all

Infrastructure is the enabler

# Overview

Worldwide IT services revenue (Gartner, billions $):

2005: 625
2006: 672
2007: 730 (projected)
2008: 779 (projected)

Outsourcing "*primary source of growth*"

"*Replaces internal IT spending and is often funded outside of IT budgets, so growth in outsourcing is possible even in the face of flat IT budgets*"

# IT outsourcing

2002: $162 billion

2007 (expected): $236 billion

(Source: Gartner, 2004)

# US imports of software and services

US Commerce department figures:

$77.4 billion in 2003

Up $7.9 billion from 2002

Exports during same period: $131 billion, up $8.4 billion

# Percentage of offshoring

Percentage of offshoring in IT budgets (Forrester):

2000: 12%

2003: 28%

# When they say it's not about the money…

… then it is about the money.

# It's about the money

*In the better economic times, companies outsourced IT to get access to scarce IT talent. But in today's down economy, saving money has bubbled to the top as one of the primary reasons for making outsourcing deals*

Computerworld, March 18, 2002

*Right now, in this economy, cost savings is No. 1 criterion*

Tim Barry, Senior VP of Application Outsourcing, Keane, 2002

*Because of the recent global economic downturn, cost reduction has been the primary driver for outsourcing over the past several years and continues as a strong driver even as economic growth returns*

Gartner, 2004

# The offshoring proposition

Low salaries
Skilled workforce
Good university system
Good communication infrastructure
Stable political structure
Efficient business conditions
Entrepreneurial culture (greed?)
No insurmountable cultural barrier
Language skills
(Often) exile community in the client country
Culture of quality and qualification (CMM, ISO...)

# The role of qualification

CMM (the Capability Maturity Model) and its derivatives, such as CMMI, as well as other standards such as ISO 900X, have been a key enabler to the takeoff of offshore development

# Other relevant aspects

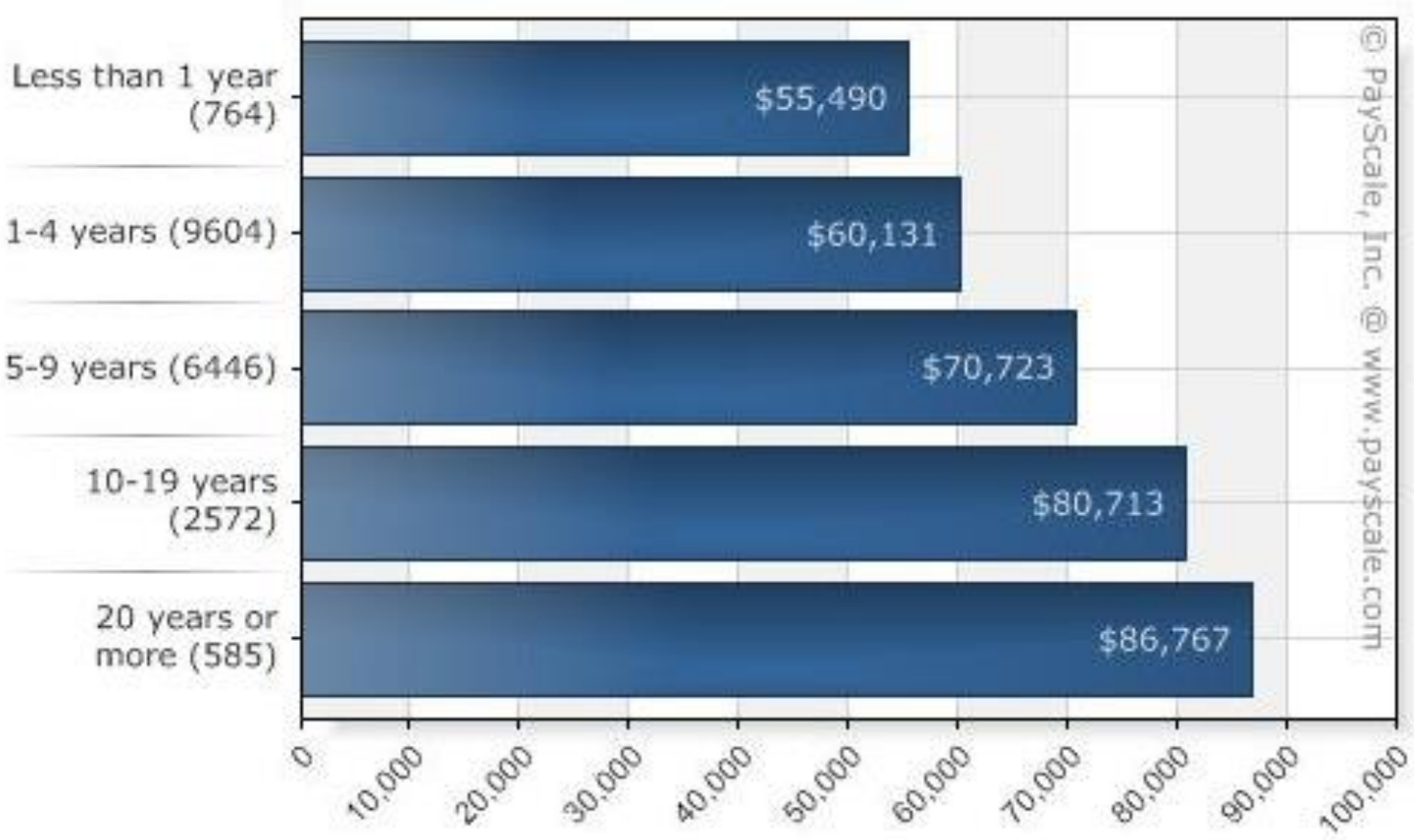
Work ethics

Language skills

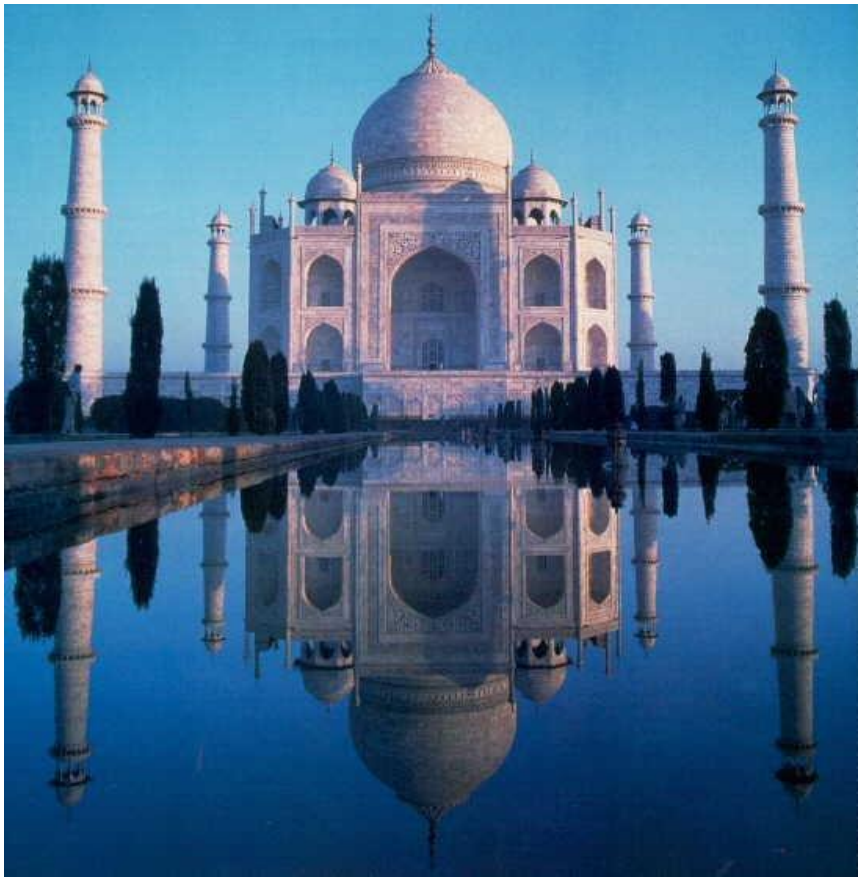
Time zones

# For comparison: US developer salaries

(Source: PayScale, 16 September 2007)



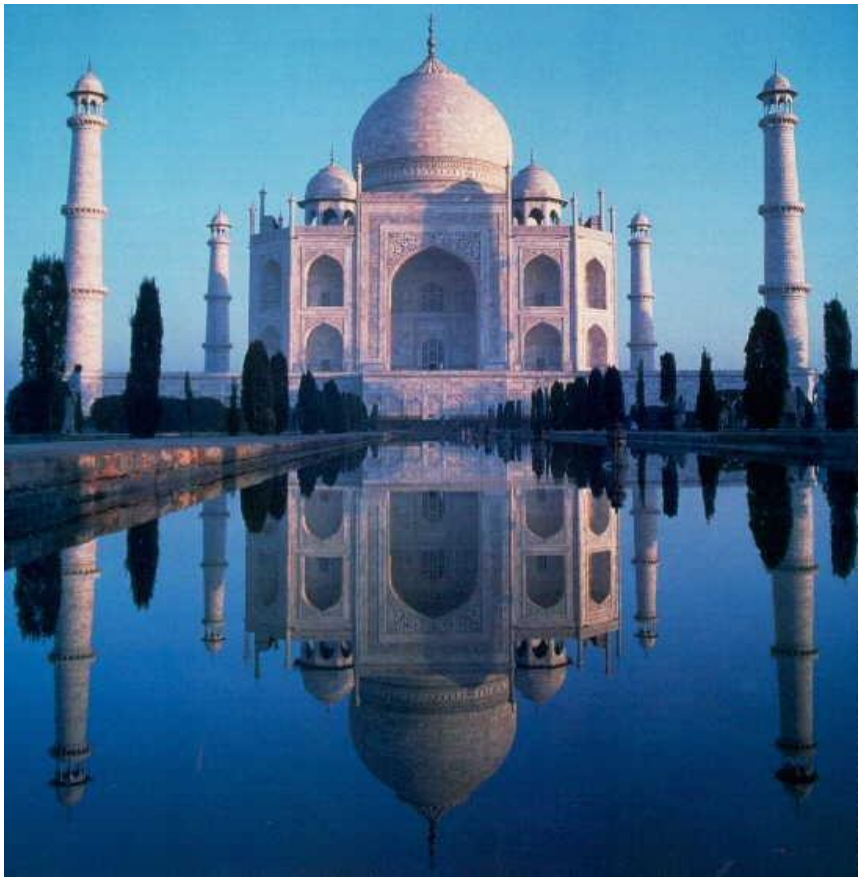
# India



Software/services exports: $31 billion in 2006-2007, up 32% (industry: $40 billion); targeted to $50 billion by 2008 (NASSCOM), 5.2% of GDP

- Official policy to support outsourcing, IT ministry
- University infrastructure, Indian Institutes of Technology; 75,000 IT graduates a year
- English widely known
- Technical salaries: $10,000 to $25,000 (average 15,600 in 2007, up 18.6%)
- IT parks (Bangalore...) have excellent infrastructure
- Key role of Indian technical diaspora in the US
- Strong emphasis on qualification (CMMI, ISO)
- The reference success story for outsourcing

# India



Large software companies: Tata Consulting Services (95,000 employees, $4 billion revenue), Infosys (76,000, $3.1 billion), Wipro (68,000, $3.4 billion), HCL Technologies, Patni

Numerous Western companies have established subsidiaries

Increased competition for talent

# China

50,000 technical graduates per year

Technical salaries: $5,000 to $20,000

Intellectual property issues remain

Infrastructure good in major cities

Strengths so far: high tech, consumer electronics, telecom, finance

IT outsourcing revenue: $5 billion in 2005, $10 billion in 2006 (50% growth), $27 billion in 2007 (Gartner)

# Russia

- Good university system, strong on mathematics and basic science. 3rd largest population of scientists and engineers per capita
- Technical salaries: $15,000 to $30,000
- Business climate volatile, bureaucracy
- Infrastructure: OK in Moscow and Petersburg. Telecoms still expensive. Excellent education system
- Strengths so far: advanced software development, Web development, research
- Significant operations of Western firms: Sun, Intel, Motorola, Alcatel, Siemens

IT outsourcing revenue: $1 billion in 2005, growing 50% a year

# Ireland

IT outsourcing revenue from US: $8.3 billion

Technical salaries: $25,000 to $35,000

Favorable tax structure, $330 million technology-education fund

English language

Strengths so far: service centers, call centers (Dell, HP, Microsoft...)

An example of a successful outsourcing infrastructure in a developed country

# Challengers

Eastern Europe: Poland, Rumania, Bulgaria, Czech Republic, Hungary, Baltic countries ("nearshore" development)

Vietnam

Thailand

Philippines

15,000 tech graduates/year, labor slightly higher than India, government support

Ghana

Government support, English official language, 10,000 IT grads/yr

Mexico

Close to US, NAFTA

Brazil

Israel

South Africa

Egypt

Mai 2004

IG Metall
# SIEMENS NACHRICHTEN

Für die Beschäftigten des Siemens-Konzerns

# Siemens-Globalisierungsstrategie gefährdet Standort Deutschland

**Siemens hat ein Programm zum Abbau und zur Verlagerung von Arbeitsplätzen in Niedriglohnländer beschlossen. Betroffen sind alle Unternehmensbereiche im Konzern und alle Tätigkeiten - Entwicklung, Programmierung, Fertigung und Verwaltung. Diese Strategie ist eine existenzielle Bedrohung für die Siemens-Beschäftigten, ihre Familien und für viele Regionen und schwächt den Standort Deutschland. Bei konsequenter Umsetzung der weltweiten „Anpassung" von Umsatz und Wertschöpfung im Konzern stehen in Deutschland langfristig über 70.000 Arbeitsplätze zur Disposition. Nur wenn wir länger arbeiten und auf bis zu 30 Prozent des Einkommens verzichten, will Siemens einen Teil der Jobs halten.**

**Wir wissen, dass nicht jeder Arbeitsplatz gehalten werden kann und dass die deutsche Gesellschaft von der internationalen Arbeitsteilung profitiert. Aber „gesellschaftliche Verantwortung" (Siemens-Leitbild) heißt auch, für Arbeitsplätze, die wegfallen, neue zu schaffen. Wir sind auch nicht gegen Globalisierung. Aber wir sind gegen Lohndumping und gegen Stellentourismus in Länder, in denen Demokratie, Menschenrechte und soziale Standards wenig gelten. Diese ausschließlich am Profit und an schnellen Ergebnissen orientierte Siemens-Strategie gefährdet den Standort Deutschland, schadet der Bevölkerung in den Zielländern der Jobwanderung und ist zudem unternehmerisch riskant.**

Wir fordern deshalb vom Siemens-Zentralvorstand:

- **Eine konzernweite Vereinbarung für die Sicherung der Arbeitsplätze und der Zukunft der Standorte**
- **Keine betriebsbedingten Kündigungen im Zusammenhang mit Verlagerungen**
- **Ausnutzung der Flexibilisierungsmöglichkeiten im Tarif statt längerer Arbeitszeiten, was nur weitere Arbeitsplätze kostet**
- **Hände weg von den Einkommen - statt dessen Optimierung der Prozesse und Nutzung aller sonstigen Einsparmöglichkeiten**
- **Keine Inanspruchnahme öffentlicher Förderung bei Arbeitsplatzverlagerungen**
- **Ein Konzern-Programm für mehr Kundennähe und für mehr Innovationen in Deutschland**

**Ich unterstütze diese Forderungen durch meine Unterschrift !**

# Effect on US jobs (Forrester)

315,000 service jobs shifted offshore by end of 2003
(less than 1% of affected categories)

Projected: 3.4 million by 2015

# 11 May 2004

## US state adopts anti-BPO bill

*(source: Rediff)*

The state of Kansas has adopted a bill seeking to bar outsourcing telephone enquiries about its food stamp program to India and other countries.

The Department of Social and Rehabilitation Services signed a contract with eFunds Corp in September 2002 to handle food stamp benefits and take clients' calls. In its 2003 annual report, eFunds said it has two customer call centers in India and that about 3,100 of its 5,400 employees are outside the United States. Outsourcing became an issue in the legislature when it was revealed that Kansas' calls about food stamps were answered by workers not in Kansas but in India.

The measure would require SRS to renegotiate its $1.7 million-a-year contract with the Arizona-based eFunds Corp. The agency said it does not know whether contract costs will increase if calls are answered in Kansas.

In March, Senator Mark Taddiken (Republican) persuaded fellow Senators to add a ban on outsourcing of food stamps work to a bill on next fiscal year's budget. Under his proposal, the ban would have taken effect on July 1. But SRS secretary Janet Schalansky told legislators that the ban would raise the cost of eFunds contract by about $640,000 as a centre will have to be set up in Kansas.

# Forms of outsourcing

| | | |
|---|---|---|
| Internal (to lower-cost divisions) | | *External* |
| Same country group | | *Offshore* |
| Specific | | *Business process (BPO)* |
| Operation (e.g. computer facilities) | | *Transfer* |
| Selective | | *Total* |
| Tactical | vs | *Strategic* |
| Transitional | | *Permanent* |
| Client-supplier | | *Partnership (joint venture)* |
| Maintenance | | *New product* |
| Development/operation | | *Research* |

# Arguments for outsourcing

Cost

Access to expertise

Focus on core business

Speed

Business process reengineering (aka change)

Control

Quality improvement

# Arguments against outsourcing

Loss of control, dependency on supplier

Loss of expertise

Loss of flexibility

Loss of jobs, effect on motivation

# Outsourcing risks

Loss of personnel and expertise
Loss of user input and business-related information
Leaks of intellectual property
Failure of third party
Disappearance of third party
Changes in business climate not addressed by contract
Insurmountable cultural differences, language problems
Communication costs, time difference, ...
Insufficiently precise contract
Contract not covering evolution
Rising costs out of modifications
Insufficient quality, detected late
Privacy issues
Security issues

# Plan

1. The outsourcing proposition (part 2: Exercise)
2. The technical issues
3. Management and validation techniques
4. Putting everything in place for successful outsourcing

*Plus: an exercise*