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# *Distributed & Outsourced Software Engineering*

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ETH course, Fall 2012

[http://se.inf.ethz.ch/courses/2012b\\_fall/dose/](http://se.inf.ethz.ch/courses/2012b_fall/dose/)

Also see project description:

<http://se.inf.ethz.ch/research/dose/>

# Our goal in this course

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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)

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- 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

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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

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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

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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

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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

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- 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

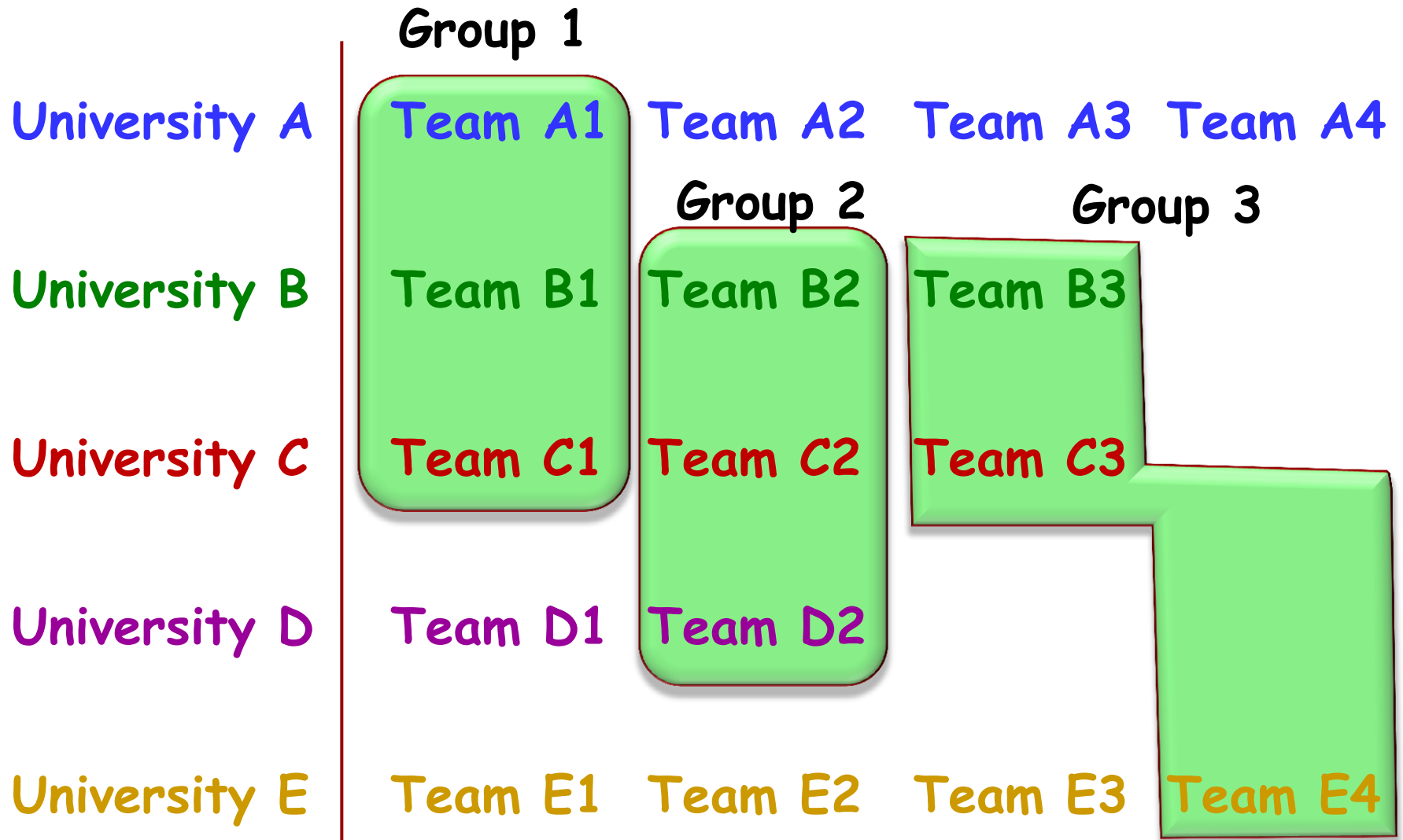
# The DOSE Course

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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 2007-2011



## 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)



## DOSE 2009:

<http://youtu.be/ajAAdEJlnk8>

<http://youtu.be/10XWBFIQFh8>

## DOSE 2011:

<http://youtu.be/UOLq77YykyA>

[http://youtu.be/\\_tA70IKm9GY](http://youtu.be/_tA70IKm9GY)

<http://youtu.be/cWtVvOe2OBM>

<http://youtu.be/SfIYBv9j78M>

<http://youtu.be/JJdwYP58hgI>

# This year project: DOSE 2012

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1. ETH Zurich, Switzerland
2. Cairo University, Egypt
3. Hanoi University of Science and Technology, Vietnam
4. ITMO, Russia
5. Odessa Polytechnic National University, Ukraine
6. Politecnico di Milano, Italy
7. Pontificia Universidade Catolica do Rio Grande do Sul (PUCRS), Brazil
8. State University of Nizhny Novgorod, Russia
9. University of Crete, Greece
10. University of Debrecen, Hungary
11. University of Rio Cuarto, Argentina
12. University of Zurich
13. Universidad Politecnica de Madrid, Spain



Project (due 17 December, presentation 18 December):  
100%

# Deadlines

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Assignment 0: Set up

Deadline: October 2<sup>th</sup>

Assignment 1: Scope Management Plan

Deadline: October 16<sup>th</sup>

Assignment 2: Requirements Document

Deadline: October 30<sup>th</sup>

Assignment 3: API with Design by Contract

Deadline: November 13<sup>th</sup>

Assignment 4: Test-Driven Development (TDD)

Deadline: November 20<sup>th</sup>

Assignment 5: Implementation in Eiffel

Deadlines: December 17<sup>th</sup>

Project Presentations: 18.12.2012



Theme: **Games**

The goal of the DOSE project is to implement complex games (card games or board games).

A list of games will be published. You can propose other games, but the complexity should be similar.

Done in Eiffel

Cluster-based, not process-based

- A **team** includes a few students (2 or 3) from one university
- A **group** is a collection of three teams, each from a different university
- Each group does the full subsystem
- Each team does a part of the subsystem

# Project Overview



Each Game:



Exercise sessions

Tuesday 9am-10am

Project presentation, December 18, 2010

Assignment 0: Set up

Deadline: Tuesday. October 2<sup>th</sup>

[http://se.inf.ethz.ch/courses/2012b\\_fall/dose/assignments/Assignment0.pdf](http://se.inf.ethz.ch/courses/2012b_fall/dose/assignments/Assignment0.pdf)

# Four key elements

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Strategy

Process

Technology

Communication

Challenges of distributed development: an industrial experience

The outsourcing proposition (part 1)



# Reference for this first lecture

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

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

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

# Eiffel Software

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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

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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

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The first principle of distributed development:

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

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?



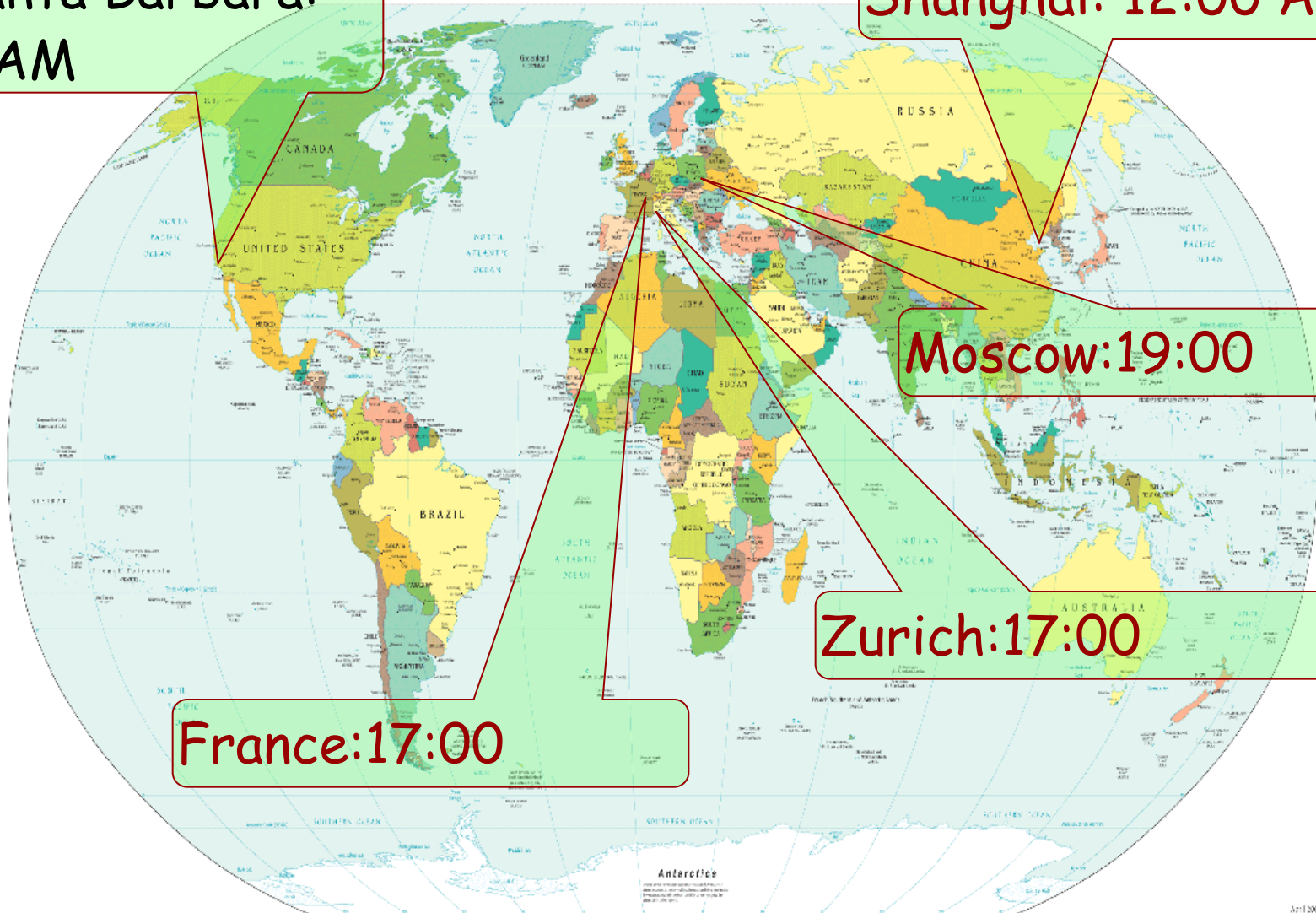
Santa Barbara:  
8 AM

Shanghai: 12:00 AM

Moscow: 19:00

Zurich: 17:00

France: 17:00





# Meeting properties

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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

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Skype (conference call, limited to 9 people)

Skype chat window

Google docs

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

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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". ☐

**s:** 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

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

Emoticons
 Set Font

Do Not Disturb
 History on



# Scripta manent

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

## 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



## 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 B I U A Link [List icons] [Table icon] [Text icon] 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 advantage 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

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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 human factor is at the center of it all

Infrastructure is the enabler

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

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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

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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

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*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

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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...)

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

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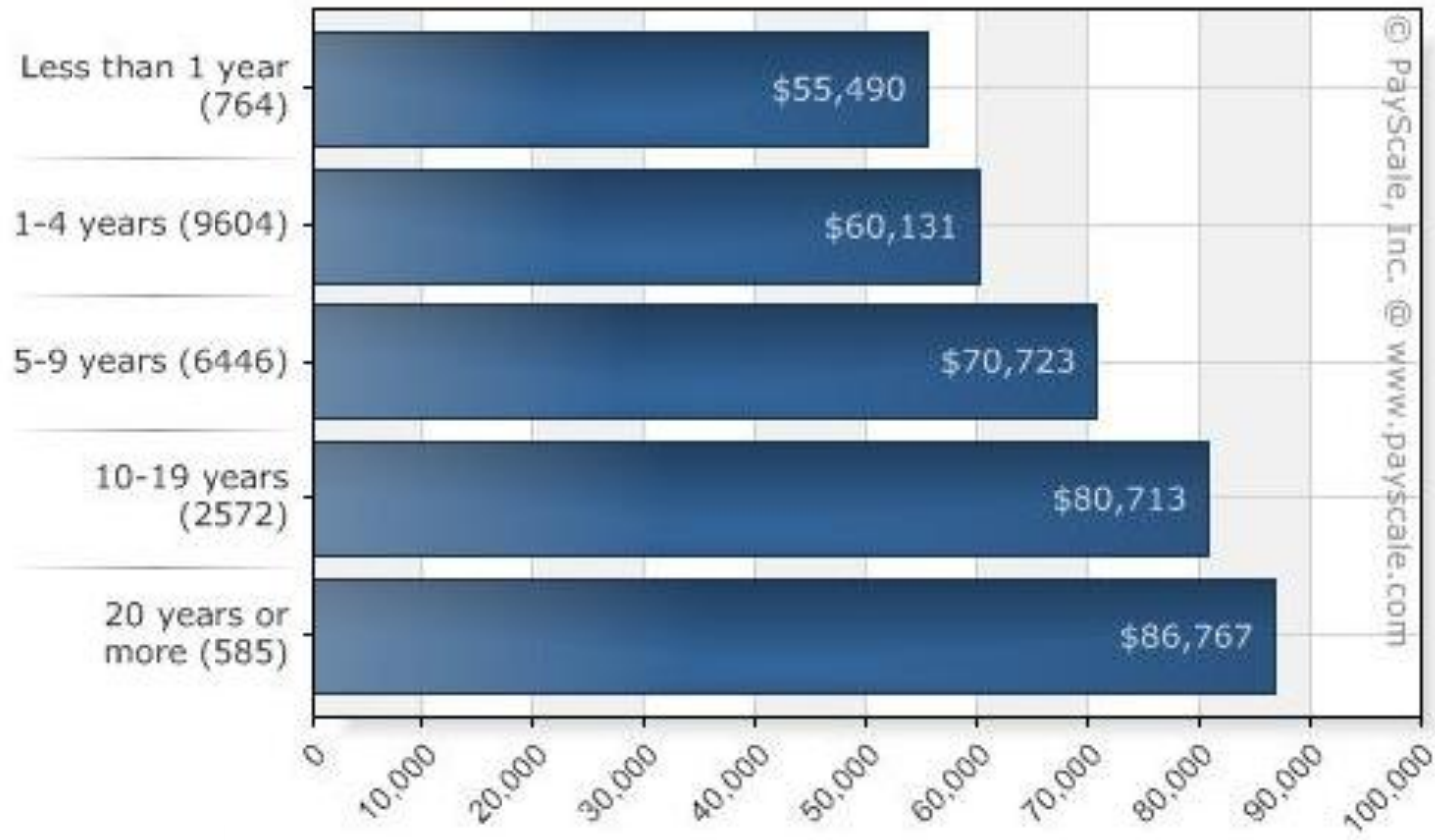
Work ethics

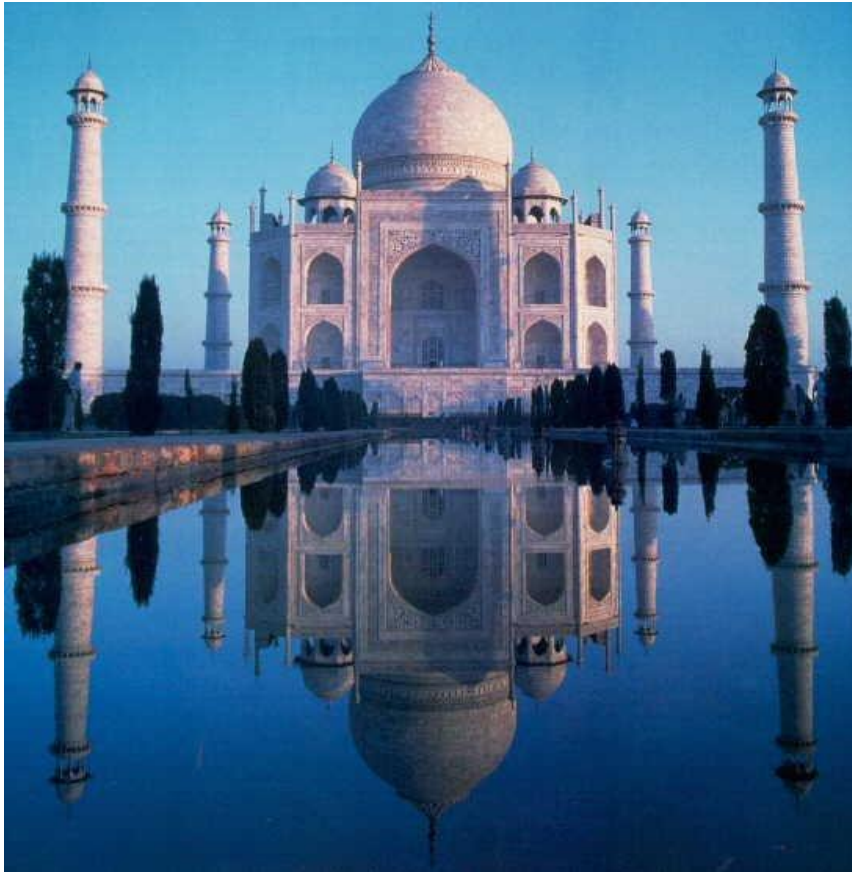
Language skills

Time zones

# For comparison: US developer salaries

(Source: PayScale, 16 September 2007)





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

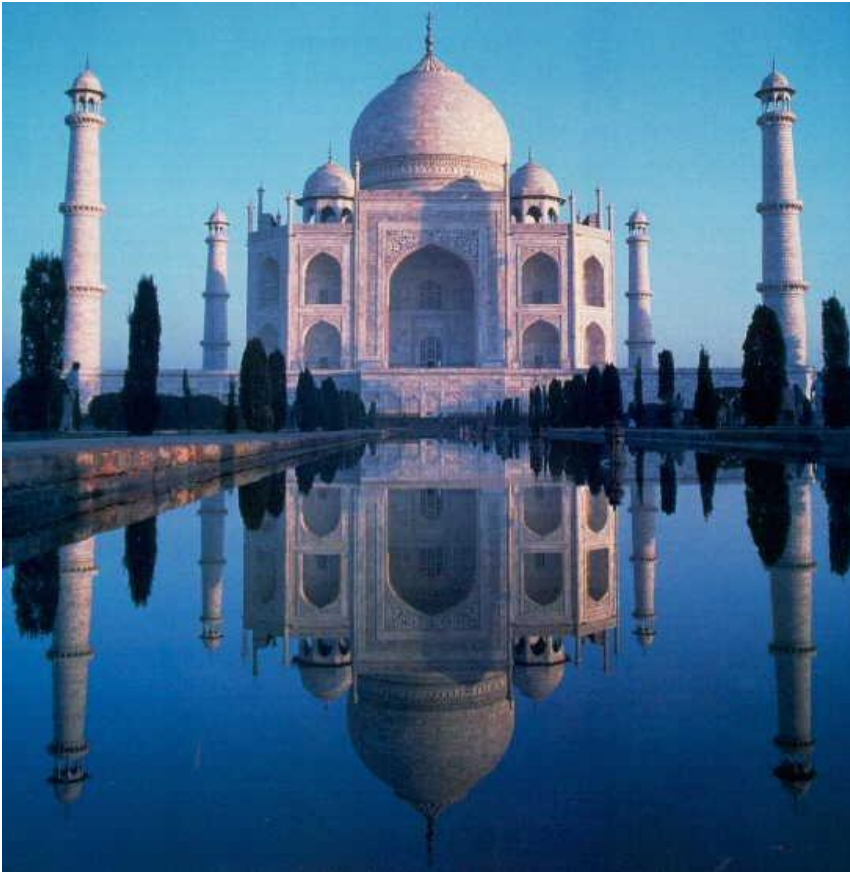
Technical salaries: \$10,000 to \$25,000 (average 15,600 in 2007, up 18.6%)

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



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



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)





Good university system, strong on mathematics and basic science. 3<sup>rd</sup> 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



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

**IT outsourcing revenue from US:  
\$8.3 billion**

# Challengers

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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





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)

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

Projected: 3.4 million by 2015



## 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

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Internal (to lower-cost divisions)

Same country group

Specific

Operation (e.g. computer facilities)

Selective

Tactical

Transitional

Client-supplier

Maintenance

Development/operation

*External*

*Offshore*

*Business process (BPO)*

*Transfer*

*Total*

**VS**

*Strategic*

*Permanent*

*Partnership (joint venture)*

*New product*

*Research*

# Arguments for outsourcing

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Cost

Access to expertise

Focus on core business

Speed

Business process reengineering (aka change)

Control

Quality improvement



# Arguments **against** outsourcing

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Loss of control, dependency on supplier

Loss of expertise

Loss of flexibility

Loss of jobs, effect on motivation

# Outsourcing risks

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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

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*