



Software Architecture

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Lecture 8: Distributed and Outsourced Software Engineering

Topics

1. The rise of Distributed and Outsourced Software Engineering (DOSE)
2. Challenges and practical advice for distributed development
3. An industrial experience
4. An Academic Experience: the DOSE course project at ETH

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The rise of
distributed
development

The context

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

Today's software ecosystems are multipolar!

- Distributed team
- Flexible assignment of tasks
- Outsourcing
- Flexibility is key: the world belongs to the nimble
- What happens in the absence of direct contact?

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!

Tract handed out
at entrance to
Siemens main
site, Munich, May
2004

Motivations



When they say it's not about the money...

... then it is about the money.

IT outsourcing

2002: \$162 billion

2006: \$278 billion

2009: \$ 327 billion

(Source: Gartner)

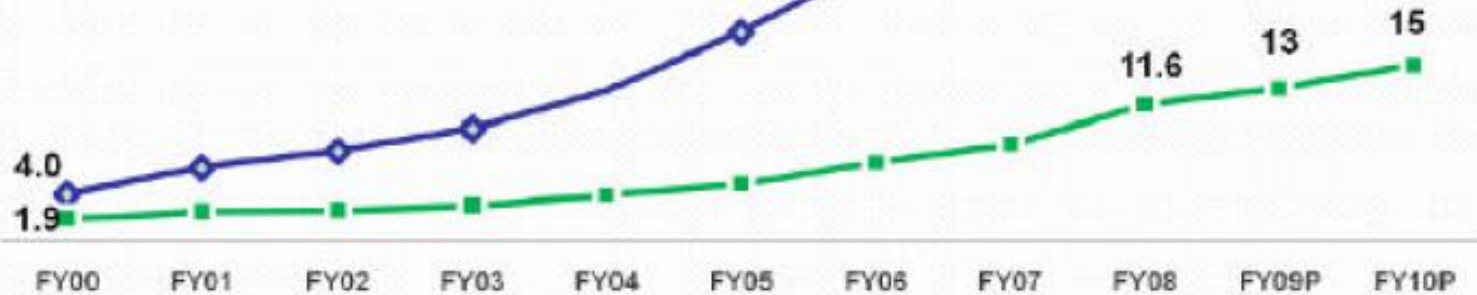
India



Source: Nasscom

CAGR	PERIOD	DOMESTIC*	EXPORTS*	TOTAL	USD Billion
10 YR TARGET	FY00-10	\$15bn @ 23.0%	\$60bn @ 31.2%	\$75bn @ 29.0%	60
ACHIEVED	FY00-08	25.4%	33.7%	31.4%	50
REQUIRED	FY08-10	13.7%	21.9%	20.1%	40.4

* Includes IT Software and Services, ES and Products, and BPO



Source: NASSCOM

Figures may vary slightly due to rounding off

^NASSCOM McKinsey Study 2005

The offshoring proposition

Low salaries

Skilled workforce

Good university system

Good communication infrastructure

Stable political structure

Efficient business conditions

Entrepreneurial culture

No insurmountable cultural barrier

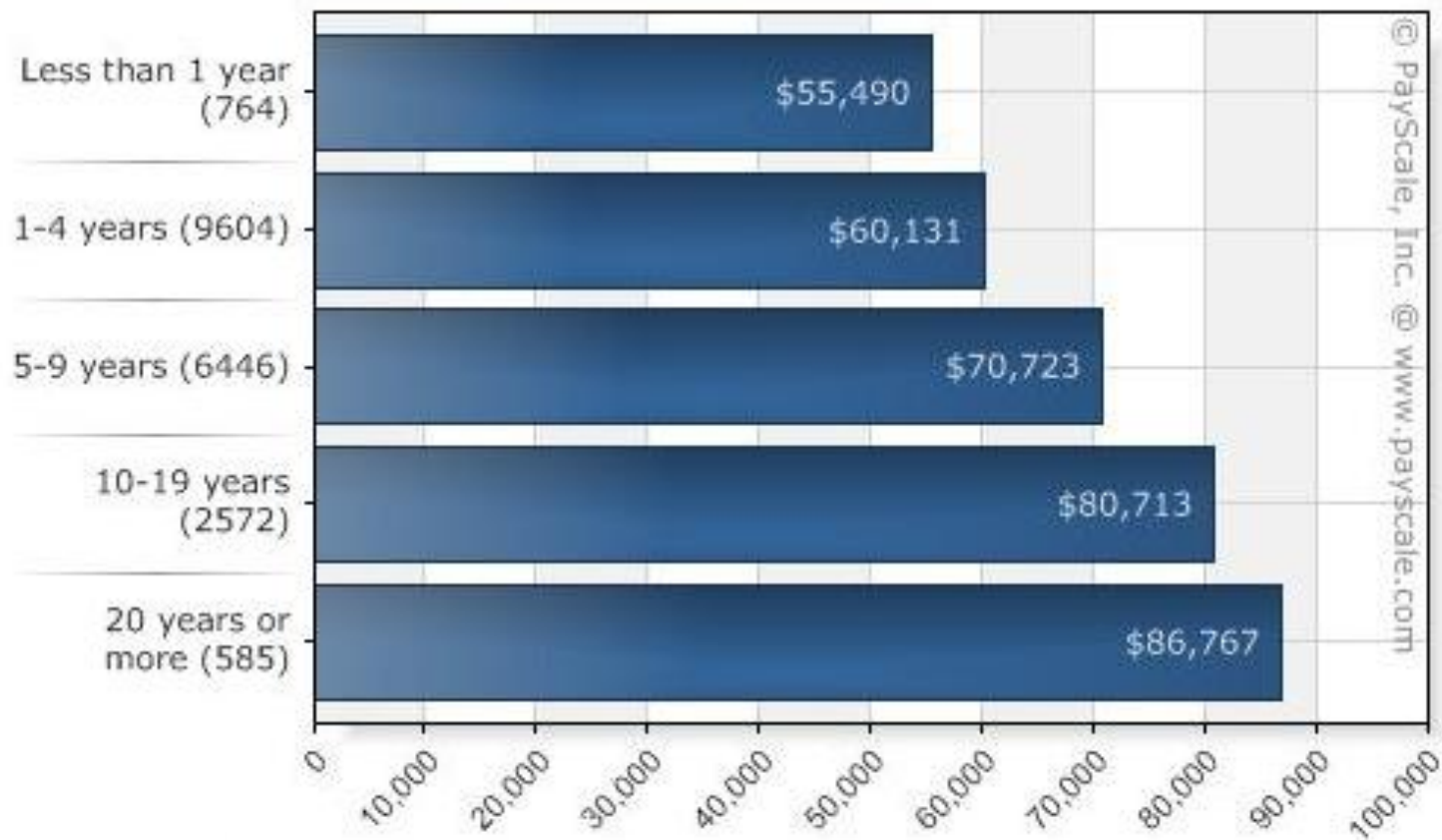
Language skills

(Often) exile community in the client country

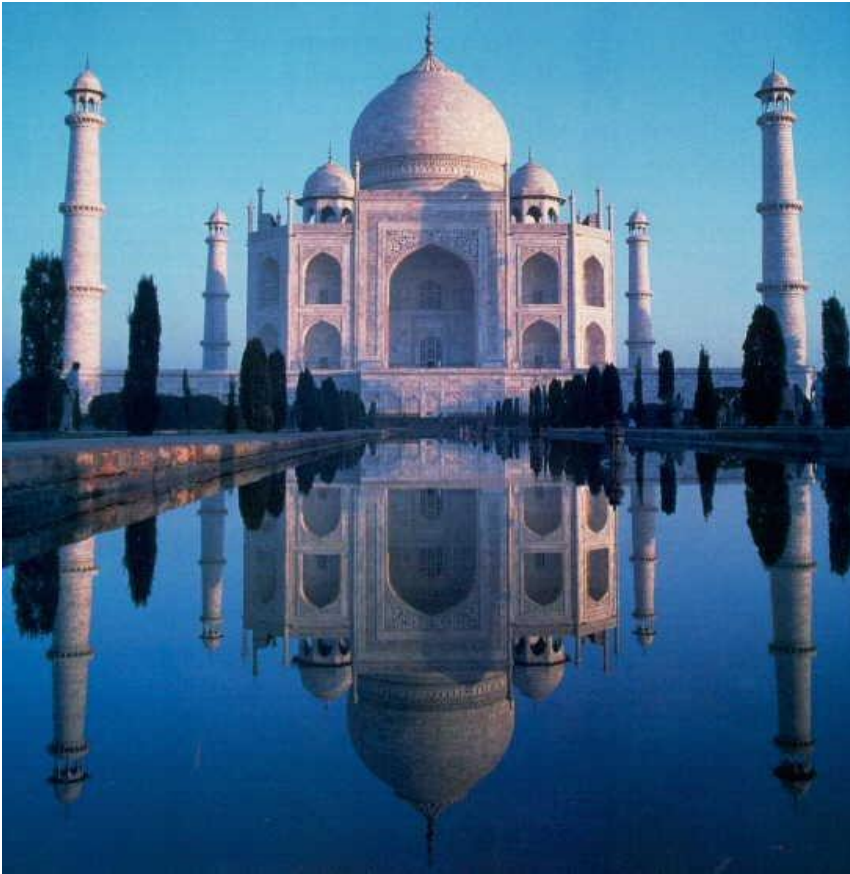
Culture of quality and qualification (CMM, ISO...)

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%)

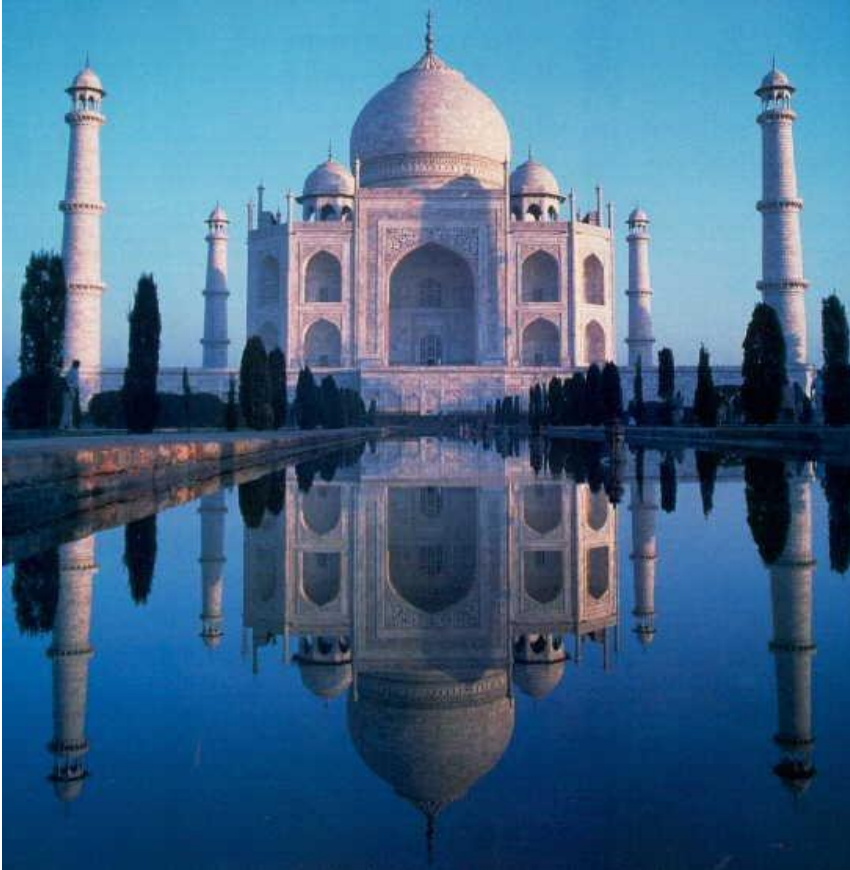
IT parks (Bangalore...) have excellent infrastructure

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



**IT outsourcing revenue:
\$1 billion (2005), \$4 billion (2010)**

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 large cities. Telecoms still expensive. Excellent education system

Strengths so far: advanced software development, Web development, research

Significant operations of Western firms: Intel, Motorola, Alcatel, Siemens...

Ireland



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...)

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

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

Arguments for outsourcing

Cost

Access to expertise

Focus on core business

Speed

Quality improvement

Arguments against outsourcing

Loss of control, dependency on supplier

Loss of expertise

Loss of flexibility

Loss of jobs, effect on motivation



NO, YOU MAY
NOT OUTSOURCE
YOUR HOMEWORK
TO INDIA.

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Challenges
& practical advice

Project management



Project management is difficult

In a traditional one-site setting, the manager can just go to a developer's office and ask to see the current state

In distributed development, it is difficult for the project manager to form a good picture of the project's progress

Configuration management plays an important role

Practical advice for project management

Provide templates

Monitor the tasks constantly

Maintain regular communication

➤ For example, one-hour weekly meetings

Remind the team about deadlines

Frequently check with developers whether deadline still realistic

Techniques of project management

Require developers to show proof of progress:

- Request to see demo
- Ask deep questions
- Look at code
- Perform code review

Define commit rules

- Must compile before commit
- Must run before commit
- Must review before commit ("RTC")
- Test suite must pass

Apply code reviews:

- Review-to-commit
- Commit-then-review

Cultural differences

Working in the same culture - common knowledge

Examples in Switzerland:

- Sechseläuten
- Being on time

Different cultures

- Different cultural backgrounds
- Different national holydays
- Different interpretations

Tram in Zurich



Train in India



Traffic in Hanoi



Cambodia



Indian culture

For example, for Indians:

“yes” means “yes, I have heard you”

“done” means “I will start to do it tomorrow”

Negative feedback is giving by

not responding

Trying not to answer

Suggesting alternatives

[Examples from: Working with India - Wolfgang Messner]

Yes, No: India



<http://www.youtube.com/watch?v=3hCV2oO2akw>

Negative feedback

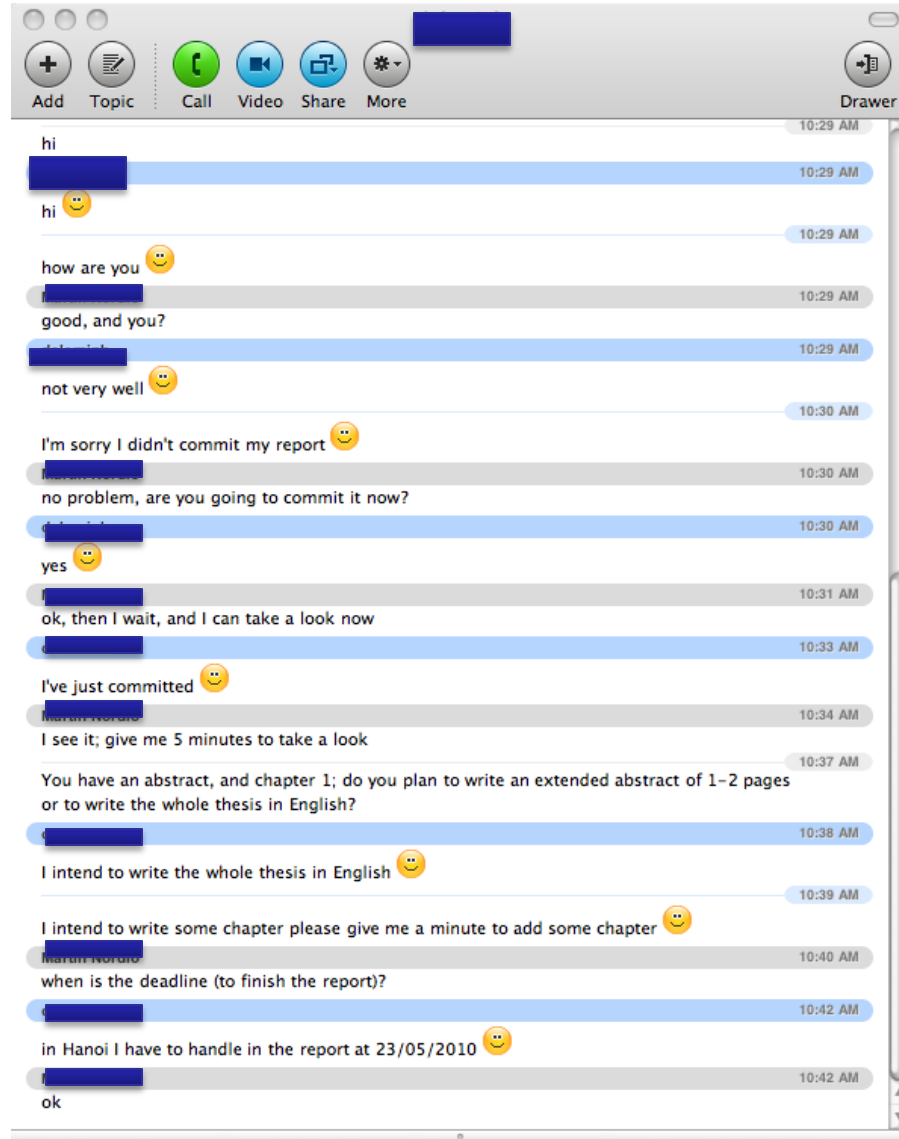
Company C in Germany sends a feedback form to Company D in India

After 5 days: C contacts D asking about the feedback

Company D: feedback form? When?

[Examples from: Working with India - Wolfgang Messner]

A chat with Vietnam



Name and family name (Vietnam)

Lê Minh Đức

Do Lê Minh



Working with Vietnam



M: Can you finish the requirements document by next week?

V: Yes.

M: But there is a lot to do, do you have time?

V: Yes.

M: Can you finish the requirement document by Saturday?

V: Yes

M: Ok, and what about tomorrow, can you finish it by tomorrow?

V: Yes, yes, yes.

Hiring in India

Person A is hired in company C to start on November 1st

Company C contacts A on October 29th to check if A still plans to start to work at C

On Monday November 1st, A decides to start to work in another company

Practical advice: cultural differences



Be aware of the cultural differences and learn about the counterpart's cultures

Indicate the country holidays in a common calendar

Take into account the country holidays when defining a deadline

Challenges: time zones



Political Map of the World, April 2007

Switzerland: 13:00

Ukraine: 14:00

Russia: 15:00

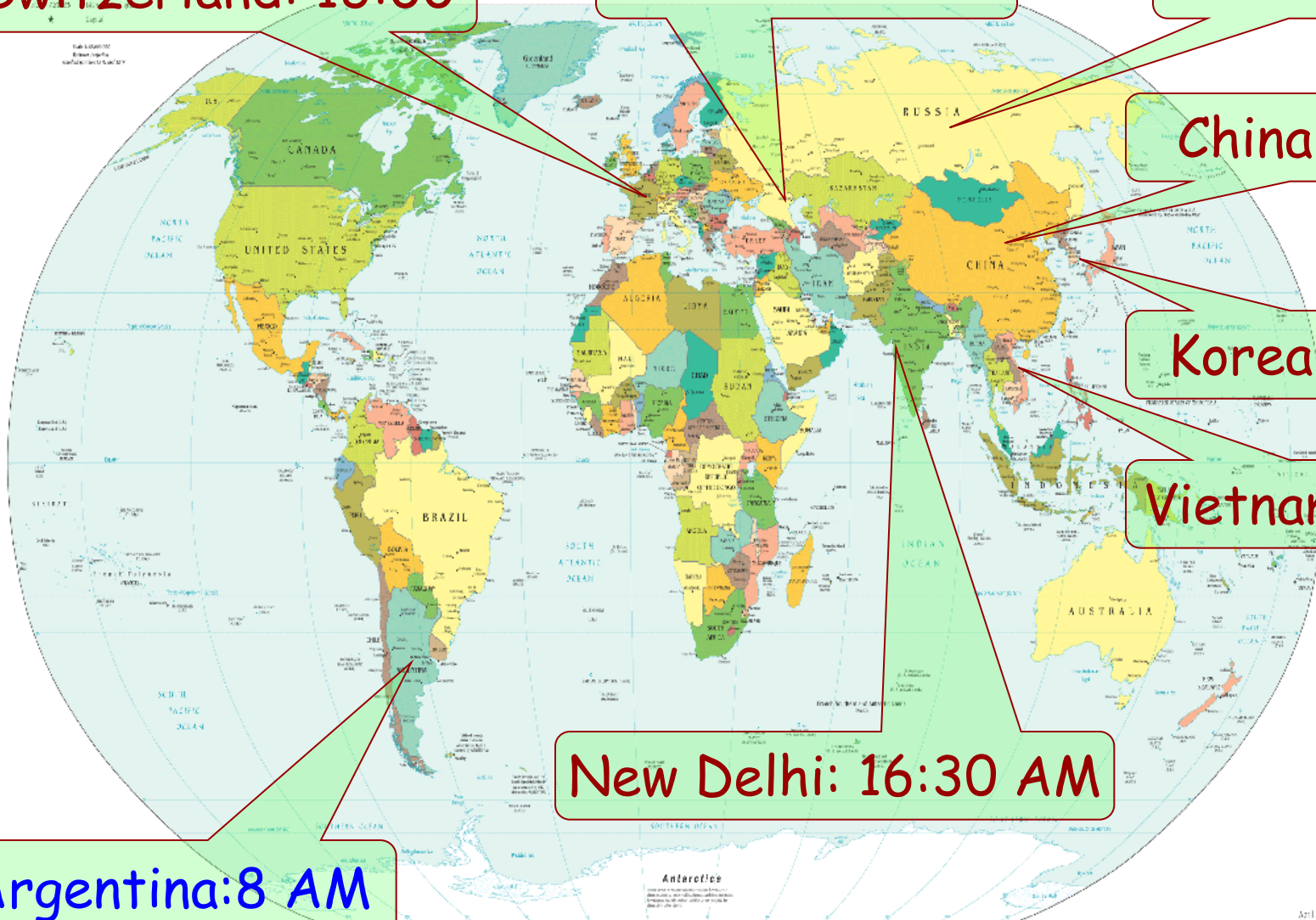
China: 19:00

Korea: 20:00

Vietnam: 18:00

New Delhi: 16:30 AM

Argentina: 8 AM



How do we organize a meeting?

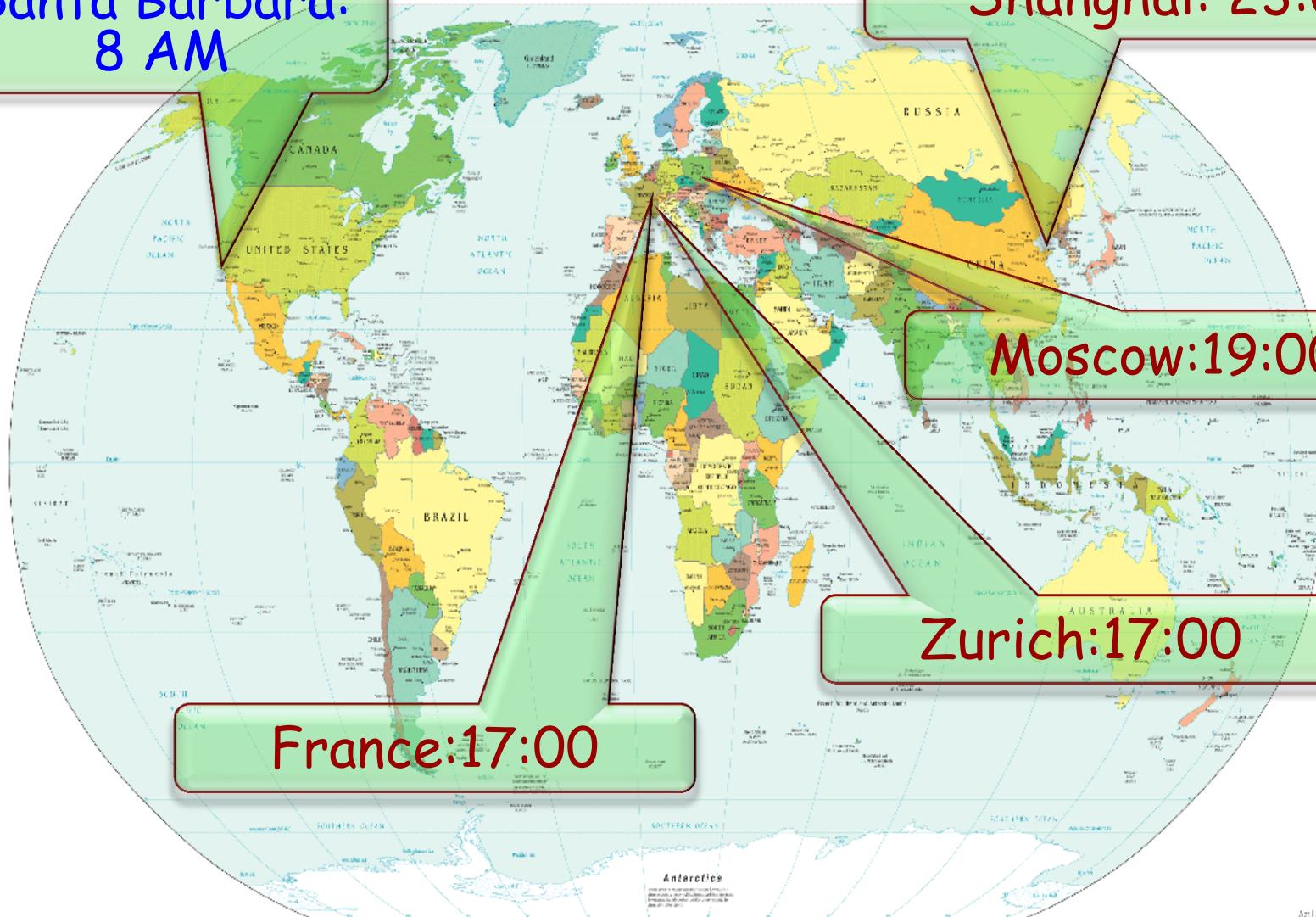
Santa Barbara:
8 AM

Shanghai: 23:00

Moscow: 19:00

Zurich: 17:00

France: 17:00



Practical advice: time zones

Keep meetings on schedule

Keep in mind the Daylight Saving Time

Do not wait to send an e-mail (even if the it is late or early in the other time zones)

Challenges: communication and language skills

E-mail is not enough - need for voice communication

Communication through phone/skype and video conference is difficult

Heavy accents

Different English mistakes

Tools are important

More practical advice

Use several forms of communications: e-mail, voice conferences, wikis, docs

Create mailing lists

Send the important information in writing

Write minutes of the meetings recording decisions taken, and action items (todos)

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An industry experience

Eiffel Software



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

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

Skype: chat window only

Scripta manent

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

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

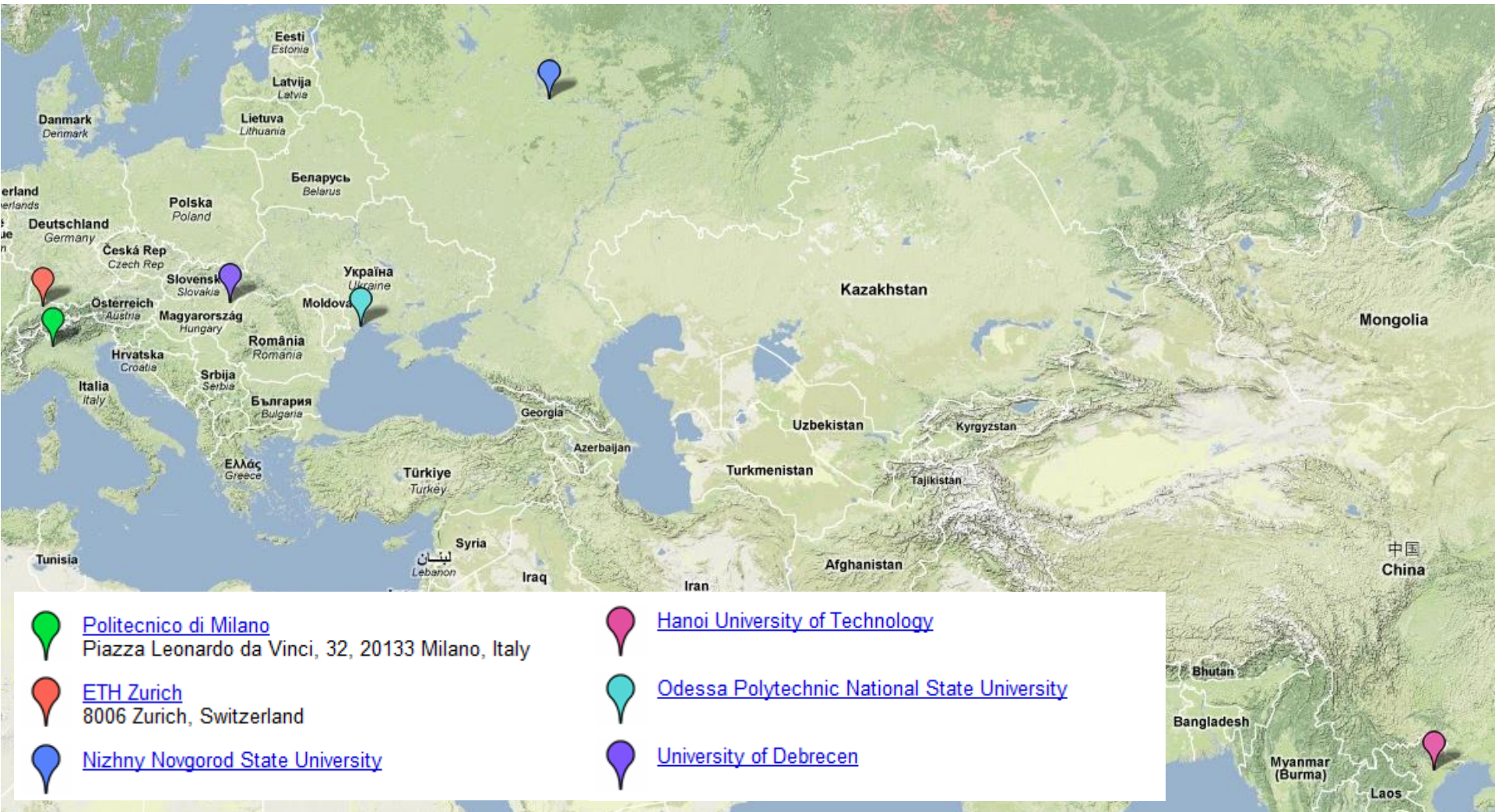
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An academic
experience

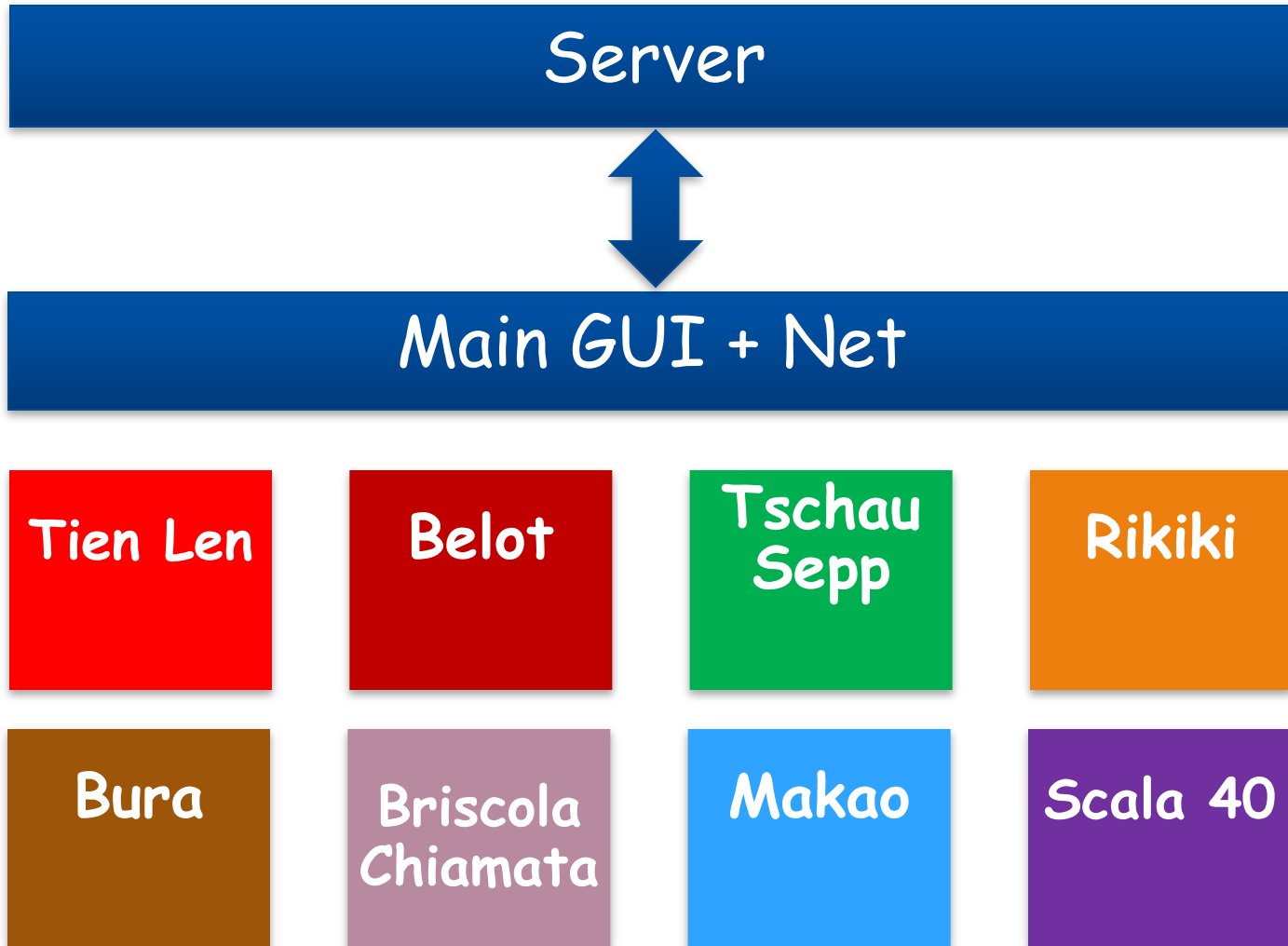
DOSE 2009



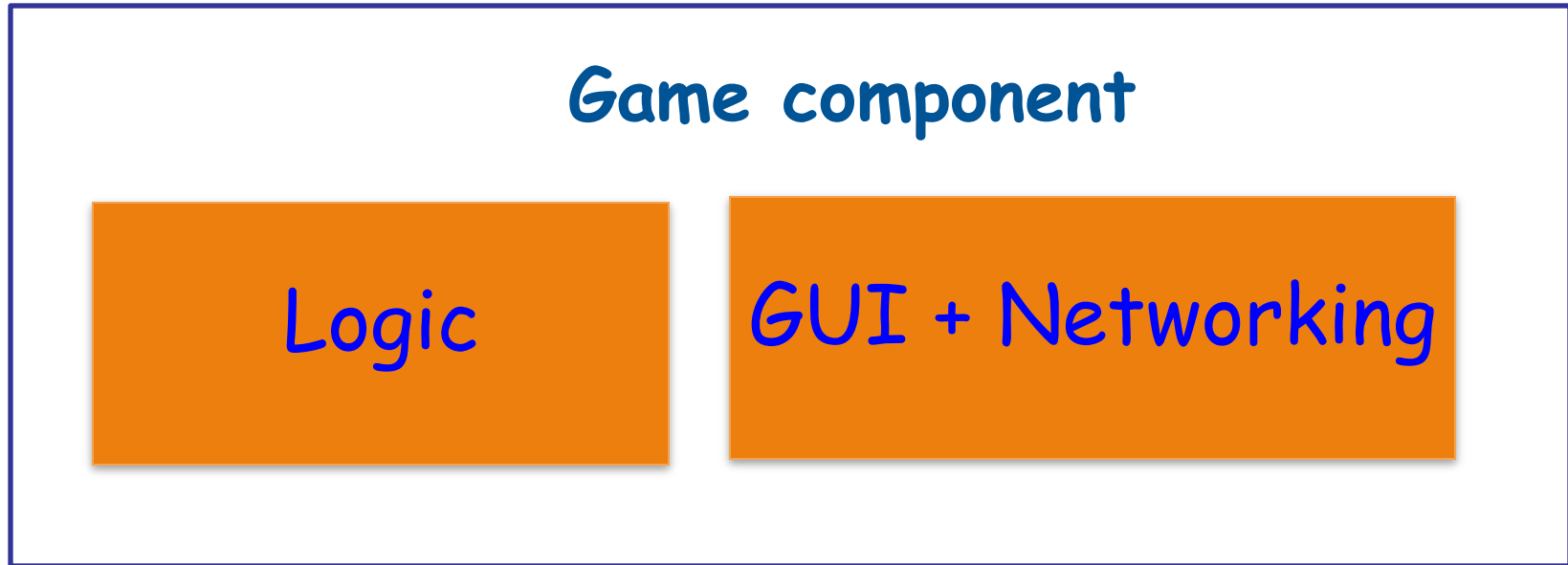
50 developers - 6 countries - 16 teams - 1 project



Application architecture



One game: two teams in two locations



Example: Logic of a Russian game is implemented in by a Russian team;
GUI is done by an Italian team.

Workflow



October 13th

Envisioning

Scope document

October 27th

Requirements Elicitation

Software requirements specification

November 3rd

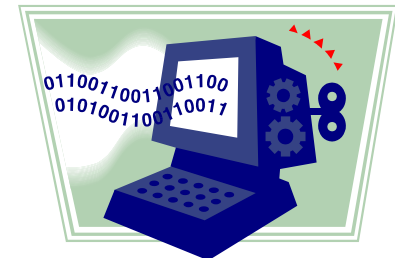
Interface Specification

Software requirements Specification + API specified

Nov. 17th

Dec. 8th

Development



Group's 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



Problems in DOSE 2009



Why is Mitko getting errors while it compiles for me. I think that Mitko might be using an older EiffelStudio

There are compilation errors in the code of the teams
Briscola Chiamata, Bura, Scala 40, and Tschau Sepp

The GUI works fine in Windows, but it does not work in
Linux

Difficulties (e-mails)

Some members of our team suffer from weak-English

Team A has implemented the system in Java, and we have implemented in Eiffel; now, we cannot integrate it, any hints?

Their document is clearly not consistent with the decisions we took in our last meeting

I'm sorry I could not make it to the implementation meeting yesterday. A water pipe in my apartment burst ... After some frantic hours of fixing and cleaning up, it is now more or less OK

Aleksey couldn't read any emails last week because his Internet cable had been stolen by a drunk bear

E-mails

... it seems that this team is total absent and reject communication (probably because of a limit in their English)...

Team A complains of a lack of collaboration with its teammates (Team B and C). Also, we received a message concerning the unwillingness of Team B of using X ...

... someone added a cluster but did not update the current project file which produced a broken build...

...please fill in the details of your functional requirement...

Problems at DOSE 2009 (cont.)

There is clear progress in the teams Scala 40 and Tschau Sepp. But, what is the status of the teams Briscola Chiamata and Bura?

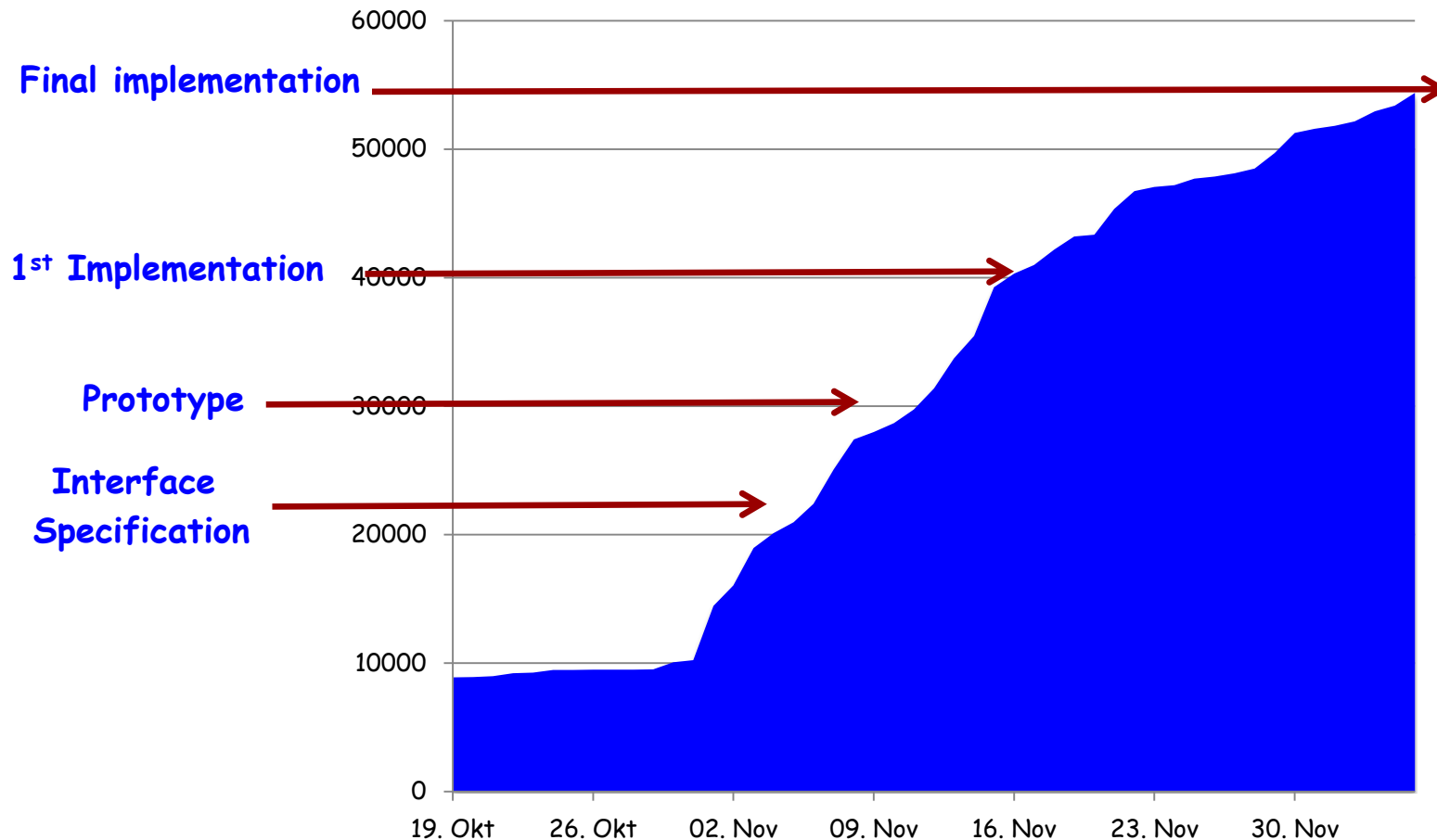
The Vietnamese team promised a new GUI by last Monday, but they have not committed yet; what should we do?

Someone added a cluster but did not update the current project file which produced a broken build

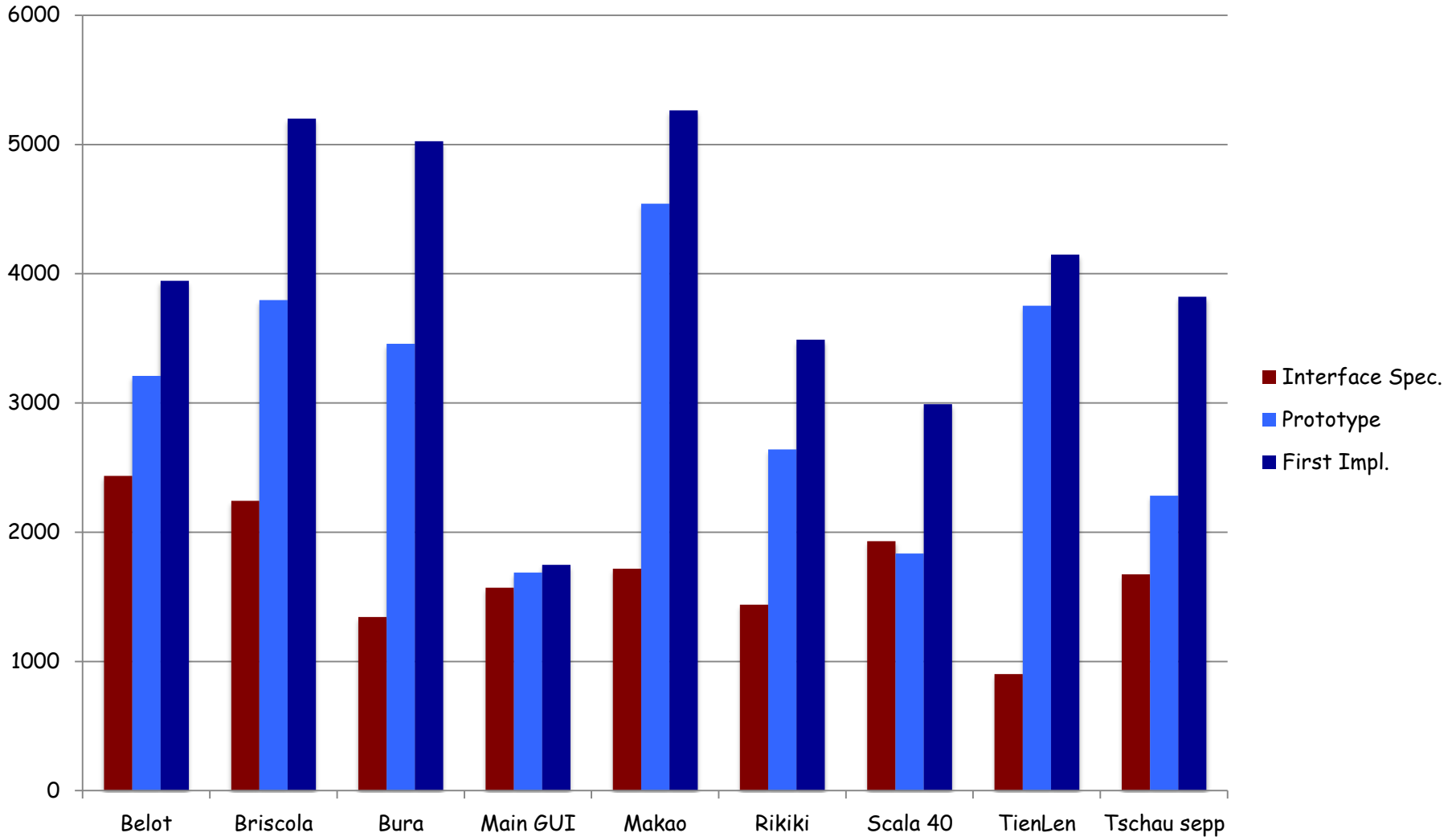
Results DOSE 2009



8 games fully implemented, integrated and deployed
55'000 lines of code



Project Management



Lessons



Setting up the project is very important: provide templates for documents, and basic implementation project

Critical part of the project should not be outsourced: keep control of what could fail the project

Communication is the core issue

Infrastructure (network, tools...) is critical