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
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?
Siemens-Nachrichten

Für die Beschäftigten des Siemens-Konzerns

Siemens-Globalisierungsstrategie gefährdet Standort Deutschland


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.
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

### India Growth

<table>
<thead>
<tr>
<th>CAGR</th>
<th>PERIOD</th>
<th>DOMESTIC*</th>
<th>EXPORTS*</th>
<th>TOTAL</th>
<th>USD Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 YR TARGET</td>
<td>FY00-10</td>
<td>$15bn @ 23.0%</td>
<td>$60bn @ 31.2%</td>
<td>$75bn @ 29.0%</td>
<td>60</td>
</tr>
<tr>
<td>ACHIEVED</td>
<td>FY00-08</td>
<td>25.4%</td>
<td>33.7%</td>
<td>31.4%</td>
<td>50</td>
</tr>
<tr>
<td>REQUIRED</td>
<td>FY08-10</td>
<td>13.7%</td>
<td>21.9%</td>
<td>20.1%</td>
<td>40.4</td>
</tr>
</tbody>
</table>

* 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

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

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

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

An example of a successful outsourcing infrastructure in a developed country

IT outsourcing revenue from US: $8.3 billion
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
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

hi

hi 😊

how are you 😊

good, and you?

dark

not very well 😞

I'm sorry I didn't commit my report 😞

no problem, are you going to commit it now?

yes 😊

ok, then I wait, and I can take a look now

I've just committed 😊

I see it; give me 5 minutes to take a look

You have an abstract, and chapter 1; do you plan to write an extended abstract of 1-2 pages or to write the whole thesis in English?

I intend to write the whole thesis in English 😊

I intend to write some chapter please give me a minute to add some chapter 😊

when is the deadline (to finish the report)?

in Hanoi I have to handle in the report at 23/05/2010 😞

ok
Name and family name (Vietnam)

Lê Minh Đức

Do Lê Minh
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.
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

- Switzerland: 13:00
- Ukraine: 14:00
- Russia: 15:00
- China: 19:00
- Korea: 20:00
- Vietnam: 18:00
- Argentina: 8 AM
- New Delhi: 16:30 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 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)
An industry experience
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
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
Rule 3

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
Rule 4

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

- Politecnico di Milano
  Piazza Leonardo da Vinci, 32, 20133 Milano, Italy
- ETH Zurich
  8006 Zurich, Switzerland
- Nizhny Novgorod State University
- Hanoi University of Technology
- Odessa Polytechnic National State University
- University of Debrecen
Application architecture

Server

Main GUI + Net

Tien Len
Belot
Tschau Sepp
Rikiki

Bura
Briscola Chiamata
Makao
Scala 40
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

Envisioning

October 13th

Requirements Elicitation

October 27th

Interface Specification

November 3rd

Software requirements specification

Nov. 17th

Scope document

Dec. 8th

Development

Software requirements Specification + API specified
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.

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

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

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.
... 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...
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 jet; 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.