



A global software project for a globalized world

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ETH Zurich and Eiffel Software

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ETH
Chair of Software Engineering



Today's software development

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, back sourcing
- 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?

**Little of this
is taught
in universities!**

ETH Zurich

Only federal university in Switzerland
(with sister institution, EPFL)
Created 1855
Associated with close to 30 Nobel prizes



Einstein, Pauli, Clausius, Bernays, ...

In computer science: Niklaus Wirth; birthplace of Pascal,
Modula-2, Oberon, Lilith

About me: at ETH since end 2001, from industry

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Software engineering courses at ETH

1. *Software engineering*

3rd year course, quasi-required

2. *Software Engineering for Outsourced and Offshore Development*

Elective course (bachelor's/master's)

Since 2004, with Peter Kolb

First course of its kind anywhere (I think)

Follows from *IEEE Computer* paper, January 2006

Used to serve as general soft. eng. course

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Specific context



"Bologna" reform in Europe: bachelor, master, PhD

At ETH: influx of outside students in year 4 (master's)

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Recent evolution of outsourcing course



From

- "Software Engineering for Outsourced and Offshore Development"

To

- "Distributed and Outsource Software Engineering (DOSE)"

Turning into

(Distributed) (software engineering course)

as well as

(Distributed software engineering) (course)

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Digression: industry practice



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Eiffel Software



Company based in Santa Barbara, California

- Used to be president,
since 2001 Chief Architect
- More active role in project management
since 2006



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

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EiffelStudio development

Two-million line code base (almost all Eiffel, a bit of C)
Major industry customers, mission-critical applications
International standard: ECMA and ISO
Open-source license, same code, vigilant user community
6-month release schedule since 2006

Developer group:

- 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

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Distributed development principle 1

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

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Distributed development principle 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)

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How do we organize a meeting?



Santa Barbara:
8 AM

Shanghai: 12:00 AM

Moscow: 19:00

Zurich: 17:00

France: 17:00



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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

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Meeting tools

Webex for conference call management

X-Lite as a replacement for Skype

Google Docs

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

Skype: chat window only

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Communication



Works, but still not perfect

Still too much non-semantic communication

Audio communication heightens problems, e.g. accents

Need to work after the meeting

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

Documents are key: mix of verbal and written word

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Distributed development principle 3



Infrastructure matters

Connection problems are not fun after the second time

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ISE weekly meeting

21-Feb-08 17:00:46
 [redacted] says: Good morning/evening

21-Feb-08 17:00:46
 [redacted] says: Hello

21-Feb-08 17:04:21
 [redacted] says: For info: the doc's url as preview:
http://docs.google.com/View?revision=_latest&docid=dd7ln5vj_8gnxzhhf&hl=en

21-Feb-08 17:05:28
 [redacted] says: there is an echo

21-Feb-08 17:05:48
 [redacted] says: never mind

21-Feb-08 17:17:50
 [redacted] says: I disagree.
 When there is a crash, if the we have multi lines, then we can know exact error point. If we write them in one line, then we have to guess.

21-Feb-08 17:18:45
 [redacted] says: we need to improve the RTNHOOK macro

21-Feb-08 17:18:55
 [redacted] says: if we improve it that it won't be a problem

21-Feb-08 17:19:00
 [redacted] says: RTNHOOK (1)

21-Feb-08 17:19:10
 [redacted] says: we have bp slot index; .. we would need to show the "nested bp slot index"

21-Feb-08 17:19:17
 [redacted] says: that's possible ... somehow

21-Feb-08 17:19:26
 [redacted] says: RTNHOOK (1,1); /* First instruction, first nested or expression */

21-Feb-08 17:20:15
 [redacted] says: Ok if we have the "nested bp slot index" issue.

21-Feb-08 17:20:26
 [redacted] says: Ok if we have the "nested bp slot index" feature.

21-Feb-08 17:21:48
 [redacted] says: It's possible to view expressions in the debugger.

21-Feb-08 17:27:14
 [redacted] says: indeed sometime doing the evaluation is not desired (due to potential side effects)

21-Feb-08 17:28:19
 [redacted] says: I was just curious of clear rules about IEX.5.1

Emm
 Ja
 Jo
 Ta
 Eiffe
 La
 mist
 P
 star

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Rule 4

Scripta manent

(Or: talk is cheap)

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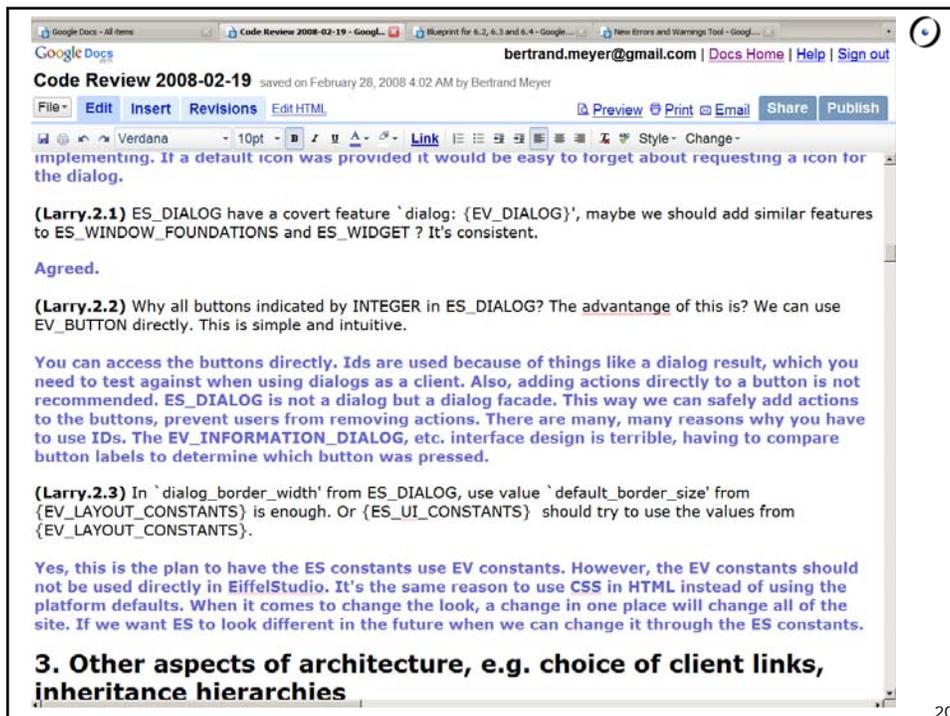
Recent addition: the remote code review

Traditional: time-consuming, tedious, questionable value

With the Web it becomes much more interesting!

- Classes circulated three weeks in advance
- Comment categories:
 - Choice of abstractions
 - 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 devoted to **unresolved** issues

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The screenshot shows a Google Docs interface for a document titled "Code Review 2008-02-19". The document content includes:

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

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End of industry digression



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Software engineering courses at ETH



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2. *Distributed and Outsourced Software Engineering (DOSE)*

Elective course (bachelor's/master's)

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Principles of teaching software engineering (1) [©]

Principles for the course as a whole:

1. Focus on the non-programming aspects

"DIAMO":

- **Describe**: specify (systems, designs, implementations...) and document
- **Implement**: build the products; this includes design as well as programming
- **Assess**: verify, validate, analyze, test, measure (products & processes)
- **Manage**: organize work, communicate, collaborate
- **Operate**: deploy systems & oversee proper functioning

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Principles of teaching software engineering (2) [©]

Principles for the project:

1. Set up a controlled environment to exercise the aspects you want to emphasize
2. The project should include programming
3. Aim for a **deployable** project
4. In a group project, divide work by subsystems (cluster), not lifecycle task
5. You design and implement what you specify
6. Learn to design a test plan for someone else's software

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Goal of the DOSE course

Prepare students to the new, globalized world of software development

Some topics:

- Requirements in a distributed project
- Quality assurance
- Project models, CMMI
- Agile methods
- Managing relationships with suppliers, contract negotiation
- ...

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Course characteristics at ETH

Elective course, bachelor's and master's

Typically 15 to 35 students

Many with industry experience

2 lecture hours (Wednesday 8 to 10), one exercise hour mostly devoted to the project

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Project: involving other universities



Since 2007:

- Odessa National Polytechnic (Ukraine)
- University of Nizhny Novgorod (Russia)
- University of Zurich

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Why we are doing this



Distributed Software Engineering raises new challenges

Techniques exist, but the skills must be taught

Students initially have no idea of the issues, but they understand them quickly and (painfully) find solutions

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

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Project principles and roles

Emulate industrial setting, but only where it makes sense

- Benefits of a controlled setting
- Goal #1 is to learn

All groups created equal

- We do **not** want one university to specify & another implement

Clear management structure

- Central management role, currently at ETH
- Technology choices imposed
 - Eiffel (as a language and method)
 - Origo software development platform
origo.ethz.ch
 - Web tools
 - Any others that may be necessary
- Universities can contribute, e.g. broadcast own lectures

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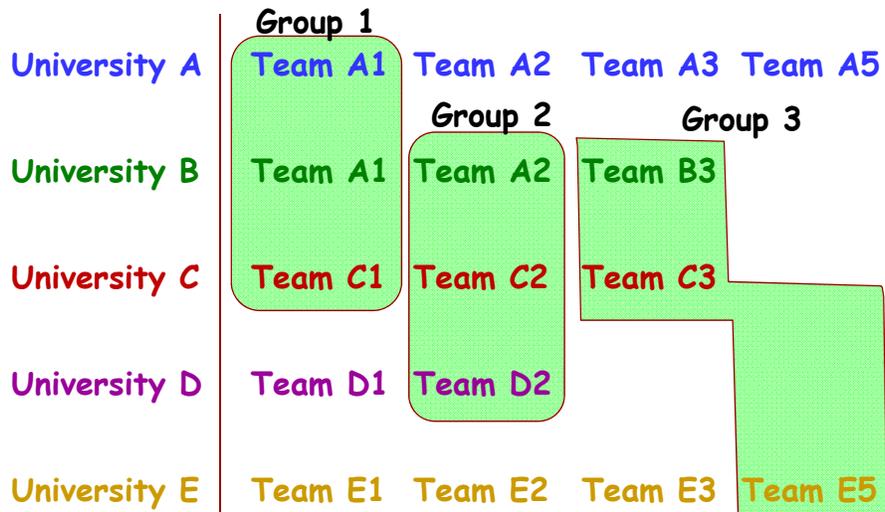
Organization

Cluster-based, not process-based

- A **team** includes a few students (2 or 3) from one university
- A **group** is a collection of groups, each from a different university
- Each group does full project
- Each team does a part of the project
- This is a part of the system ("Cluster"), not a part of the lifecycle

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Teams and groups



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Organization

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Each team does a part of the project

This is a part of the system ("Cluster"), not a part of the lifecycle

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Example system & clusters (Fall 2007 course)

Analyze call for papers to feed Informatics Europe's Computer Science Event List (CSEL)

Clusters:

- Natural language analysis
- Editor (for human correction)
- Orchestration, and connection with CSEL

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The Computer Science Events List

events.informatics-europe.org

The screenshot shows the website 'The Computer Science Event List' with a navigation bar and a list of current events. The table below is a representation of the data shown in the screenshot.

Conference Name	Date	City	Country	Paper deadline	Main sponsor	Publisher
Informatics Education Europe III	04/12/2008 - 05/12/2008	Venice	Italy	15/05/2008	ACM	
Seventh European Conference on E-Learning	06/11/2008 - 07/11/2008	Agia Napa	Cyprus	10/07/2008	University of Cyprus	Academic Conferences International
International Workshop on Computational Intelligence in Security for Information Systems (CISIS'08)	23/10/2008 - 24/10/2008	Genova	Italy	14/03/2008	Institute of Electrical and Electronics Engineers, Inc.	
Distributed Frameworks, Multimedia and Applications	21/10/2008 - 22/10/2008	Penang	Malaysia	30/05/2008	Universiti Sains Malaysia	
Workshop in conjunction with EFC'08	20/10/2008 - 23/10/2008	Milan	Italy	09/05/2008	EROS	Springer-Verlag LNCS series
AccessNets 2008	15/10/2008 - 17/10/2008	Las Vegas, Nevada	United States	01/04/2008	ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering)	
22nd Brazilian Symposium on Software Engineering	13/10/2008 - 17/10/2008	Campinas	Brazil	05/05/2008	Brazilian Computer Society	Brazilian Computer Society (SBC)
Second European Conference on Software Architectures	29/09/2008 - 01/10/2008	Paphos	Cyprus	14/04/2008	University of Cyprus	Springer-Verlag
SYNSAC 2008 - 10th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing	26/09/2008 - 29/09/2008	Timisoara	Romania	15/05/2008	West University of Timisoara	IEEE Computer Society Press
Logic and Information Research	22/09/2008 - 26/09/2008	Leiden	Netherlands	n/a	Lorentz Center	
26th ACM International Conference on Design of	22/09/2008 - 24/09/2008	Lisboa	Portugal	02/03/2008	ACM SIGDOC	ACM

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Example system & clusters (Fall 2007 course)

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Main lesson from first session

The importance of APIs

Techniques of abstraction & contracts

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Lessons from first session

- Success (partial)! All 3 consortiums did reasonably well, one produced a working implementation
- It took a few weeks for students to understand what this was about, and some more to really get to work
- Each consortium found ways to interact, e.g. regular Skype meetings, in spite of often bad conditions
- All found the project hard
- All found it extremely enriching, learned a lot
- Worked much more than expected for such a course
- Understood the great, great, great importance of APIs

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Project presentation

Attended by
students from
all universities
involved

(through Skype)



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Next time



Fall 2007 (18 September to 18 December)

More universities will join (Politecnico di Milano, ...)
Learn from previous session, develop interesting system

What you need:

- Interest and commitment
- A suitable course, with reasonably similar schedule
- A group of potentially interested students
(may be volunteers in an existing course)

Use of Eiffel is not an issue (but is a benefit)

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Join us!



se.ethz.ch/dose

Or just write to me

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Other innovative teaching work at ETH

Rethought & overhauled the intro prog. course

"Outside-in" approach (inverted curriculum)

- Learn from example
- Thoroughly O-O (incl. inheritance, genericity etc.), Eiffel
- 150,000-line "Traffic" library: multimedia 3-D simulation
- Use powerful software through interfaces & contracts
- From consumer to producer
- Gentle introduction of formal methods (Design by Contract)
- Outstanding student projects (e.g. games, scripting)
- Online textbook (to be published 2008): *Touch of Class*

touch.ethz.ch

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Lessons

The world has gone global, so has the software world

Many difficult issues, failure always possible

Some solutions exist, we can teach them

Many software engineering lessons apply, made even more relevant by distributed development

Communication is the core issue:

- Between people
- Between modules: crucial role of APIs and contracts

Infrastructure (network, tools...) is critical

Universities should teach this

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