

Global Software Development: Technical, Organizational, and Social Challenges

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Abstract

The International Workshop on Global Software Development was held in Portland (Oregon, USA) on May 9 2003, as part of the International Conference on Software Engineering 2003. A multicultural group of twenty-five people contributed to a successful workshop that debated the continued challenges of software development in global teams. The workshop consisted of an invited talk, sixteen short presentations, and fruitful discussions. We present an overview of the workshop motivation and then focus on the workshop's technical program. The workshop web site, including papers and slides, can be found at <http://gsd2003.cs.uvic.ca>.

Keywords: Global software development, dispersed software teams, collaboration between distant sites

Background

This workshop was a continuation of the last five ICSE workshops on the same topic. While the first four editions (1998-2001; [1-4]) were more technology-focused, the 2002 edition changed the name from "Software Engineering over the Internet" to the more general "Global Software Development" [5].

Global software development has been and continues to be a phenomenon fueled by factors such as access to a large and specialized labor pool, reduction in development costs, global presence and proximity to the customers. While we are witnessing reports of successful global teams, research reveals that distance contributes to heightened complexity in organizational processes [6, 7]. Primarily, processes of communication, coordination and control are affected by distance, with direct consequences on how software is defined, constructed, tested and delivered to customers, as well as how its development is managed. Further, cultural issues are possibly the most confusing and interesting feature of global teams. Members with diverse attitudes towards hierarchy, time management and risk avoidance come to work together in cross-functional teams.

These are only some of the factors that bring challenges to managing software projects developed in geographically distributed structures. Understanding the intricacies of this complex phenomenon is critical in framing research directions that aim at improving global software development practice. There is a need for tools and techniques that not only improve development processes but also address organizational and social issues in global software development. The previous workshops took steps toward identifying and understanding issues in the complex phenomenon of global software development. In particular, the empirical evidence and discussions during the 2002 workshop indicated that technol-

ogy is only a small part of enabling effective global teams; there is a strong need to address the study and practice of global software development from a multidisciplinary perspective, in which issues of social nature are as important as those of technical nature.

Workshop Overview

We organized the 2003 edition of the International Workshop on Global Software Development to continue fostering fruitful interactions between industry practitioners and researchers, and help grow a community of interest in this area.

The workshop sought participants to cover the following themes within the global software development area:

- Empirical evaluations of effectiveness of global software projects
- Technologies and tools for distributed development environments
- Software engineering methodologies and processes for GSD
- Communication, collaboration, and knowledge management in distributed organizations

Interested participants from academia and industry were invited to submit either technical or position papers. Workshop organizers selected fifteen technical papers and one position paper (all available at the workshop web site [8]), based on their relevance to the workshop topic and potential for discussion.

The one-day workshop consisted of an invited talk, four sessions organized around some of the key issues emerging from the papers, and a plenary discussion. Presentations in the sessions were limited to ten minutes followed by discussions. Overall, twenty-five people attended the workshop, varying from participants working in software engineering, management and even anthropology.

Technical Program

This section summarizes the presentations and, where appropriate, includes notes from the discussions.

Invited Talk

J. Herbsleb, "Research Methods and Theory in Global Software Development"

Jim Herbsleb from Carnegie Mellon University gave an opening invited talk where he presented the research methods he applied while studying multi-site development at Lucent Technologies. He pointed out some social problems that negatively affect global software development:

- Lack of unplanned (informal) contact; participants noted that the opposite problem for collocated projects is having too many meetings.
- Not knowing who to contact about what: maybe the actual problem is finding the right experts to do the work.
- Difficulty of initiating contact: 70% of phone calls do not complete, mostly as a result of cultural/language differences.
- Ability to communicate effectively: e.g., when sharing documents, or needing to point to things.
- Lack of trust and willingness to communicate openly, because of fear to be stolen of expertise and lose the job: "I don't want to cooperate because they'll take over my job".

Negative effects are:

- inability to deal effectively with unexpected, re-negotiated commitments
- issue resolution paralysis
- difficulty to stay "in the loop"
- ineffective collaborative sessions

He presented the solutions that he applied and empirically tested within the Lucent distributed development environment:

- Tools to increase communication opportunities and effectiveness: e.g., team portal, instant messaging, group chat, online calendars.
- Models of distributed development on how to divide work in order to lessen communication.
- Documented best practices: e.g., co-located kickoff meetings.

He also briefly presented some current theoretical work to characterize and make predictions about coordination of engineering decisions.

The main message from the talk was that global software development provides a setting for understanding software *development in general, because very common problems of coordination are naturally exposed to observation and experimentation.*

Tool Support

D. Damian, J. Chisan, P. Allen, B. Corrie, "Awareness meets requirements management: awareness needs in global software development"

James Chisan and Polly Allen from the University of Victoria (Canada) addressed the problem of workspace awareness in requirements management process in global software development endeavors. They proposed a preliminary list of features for awareness support in geographically distributed requirements management, and discussed their approach while researching these awareness issues.

F. Lanubile, "A P2P Toolset for Distributed Requirements Elicitation"

Filippo Lanubile from the University of Bari (Italy) addressed the problem of how a decentralized systems, based on a peer-to-peer architecture, can be exploited to support the key activities of global software development. As a proof-of-concept, he presented a peer-to-peer toolset for distributed requirements elicitation, which incorporates tools for the different stages of the elicitation phase, including workshops and a voting system.

L. Aversano, A. Cimitile, A. De Lucia, "A Communication Protocol for Distributed Process Management"

Lerina Aversano from the University of Sannio (Italy) presented an asynchronous communication protocol for distributed process management adopted within the GENESIS project. She showed how the process management subsystem enables distributed process modeling and enactment on different organizational sites through an event dispatching architecture.

K. Fujieda and K. Ochimizu, "Investigation of Repository Reprecation Models in Globally Distributed Configuration Management"

Kazuhiro Fujieda from the Japan Advanced Institute of Science and Technology described the challenges of how to maintain different, asynchronous copies of the same CVS repository in different locations, some potentially offline. The tool will address a need that many OSS developers have: to update the personal CVS repository on an offline laptop, and then synchronize it with the main CVS repository.

A. Braun, A. H. Dutoit and B. Brügge, "A Software Architecture for Knowledge Acquisition and Retrieval for Global Distributed Teams"

Oliver Creighton from Technische Universität München (Germany) proposed, on behalf of the authors, a distributed communication space, called iBistro, aimed to overcome problems resulting from miscommunications and information loss in informal or casual meetings. He focused on presenting the technical architecture for iBistro, called the distributed concurrent blackboard architecture (DCBA), and a first test of the prototype of the DCBA between the National University of Singapore and Technische Universität München.

O. Creighton, A. H. Dutoit, B. Brugge, "Supporting an Explicit Organizational Model in Global Software Engineering Projects"

Oliver Creighton from Technische Universität München (Germany) proposed a central project directory service supporting the authentication of users, the storage of user-specific attributes, team compositions, roles, and access control lists. This project directory, based on an organizational model, should be accessed by any SE tool in the project for minimizing redundancy in the organizational knowledge stored across tools, and then minimizing inconsistencies. He described an evaluation scenario involving students both in Germany and the US.

N. Boulila, A. H. Dutoit, B. Brügge, "D-Meeting: an Object-Oriented Framework for Supporting Distributed Modelling of Software"

Naoufel Boulila from Technische Universität München (Germany) presented the D-Meeting framework for supporting synchronous collaboration among distributed groups of developers, and a

framework application, called D-UML, which allows a team to interact, and together create UML diagrams and store rationale knowledge.

Empirical Studies and Experience Reports (1)

D. M. German, "GNOME, a case of open source global software development"

Daniel German from the University of Victoria (Canada) described the organization and management of the GNOME OSS project. As a former contributor, he presented the common toolkit for software development, how contributors work within the project, how requirements gathering takes place, and the administration structure, rooted in the GNOME Foundation. An interesting aspect of the project was that GNOME communication relies not only on traditional asynchronous tools (such as mailing lists and web sites) but also on synchronous tools (specifically Internet Relay Chat) to mimic "watercooler conversations" between developers.

L. Kiel, "Experiences in Distributed Development: A Case Study"

Lori Kiel, an anthropologist from the University of Alberta (Canada), reported the findings from a case study that involved a migration/reengineering project distributed across the Canadian and German offices of a mid-sized software development organization. After the effort failed, she focused on understanding the contributing factors. She found that there was conflict among the teams emerging from social, cultural, linguistic and political factors. Time-zone differences limited the effectiveness of synchronous communication. She coined the term "angry-grams" for email messages exchanged between distant sites: the delay introduced by an asynchronous tool such as email exacerbated conflict.

A. Bianchi, D. Caivano, F. Lanubile, G. Visaggio, "Defect Detection in a Distributed Software Maintenance Project"

Alessandro Bianchi from the University of Bari (Italy) reported the findings of a successful case study involving a massive maintenance project distributed across the Italian offices of a big software development organization. Analysis of collected defect data showed no differences between the work done in a single place and the work split in two places. This successful distributed project might be explained by homogeneous behavior of the two sites (both Italian and CMM-3 certified, they followed the same process) and a well known application domain.

R. Prikladnicki, J. Audy, R. Evaristo, "Requirements Management in Global Software Development: Preliminary Findings from a Case Study in a SW-CMM context"

Rafael Prikladnicki from the Pontifical Catholic University of Rio Grande do Sul (Brazil), presented a case study conducted in a multinational organization that has offshore software development centers in Brazil, India and Russia. He identified the difficulties in the analysis and management of requirements for a software project in this type of environment, and offered a set of lessons learned to be effective in working with requirements management in global software development (e.g., training in soft skills, and a certification process in a quality model).

M. Paasivaara, "Communication Needs, Practices and Supporting Structures in Global Inter-Organizational Software Development Projects"

Maria Paasivaara from the Helsinki University of Technology

(Finland) presented a survey, based on thirty-two interviews from seven global inter-organizational projects, which aimed at identifying communication needs, supporting structures and communication practices between the customer and the subcontractor(s). The most surprising result was that companies, even though successful, did not have clear structures and practices that were commonly used in all inter-organizational projects. The practices (e.g., regular meetings to keep people informed, or kick-off meetings to help build trust) were mainly project specific and created by trial and error.

Empirical Studies and Experience Reports (2)

J. A. Espinosa and E. Carmel, "Modeling Coordination Costs Due to Time Separation in Global Software Teams"

Alberto Espinosa from the American University (USA) presented a model of coordination in global software teams to understand the consequences of time separation and quantify the cost of miscoordination. He showed results from a simulation of the model: coordination and vulnerability costs (e.g., misunderstandings, rework) are very sensitive to the timing of requests, but this effect diminishes with less time separation. The co-author, Erran Carmel, pointed out that the effectiveness of the "follow-the-sun" approach is more a myth than a reality. From the discussion it emerged that it works more for documentation writing than for software development.

J. Pyysiäinen, "Building Trust in Global Inter-Organizational Software Development Projects: Problems and Practices"

Jarkko Pyysiäinen from the Helsinki University of Technology (Finland) presented a survey, based on interviews from nine Finnish global inter-organizational software development networks, which aimed at identifying the factors involved in the development of trust. He stated that promoting familiarity and confidence in the beginning of projects may help to build trust also in the case of geographically and organizationally dispersed networks. Mutual feedback and open negotiation appear to be useful to maintain trust, which is even more challenging than initial trust building.

S. J. Butler, S. Hope, "Evaluating Effectiveness of Global Software Development Using the eXtreme Programming Development Framework (XPDF)"

Samantha Butler from the University of Wales (United Kingdom) presented an ongoing pilot study to evaluate eXtreme Programming when used in remotely conducted projects. Although the experiments are conducted with undergraduate students in the same course, distance is simulated by the exclusive use of telephone, NetMeeting, and a code-sharing tool for collaboration purposes.

I. Čavrak and R. Land, "Taking Global Software Development from Industry to University and Back Again"

Igor Čavrak from the University of Zagreb (Croatia) described the challenges of teaching global software development and running student projects distributed between a Croatian and a Swedish university, such as "how to financially support kickoff meetings"?

Final Discussion

The final discussion concentrated on the following questions:

- Is global software development a pain to be alleviated or an opportunity with its own benefits?

All participants agreed that global software development is more a necessity born of group integration from mergers and acquisitions or business strategies of offshore sourcing of software development work.

- What are the main challenges?

Participants agreed that the main challenges continue to be the lack of informal communication, the cultural differences between distant sites, and the difficulty of building trust among remote developers.

- What solutions (technical and methodological) are the most deployed?

There are some patterns which appears to have been applied successfully in different contexts: kick-off meetings, periodically collocated meetings, initial cultural training, and group chats with photos to decrease social distances.

- What solutions (technical and methodological) are the most promising?

Some participants pointed out the importance of iterative development methods to increase reciprocal trust and synchronize the project, even if distant sites have different processes. Other participants mentioned the need for tools which can fill the lack of informal communication and provide group awareness. Other promising research has started on the topic of coordination of global software teams.

Conclusions

The goal of this workshop was to provide an opportunity for researchers and industry practitioners to explore both the state-of-the-art and the state-of-the-practice in global software development (GSD). While academic researchers took this opportunity, the same did not happen for industry practitioners. Unfortunately the sad state of the economy, especially in the telecommunication industry which has been in the lead of global software development in the past years, has led to a step backward in the direct involvement of industry participants in community events, including this workshop edition. However, participants still had a chance to share and discuss their work with others in the field, and gained a better understanding of the key issues facing practitioners, thanks to the invited talk and reports coming from industrial experiences.

Based on the enthusiastic feedback from participants, we consider this workshop successful in fostering interaction between participants and helping to grow a community of interest in the area of global software development.

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