Multi-year Results of Using an OPEN Global Research and Development Process on Three Different Application Domains

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We present our experience with three large projects that were developed using our OPEN Global Research and Development Process [2] over a 5 year span.

The three projects are significantly different in the domain of applicability and scope but were all developed using the same process for OPEN Global collaboration.

Our OPEN Global Collaboration process is based on the identification of global competence centers staffed with domain experts that are managed by a central team responsible for high-level requirements, overall architecture and quality assurance [1], [3]. The key enabler for our OPEN Global Collaboration process is the selection of the domain experts of the global competence centers. These domain experts are internationally recognized experts and they are responsible for the complete specification and development of the components under their responsibility. This is a key insight as it significantly reduces the required communication between the central and remote teams. As a consequence, our process the communication is centered on the interface between components and not on the detailed component specifications. The key characteristics of the OPEN Global Collaboration process are:

- Hybrid centralized distributed management approach with minimal centralized control
- Work allocation to competence centers based on domain of expertise
- Frequent communications between teams
- Informal requirement specifications
- Open source approach

The first project consisted of the integration of existing UML-based front ends with several performance modeling tools. The final objective was to generate performance models using UML specifications and to be able to solve the model using several different performance modeling frameworks. The development teams were located in the United States, Italy and Brazil [9], [4], [1], [3]. Two remote teams supported different UML front-end frameworks and two other remote teams supported two different performance modeling frameworks [4]. This project spanned two years of development and was instrumented for software engineering data collection. The key project result was the understanding of the differences in the XML interfaces between several UML front-ends. The collected data was used to study the effectiveness of our OPEN Global Collaboration process and to support the analysis of the communication patterns among team members. We have learned that the first project used an architecture that enabled efficient communications. In addition, the data supported our hypothesis that a ‘system of systems’ process for global software development could help mitigate the communication needs in global software development projects.

The second project consisted of architecture validation and testing of a mission critical Oil Drilling Platform [6], [5] with teams located in the United States, Italy, Brazil and Germany. This project spanned two years and was divided into two phases. The first phase consisted of architecture development and review [5] and the second phase consisted of modeling, analysis and testing of the developed architecture [6]. The complexity and criticality of the mission-critical Oil Drilling Platform architecture required a diverse range of expertise for review and modeling. Our OPEN Global Collaboration process was used to recruit domain experts on real-time systems, software reliability, hardware reliability and different simulation modeling approaches: sensitivity analysis, and embedded simulation [6]. We used the center of competence domain experts to support the distributed architecture review process [5] and to support the detailed modeling and testing of the final architecture [6]. This project result was two-fold. First, the development of a real-time architecture framework to support mission-critical applications was implemented. Second, the project non-functional requirements were validated using real-time, sensitivity analysis and embedded simulation modeling using the actual project code.

The third project domain of applicability is the development of a modeling infrastructure for smart-grid distribution automation networks [7], [8] with teams located in the United States, Brazil, Germany, Switzerland and France. The third project objective is to develop an optimization framework for distributed automation smart-grids. This project has been ongoing for about 1 year. The domain expertise required to support this project is electrical engineering, software engineering, Markov chains and mathematical optimization. The application of our OPEN Global Collaboration process to the third project has been perceived as very...
successful. We were able to engage a team of internationally recognized experts on all of these domains to work together on solving a very complex problem: the development of a holistic framework for optimization of distribution automation networks using electrical engineering power flow analysis equations and analytical solution of Markov chains.

Interview results with members of the three projects are presented below. The project members were asked to describe the benefits, challenges, and other observations related to their experiences using our OPEN collaborative research and development process.

The following benefits of using the OPEN Global Collaboration process were identified:

- Works surprisingly well,
- Required meetings once/other week,
- Cost minimal,
- Modularized collaboration, under same story line,
- Enriching experience to collaborate with experts from several domains, as technical horizon is expanded. Rich diversity of knowledge and of social network. It is inspiring to work with researchers from different continents. I met researchers from both different research areas and background and from my own research area, all working on a shared vision.
- Interesting insight into other research areas and other approaches to problems could be gained.
- We could have in depth discussions about the open challenges,
- The mix of research topics with overlaps between the different researchers was highly fruitful,
- I imagine that such a diverse but focussed group can hardly be reached on a national or city level.

The following areas for improvement were identified:

- Need better teleconference system,
- Drawback to modularize as need a lock to revise work as one. Final work release must be centralized,
- High communication overhead experienced during the telephone conferences.
- Telephone conferences are helpful and probably cannot be replaced by email communication. However, teleconferences take up much time.
- The discussion is slower than what I am used to from other project meetings, possibly due to the large size of the group, but also due to the limits of communication technology (speech is not perfectly audible across the world, microphones are differently tunes, etc.).

The following observations were made in the interviews:

- Cultures of participants are slightly different but there is no need to interact intensively with other cultures as each domain expert focus on its own domain of expertise,
- Able to find time that works for everyone,
- I believe that the lead of the group is essential: someone must assume the leading role, organize the meetings and set the vision that others work on.
- The different domain experts provide their share to the vision and influence it. However, I doubt that such a collaboration would work without a clear project leader.

In summary, we conclude that a OPEN Global Collaboration process that focuses on the required technology and minimizes management overhead can be used to develop successful technology in several different domains of applicability.

REFERENCES