Information and Software Technology 56 (2014) 1–5

Contents lists available at ScienceDirect

Information and Software Technology

journal homepage: www.elsevier.com/locate/infsof

Editorial

Global software engineering: Identifying challenges is important and providing solutions is even better

1. Introduction

Global Software Engineering (GSE) has become a mainstream trend in industry. An increasing number of companies, irrespective of size and location, have been getting their software developed in an arrangement where a majority of stakeholders are distributed across geographical, temporal, and socio-cultural boundaries. The transformation of GSE from a phenomenon to a paradigm has been spearheaded not only by business needs and organizational desires but also consistent efforts of the GSE community. There has been a dedicated conference series to this area, the International Conference on Global Software Engineering (ICGSE) and its 6th edition provided the two articles that have been included in this special section. This editorial aims at not only to introduce the two articles included in this special section but also to report a sample of the topical trends of research published in the ICGSE series on challenges identified and solutions. It is quite clear that there was a huge amount of efforts dedicated to identifying and reporting GSE challenges but the community has been slow on reporting potential solutions to the known challenges. Whilst it is important to make researchers and practitioners aware of the potential challenges and risks, it is even better to systematically devise, empirically assess, and sufficiently report solutions to the known challenges. Through this editorial we also introduce a framework of ten heuristics for devising, developing, and managing a GSE team for successful implementation of the GSE paradigm in an organization.

2. Thematic trends of research published in ICGSE

Not always but most of the time, GSE projects tend to be large and complex with several dozens of stakeholders who may have to face several kinds of challenges characterized by the need of new and novel coordination, collaboration, and communication mechanisms [1–3]. As previously mentioned, ICGSE has played an important role in building a body of knowledge about the potential GSE risks and challenges related to communication, coordination and control caused by temporal, geographical and socio-cultural distances. It was deemed appropriate to review the topical trends of a selected set of papers from previous ICGSE conferences. For this purpose, we decided to randomly selected 10 research papers from each of the ICGSE conferences between 2006 and 2011 and perform a shallow thematic analysis to identify the topical trends and categorize the selected papers. Table 1 shows the themes and trends that have been identified. Following is the brief description of each of the themes and the relevant papers.

2.1. Communication

There has been a lot of effort dedicated to study communication in the context of GSE. We identified 11 papers from ICGSE specifically investigating communication matters. The covered topics ranged from the perspective of the role and choice of communication media [4–7] to browsing into the communication patterns [8,9], and associated challenges and solutions [10–12].

2.2. Coordination

We could only identify 3 papers specifically studying coordination in GSE. It is interesting to note that coordination is a hugely researched topic in virtual teams but there has not been much research reported in ICGSE series. The identified papers covered issues such as roots of coordination breakdown in GSE [13], provision of solutions in form of practices [14] and coordination index [15].

2.3. Collaboration

It is well known that software engineering is a collaboration-centric activity that can be negatively impacted by distribution factors in GSE. The ICGSE has published several papers reporting different kinds of challenges, which are directly or indirectly, related to collaboration among GSE project team members. We have identified 9 papers (i.e., shown in Table 1) that mainly focus on different aspects of the collaborative challenges and potential solutions in GSE.

2.4. GSE models and processes

This sub-category contains the papers reporting topics such as reference models for successfully conducting GSE [29,64], business strategies [30], process descriptions [32] and the issues associated with software development processes such as requirement engineering [34,33], design [23] and software architecture evaluation [65].

2.5. Project management in GSE

This sub-category includes all the papers discussing the topics for managing GSE projects such as conducting Scrum practices [40,42,43,66], risk management strategies [44,45], and relevant models provided for task allocation [46,47], effort estimation [48] and process description.

0950-5849/$ - see front matter © 2013 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.infsof.2013.10.002

Table 1
Thematic distribution of the reviewed studied published in ICGSE between 2006 and 2011.

Themes		Number of primary studies	Primary studies
Communication		11	[6,11,5,12,7,4,10,9,8,16,17]
Coordination		3	[15,13,14]
Collaboration		9	[18–26]
Software Development Governance in GSE [27]	GSE Models and Processes	12	[28–39]
	Project Management in GSE	11	[40–50]
	General GSE Practices	8	[51–58]
	Knowledge Management (KM) in GSE	5	[59–63]
Total		60	

2.6. General GSE practices

This theme describes the papers covering general GSE practices such as the challenges and benefits of applying agile approaches in GSE [55,67], the guidance for successful product transfer [51], and more generic topics such as the suitability of the roles in distributed arrangements [52], the interdependency of distribution dimensions [53], and the challenges and successful practices associated with distributed testing [56].

2.7. Knowledge Management (KM) in GSE

This theme covers the papers either targeting architectural knowledge management specifically [61,62,60] or discuss the impact of different factors and circumstances associated with distributed development such as organizational decisions [59] and culture [68] on managing knowledge.

Apart from thematic trends of GSE research identified from the randomly selected 60 papers published in ICGSE 2006–2011, it would also be appropriate to indicate that there was a panel discussion during ICGSE 2011 on the "***Unique challenges of GSE in Europe***". The motivation for this panel came from our observation that there had been relatively less attention to the unique challenges caused by a particular geographical location, for example Europe. The panel discussion resulted in the identification of two key GSE challenges where European nuances appeared significant and important to address:

- Cultural issues in the context of Europe are complex as there are several dozens of different cultures within Europe itself let alone the cultural diversities that characterize GSE. It was felt that whilst the general level of maturity to deal with culture specific issues has increased over the last decade, the challenges related to cultural issues in general and in an European context in particular cannot be underestimated. One solution to address country- and company-specific cultural issues is to take equality partnership approach. It was recognized that client and vendor relationships are very much transaction oriented and does not encourage investigation of time and energy in identifying, understanding, and addressing cultural challenges.
- Language related issues can have more GSE challenges for Europe than other parts of the World. It was felt that native English speakers can understand different accents in general and strong Asian accents in particular with relatively less amount of time and effort as compared to their European counterparts. It was argued that US companies are diverting most of their outsourced software development and maintenance to India because the USA companies and their staff have more cultural similarities or understandings of Indian business models and software development professionals compared with their European counterparts. It was also pointed out that the emerging trend among USA companies of near-shoring to South American countries has been motivated by cultural and language similarity in general.

3. Strategies for taming GSE challenges

In our observation, there are four key factors that determine how difficult a GSE project is (Fig. 1).

- Sites: The geographic distribution of team members, working in different time zones and cultural differences impede the collaboration.
- Target system: In particular non-functional requirements such as performance or security frequently impact large parts of the target system and hence multiple sites. The software architecture of the target system significantly determines the dependencies between parts of the system, which implies the need for communication.
- Organization: Processes and IT infrastructure are the basis for the work of global teams. If all team members are working on the same goal depends on the targets of the organizational units and sites as well as the prevailing incentive structures.
- Employees: The language skills and communication abilities of the employees, their technology and domain knowledge as well as their experience with distributed projects have significant influence on the collaboration.

Based on our experiences of numerous GSE projects, observations from conducting dozens of empirical studies of GSE projects, and an extensive review of literature, we have identified ten heuristics for carefully planning, organizing, and managing GSE projects and successfully addressing the four key factors described above.

3.1. Plan the distribution deliberately

Plan the software architecture and distribution of tasks deliberately in order to reduce dependencies [69,70]. Ambiguities in the

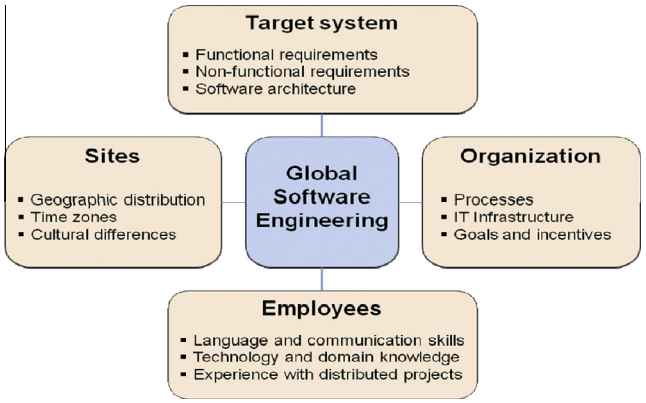

Fig. 1. Influencing factors of GSE.