

Software Quality Management Improvement through Mentoring: An Exploratory Study from GSD Projects



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Abstract. Software Quality Management (SQM) is a set of processes and procedures designed to assure the quality of software artifacts along with their development process. In an environment in which software development is evolving to a globalization, SQM is seen as one of its challenges. Global Software Development is a way to develop software across nations, continents, cultures and time zones. The aim of this paper is to detect if mentoring, one of the lead personnel development tools, can improve SQM of projects developed under GSD. The results obtained in the study reveal that the influence of mentoring on SQM is just temperate.

Keywords: Global Software Development, Mentoring, Software Quality Management.

1 Introduction

Distributed software development is becoming the norm for the software industry today [1]. GSD involves the development of application software through interactions of people, organizations, and technology across nations with different backgrounds, languages, and working styles [2]. GSD is a particular kind of Distributed Software Development (DSD) in which teams are distributed beyond the limits of a nation [3]. Cooperating over barriers of different organizations, nations, languages, time-zones and cultures is a multifaceted field of partially inter-related problems, including communication, knowledge exchange, and the coordination of international work groups [4].

This modern business strategy is based on developing high quality software in low-wage countries at low cost [5]. GSD has also been named as offshore software development, global software work, 24-hour development teams, follow the sun and round the clock.

Literature has reported several benefits related to the adoption of GSD. The most conveyed benefits include lower costs (e.g., [6]; [7]; [8]; [9]), greater availability of human resources and multi-skilled workforce (e.g. [10]; [11]; [12]; [13]), and shorter time-to-market cycles (e.g. [11], [14]; [15]). In a recent work [16], GSD is justified as because of the desire to extend working days, to benefit from the distribution of resources, to reduce costs and to be demographically closer to the target consumer.

But literature reported also challenges and issues related to GSD adoption. One of the challenges for GSD is quality and its management [12]. According to [17], quality usually is not directly affected by the distributed nature of GSD projects; however, some papers describe indirect effects of distributed collaboration on quality [18], [19]. Other authors are more categorical about the link between quality and GSD. Thus, [20] reported regular quality problems in the products developed offshore and [21] asseverates that the “follow the sun” model is essentially a quick-and-dirty strategy that converts a schedule problem into a quality disaster.

Given that quality management is an important competitive advantage in organizations with geographically distributed software development centers [22], the aim of this paper is to find out if mentoring could be an effective way to disseminate SQM practices among software development centers in order to mitigate the problems already reported in the literature.

The remainder of the paper is organized as follows. Section 2 surveys the relevant literature about mentoring. Section 3 describes the study about the use of mentoring as a facilitator of SQM in GSD environments. Section 4 brings the main conclusions and Section 5 depicts future works.

2 A Review of the Literature on Mentoring

Friday, Friday and Green [23] defined mentoring as an improvement process concerning a number of aspects related to a professional career, but also with the global improvement of the individual, which requires a senior advisor and a junior protégé. The People-Capability Maturity Model (P-CMM) [24] stated that the purpose of mentoring is to transfer the lessons learned from experienced personnel in a workforce competency to other individuals or workgroups. The pioneering work on mentoring [25], [26] suggested that mentoring is a powerful influence on success in organizational environments [27]. As a result of mentoring outputs, the protégé achieves a remarkable improvement in his professional career [28], [29], [30], a higher income [29], [31] and more satisfaction and social acceptance in the working environment [27], [32].

However, many recent studies reported that mentoring is a good predictor of an individual's career satisfaction yet only a very modest predictor of an individual's career ascendancy (e.g. [27], [31]). Thus, although mentoring mattered for career success, it represented just a part of a constellation of career resources that are embedded within individuals and their relationships [33].

Mentoring is a tool widely employed for knowledge management [34]. In software development projects, mentoring dramatically reduces the learning curve for inexperienced human resources [35], [36]. In this field, mentoring has been identified as a technique or strategy used for knowledge management [37] and human capital development [38]. Niazi et al. [39] pointed out that mentoring is a vital element of the implementation of software process improvement. More recently, mentoring has been identified as one of the leading success factors in adopting agile software development practices, since it expands the organizational culture [40], [41]. These results can be extended to expand national culture among foreign practitioners [42]. Nevertheless, in [43] authors stated the distance between the theoretical programme design and its application is one of the factors that decrease the efficiency of mentoring in software companies. In spite of their imperfect implementations, reports on the use of mentoring in GSD teams can be found (e.g. [44], [45], [46], [47], [48], [49]), however, to the best of author's knowledge, specific works about the influence of mentoring on SQM in GSD environments are still needed.

3 Study: Impact of Mentoring on SQM in GSD Scenarios

This section presents the study conducted in this paper. Such study is aimed to investigate the effects of mentoring techniques for SQM in the context of GSD working environments.

3.1 Research Design

This study is designed to be an exploratory study conducted using qualitative research techniques. The aim of the study is to identify which processes within SQM can be more influenced by the use of mentoring in GSD teams. Taking this into account, the output of the study is two-fold. The first output is a ranking of SQM processes with respect of its improvement by means of the application of mentoring. The second output is score on the impact of mentoring in such processes using a 1-4 Likert Scale (1= Low, 2= Medium, 3=High; 4=Very High).

The research tool selected to perform the study is a focus group. Focus groups involve assembling small groups of peers to discuss particular topics [50]. Discussion within these groups, although directed by a researcher, is largely free-flowing [51]. The use of discussion groups in software engineering and information systems development research activities has been extensively reported in the literature (e.g. [50], [51], [52], [53], [54], [55]).

Data collection was done as follows. The meeting was designed to be facilitated by three researchers (one in each location). Participants were connected using

videoconference and assisted on-site by a researcher. The focus group's virtual meeting lasted approximately 35 minutes. During the meeting, researchers took extensive notes as well as videos. In accordance with previous literature [55], the session started with a brainstorming, where subjects thought about personal experiences on SQM, GSD and the use of mentoring. They use post-it notes to write down impressions and issues about the each of the SQM process. Once this step was completed, they discussed for 20 minutes the importance of each challenge and ranked the final list. The starting point was the list of processes of SQM. According to IEEE12207.0-96 [56], these processes are:

- Quality assurance process: The aim of this process is to provide assurance that the software products and processes in the project life cycle conform to their specified requirements by planning, enacting, and performing a set of activities to provide adequate confidence that quality is being built into the software [57].
- Verification process: Verification is an attempt to ensure that the product is built correctly, in the sense that the output products of an activity meet the specifications imposed on them in previous activities.
- Validation process: Validation is an attempt to ensure that the right product is built, that is, the product fulfils its specific intended purpose.
- Review process. Review is a process or meeting during which a software product is presented to project personnel, managers, users, customers, user representatives or other stakeholders for comment or approval. Reviews include Management reviews, Technical reviews, Inspections and Walk-throughs [58].
- Audit process. The purpose of a software audit is to provide an independent evaluation of the conformance of software products and processes to applicable regulations, standards, guidelines, plans, and procedures.

3.2 Sample Description

The sample consisted of one woman (20%) and four men (80%), with an average age of 42.4. Each of the participants was selected on the basis of his/her previous experience in all issues that the study covered: GSD, SQM and mentoring.

3.3 Results

Table 1 lists in alphabetical order the SQM processes explained by using excerpts from direct transcripts of the focus group session.

Table 1. Opinions of the influence of mentoring in SQM Processes within GSD projects

SQM Process	Excerpts
Audit process	Audits involve a formal group of independent people; it's not easy to suggest them to just one person" "Audits are expensive" "Audits are very difficult to assimilate by project personnel and company managers"
Quality assurance process	"I think that almost every software corporation has a software quality plan. But in the case of the absence of it, I think it won't be easy to convince them to adopt one" "Sometimes quality approach is not the same overseas" "This process can be seen as the key process here as it contains all the others in it. It's very broad"
Review process	"There are many kinds of reviews. Many of them rely on individuals. It's easier to convince an individual than a whole corporation" "I always suggest more junior professionals to perform managerial reviews. It does not matter if I'm performing a formal mentoring or just in an informal conversation"
Validation process	"Mentoring validation is the easiest thing here. It's easier to convince someone to look at requirements than to organize an audit, for instance"
Verification process	"I've had bad and good experiences with verification and GSD. Talking about the bad ones, many times a partner presents a good quality plan but, once the development starts, there's not a single attempt to follow it"
General	"There are many differences among partners. There are several of them with high level of quality concern and others that their processes has nothing to do with quality"

Table 2 presents SQM processes ordered by importance and including the impact factor of mentoring among them. These results come from the sum of the punctuations given by subjects.

Table 2. Ordered SQM processes including mentoring impact factor

Rank	SQM Process	Mentoring Impact Factor
1	Validation process	2= Medium
2	Review process	2= Medium
3	Verification process	2= Medium
4	Quality assurance process	1= Low
5	Audit process	1= Low

3.4 Discussion

Results show that the impact of mentoring to adopt quality processes in GSD is restricted. This detail confronts with the fact that mentoring is a valid and recommended tool to implement quality related practices [59]. A possible explanation

for this light influence may be the atomized analysis of SQM processes. This approach could be not convenient in our case. SQM can be adopted, but according to subjects' responses concrete cases and processes are not easy to mentor.

Thus, authors suggest combining mentoring with a companywide quality strategy in which norms and models must be adopted and updates to give quality to all software process. Concerning the importance of software improvement initiatives, subjects agree that, in many cases, the maturity of offshoring partners (CMMi maturity level) is higher than the contractor's.

Other important aspect regarding results is that subjects were informed that mentoring will be performed through the internet. As is widely reported in the literature, e-mentoring can be seen as the second best option, although it also has its advantages. A suggestion to improve the effectiveness of this technique could be to mix e-mentoring and t-mentoring in order to break the barriers of distance. However, due to the high cost of travelling, this set up must be considered only in long term relationships. Thus, suggestions could be to exchange software developers among project sites on a temporal basis in order to provide informal mentoring and cultural interchange; to organize workshops, especially at the beginning of the project and finally, to promote continuity in partnerships.

One issue that must be highlighted is the need of correct mentoring support. Both quality issues and mentoring success roots on the effective process support by the organization. Thus, organizations and managers must champion the process in terms of resources and times to aid the correct application of mentoring processes.

Finally, several works have highlighted the importance of quality issues for GSD (e.g. [60]) in terms of product quality and design quality, among others, but also claimed that there are not unique solutions to the known problems. Since GSD roots on cultural differences, on the construction of the third culture, mentoring can be a mean, but not the only way to develop it.

3.5 Limitations of the Study

The aim of this paper is to present an exploratory study. It may not be appropriate to generalize from a small sample (5 subjects) pertaining to European companies. However, taking into account that this is just a prospective study, data should provide potential start-points for further developments. In any case, the empirical research conducted is not strong enough to estimate the impact of mentoring on SQM in GSD.

For future works expanding the exploratory nature of this study authors suggest to expand both the sample and the composition of it in terms of corporations, nations and cultures represented.

Other important limitation comes from the level of granularity of the topics under study. Thus, V&V or audit processes might be too wide, for instance; the activity level could drive perhaps to more interesting conclusions.

4 Conclusions

This paper presents an exploratory study on the significance of mentoring practices for SQM in GSD teams. Results show that, although mentoring is seen as a good tool

to support personnel development, the impact of these practices to mentor software quality issues is just moderate. However, the distribution of this impact among SQM practices is not equal. Processes like Validation, Review and Verification are more sensible to mentoring in GSD scenarios. This starting point gives way to a broader set of studies devoted to this issue. Next section depicts these studies.

5 Future Work

The current work proposes three types of initiatives which should be explored in future research. Firstly it is aimed to complement this exploratory and qualitative study with a more ambitious qualitative study along with a quantitative approach that enlarges the validity of the effort. The aim of the second study is to dig deeper into SQM processes and their best approach to implement them in GSD scenarios. Thus, it is aimed to get some measurable results of increased Software Quality due to the application of mentoring in GSD scenarios. Finally, authors propose to study the influence of other personnel development practices in this setup, more precisely, authors suggest to study the impact of coaching in the spread of SQM practices.

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