

Software Engineering Occupational Stress and Knowledge Sharing in the Context of Global Software Development

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Abstract — The success of a software development project does not only rely on technical support but also depends on human and social factors. The human side of software development has been ignored in the past decade or so, which calls for increasing our efforts to understand this side of software engineering. Human knowledge and creativity is the cornerstone for software development. However, this human knowledge has lesser or no value when it is isolated or individualized; hence knowledge sharing becomes critical for the success of software projects. The dilemma with knowledge sharing is that there are many impediments to it. One such impediment can be occupational stress which has increased after the globalization of software engineering. In the context of Global Software Development (GSD), the objective of this paper is to highlight the impact of software engineering occupational stress on knowledge sharing. To highlight this important relationship a thorough literature survey has been conducted and the results of the survey are presented in this paper.

Keywords—Knowledge Sharing; Occupational Stress; Software Engineering; Global Software Development GSD

I. INTRODUCTION

Software engineering is regarded as a knowledge intensive process [1] which is dependent on the input of human knowledge, intelligence and creativity [2]. Keeping this in mind, it is evident that human and social aspects would play a key role in the success of software development projects; however research addressing this side of software engineering, especially in the context of global and distributed software engineering, is scarce [3][4][5]. In the last decade or so, researchers mainly focused on the technical and quantitative side of software engineering [6]. This calls for more research to understand the human side of the software engineering. Using the literature, this paper will highlight the relationship between occupational stress and one of the key Knowledge Management (KM) areas, *Knowledge Sharing*.

A. Problem Statement

Human knowledge and creativity are the two primary inputs for the process of Software development [2]. Knowledge, when individualized or isolated, has lesser value [7], hence sharing of knowledge is important to leverage its full

potential. In the context of software engineering, knowledge sharing plays a key role for the success of software engineering projects [1]. Hence it is important to study knowledge sharing in the context of Global Software Development (GSD).

GSD has made the nature of software engineering occupation more demanding. Hence nowadays software engineers face various kinds of pressures [8], for example, the pressure to update their skills according to the continuous change in tools, technologies and methods [9]. These pressures can increase software engineers' occupational stress. Several aspects peculiar to GSD (i.e. time zone differences, linguistic differences, technological issues, cultural issues and lack of trust) also contribute to the stress of software engineers. In return this stress can affect employee's behavior [10]. Because of this impact of occupational stress on individual's behavior, it is likely that software engineer's knowledge sharing behavior will be impeded by occupational stress; however, there has been a lack of research work on the potential daunting effects of stress on knowledge sharing behavior of software engineers. This sets the motivation for this study, and leads us to the next section which will describe the objectives of the study.

B. Objectives of the Study

The preceding paragraphs clearly show that it is essential to analyze the effect of stress on software engineer's knowledge sharing behavior. This study will highlight the impact of occupational stress on knowledge sharing behavior of software engineers in the light of a comprehensive literature review. Hence, through literature review, the objective of the current study will be:

- To highlight the effect of occupational stress on knowledge sharing behavior of software engineers

II. LITERATURE REVIEW

A. Software Engineering (SE) and Global Software Development (GSD)

Software is developed by professionals who employ their skills to develop customized software products for manufacturing and service industries [11]. These professionals, popularly known as software engineers, are involved in the

profession known as Software Engineering. As a process software engineering is “the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software” [12].

With the advent of globalization, a phenomenon emerged in software engineering known as Global Software Development (GSD) [13]. GSD involves “the development of application software through interactions of people, organizations, and technology across nations with different backgrounds, languages, and working styles” [14]. This phenomenon brought many benefits such as low development cost, high performance, access to an expert and larger pool of software engineers, possibility of round the clock software development which will result in reduced project timeline and possibility to remain close to the customers [13] [15] [16] [17]. However, with GSD came several issues including temporal, geographical, socio-cultural, historical, technical and political issues [18]. These factors have made the nature of software engineering occupation more demanding. Hence nowadays software engineers have to face various kinds of pressures [8]. These pressures can increase the stress of software engineers, which will be discussed in the upcoming section of this paper.

B. Software Engineering Occupational Stress

As mentioned earlier, nowadays software engineers have to face various kinds of pressures including global pressures in terms of market and competition, technology pressures in terms of updating and developing skills and local pressures in terms of working hours, changing work culture, changing teams, and changing peer group [8]. At individual level the response to all these pressures can be stress, as in [19] defined stress as “the response to an inappropriate level of pressure”.

Stress effects employee’s behavior [10] [20], can lead to decrease performance, absenteeism, turnover, accidents, errors, drug, abuse [21], poor quality products [22] and decreased productivity [20]. Hence it becomes important to study occupational stress in every profession.

Why is it important to discuss occupational stress in software engineering? This can be explained in two ways. Firstly, the nature of the software engineering job is characterized by high intellectual demand [8] and hence it can be a stressful job [22]. As in [22], aggressive schedule and overtime can lead to stress among software developers. The author further posits that this stress can lead to defects in the software quality. For example a stressed programmer is not only more likely to put in small bugs but can also put in a very serious bug [23]. Secondly, the GSD environment adds to this pressure with issues like high ambiguity, which can result in frustration among the development team [24]. Factors peculiar to GSD such as time zone differences, linguistic differences, technological issues, cultural issues and lack of trust can also increase the pressure on software engineers and are a major impediment to communication and knowledge sharing.

Researchers have studied occupational stress among the professionals of various fields such as human service professionals, teachers, accountants, managers, nurses and pilots, firefighters as well as in various contexts such as manufacturing firms, accounting firms, schools, colleges,

hospitals, airlines and the like, however very small attention has been given to the occupational stress among software engineering professionals [11]. As in [11], majority of the studies which have attempted to study stress among IT workers, have actually targeted Management Information Systems (MIS) professionals, who have distinct characteristics as compared to software developers. The study as in [11] develops an instrument to measure stress among software developers. The authors mention ten causes of stress, peculiar to software developers, to measure stress among software developers working in software development process. These causes have been illustrated in Table 1.

TABLE I. FACTOR TO MEASURE SOFTWARE ENGINEER’S STRESS BY [11]

Fear of obsolescence	Individual team interactions
Client interactions	Work family interface
Role overload	Work culture
Technical constraints	Family support towards career
Workload	Technical risk propensity

C. Knowledge Sharing

Knowledge sharing can be defined as sharing of important knowledge and experience between organization members [25]. Knowledge sharing has become one of the most important and widely researched processes of Knowledge Management (KM) [26] [27]. The importance of knowledge sharing in KM can be analyzed from the fact that it is not only one of the biggest challenges for the success of KM initiatives but it is also a primary reason of the organization and measurement of KM [21] [28] [29]

Knowledge sharing can contribute to the overall well being of the organization in various ways including high performance [30] [31], increased resources and decreased errors [25], improved decision making [32], accelerated overall learning both at organization as well as individual level [33], and increased innovation capability of the organization [34]. However, knowledge sharing is an unnatural process [35] and can be hindered by various barriers [33].

D. Knowledge Sharing in Software Engineering

As described earlier, software development is a knowledge intensive process, in which every member of the team has limited knowledge [1] [36]. Individual knowledge has lesser value for organizations until the individuals open up their minds to share it with others [7]. Hence, knowledge sharing, communication and collaboration, among the development team and between the team and the customer, are the keys not only for the success of conventional software development projects [1] but also agile methods of software development [36]. Without an effective sharing of information and knowledge, the project can suffer from unsuccessful collaboration [37] which can lead to the failure of project.

Effective knowledge sharing can benefit software organizations in multiple ways, including avoiding knowledge drain by capturing individual’s knowledge before he leaves the organization, improving knowledge dissemination in the organization, enhancing the knowledge base of the organization by bringing the knowledge of distributed

members into organizations knowledge repository, effective sharing of domain knowledge and expertise between the development team and the customer and hence effective identification of the system requirements, effective capturing of the tacit knowledge of the members, improving effectiveness of the group, enhancing trust among group members etc [36] [38]. In the context of GSD, globally distributed teams have employed various technologies to aid knowledge sharing, however challenges to effective knowledge sharing still exist, mainly because of cultural, time zone and geographical differences [14] [39] [40].

As mentioned above, there are various factors that can impede knowledge sharing in the distributed software development projects; however, to fill the research gap, this study will attempt to understand the effect of software engineering occupational stress on knowledge sharing among the software development project members. Based on limited available literature, the forthcoming section highlights the relationship between stress and knowledge sharing behavior.

E. Software Engineering Occupational Stress and Knowledge Sharing

Several studies have analyzed the impact of variables which impede knowledge sharing in various settings; however no study, to the best of author's knowledge, has analyzed the impact of occupational stress of software engineers on their knowledge sharing behavior. The link between stress and knowledge sharing is quite apparent. For example, various antecedents of occupational stress have been regarded as barriers to knowledge sharing. At individual level, as software developers are bound by project deadlines, time constraint can lead to stress [41] [42]. This lack of time has been regarded as a major impediment to knowledge sharing [33]. At the same time, relationship with others in the organizations can cause stress [43]. For knowledge sharing, lack of trust is an impediment [33]. It is evident that lack of trust leads to bad relations with others, hence it can be assumed that lack of trust and bad relations are similar antecedents of knowledge sharing and stress. At organizational level, working conditions and physical surroundings can be a cause of stress [43] which has also been mentioned as a barrier to knowledge sharing as in [33]. The factors peculiar to GSD, such as cultural, time zone and geographical differences are also a challenge to effective knowledge sharing [14] [39] [40].

The aforementioned similarities are few examples which highlight the possible relationship between stress and knowledge sharing. Hence it is imperative to empirically test the relationship in the context of software engineering.

The preceding paragraphs lead us to our main proposition.

Proposition: In a GSD environment, with time zone differences, linguistic differences, technological issues, cultural issues and lack of trust, SE occupational stress will be higher and will impede knowledge sharing.

III. RESEARCH METHODOLOGY

The methodology adopted in this paper is literature survey from journals, conference papers and books. The objective was

to highlight the effect of software engineering occupational stress on knowledge sharing behavior of software engineers in a GSD setting. The upcoming section will highlight the future work which will be undertaken based on the premise described in preceding sections of this paper.

IV. FUTURE WORK

In future the proposition will be empirically tested. For this purpose, the survey method will be used and the data will be gathered from software engineers working in Small and Medium software enterprises (SMEs). The analysis will be conducted using Structured Equation Modeling (SEM).

In future, Theory of Planned Behavior (TPB) can be used to provide a theoretical foundation to the framework. Other variables, such as GSD communication barriers and software engineer's personality type, can also be added into the study. These variables can play a key role in understanding occupational stress as well as knowledge sharing behavior of software engineers. At the same time, it will be imperative to study the impact of software engineer's knowledge sharing behavior on his creativity.

SMEs are playing a crucial role in today's economy [44] and comprise of 99.2% of software development companies, with less than 250 employees [45]. The dependence of SME on flexible forms of work makes them vulnerable to the challenges faced by distributed teams such as cultural and linguistic distances [46] [47]. Hence they become ideal to study variables like stress and knowledge sharing.

V. CONCLUSION

In the light of available literature, this paper has theoretically highlighted the effect of software engineering occupational stress on knowledge sharing behavior of software engineers in the context of Global Software Development (GSD). GSD has increased the pressure on software engineers, which can result in high level of stress. This occupational stress can impede knowledge sharing among software engineers. This study is just a foundation for a more comprehensive analysis and testing of the subject in future.

VI. REFERENCES

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