Challenges Faced by Stakeholders during the Requirement Engineering Phase: An Exploratory Study

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Stakeholders are the backbone of any organization and play a vital role in the completion of any product. Different stakeholders with different roles, skills, natures, and experiences are involved throughout the Software Development Life Cycle (SDLC). Unlike other phases of SDLC, Requirement Engineering (RE) requires more stakeholders, active participation, focus, and collaboration. However, stakeholder involvement makes the RE phase more difficult and impacts other phases of Software Development. The inherent complexity of the RE phase is due to numerous factors, including diverse skill sets, language disparities, comprehension issues, and lack of interest, thereby rendering it particularly challenging for stakeholders. Literature also highlights some practices to resolve these issues, like enhancing communication and building trust among team members to overcome these challenges, but still, all these challenges affect software development in one way or another, and lead projects toward failure.

Keywords: Requirement Engineering, Stakeholders, Software Development, Challenges

Introduction:

Software development involves several distinct phases [1], with Requirement Engineering (RE) serving as the foundational stage of the Software Development Life Cycle (SDLC) [2]. Requirement Engineering (RE) is the most crucial phase in the Software Development Life Cycle, as all subsequent phases rely heavily on its input [2]. RE controls all activities from requirements elicitation to the implementation phase, making it the most critical and complicated phase [3][4]. During the Requirement gathering phase, the development team interacts directly with the stakeholders' representative(s) [1]. The initial output of this interaction can be in the form of stakeholder user stories, which define stakeholders' real needs and expectations [2]. However, since different stakeholders may propose varying and sometimes conflicting demands, determining exactly "what to build" in alignment with the client's and stakeholders' priorities remains a significant challenge. The Merriam-Webster dictionary defines influence as "the power to change or affect someone or something". In the context of this study, influence can be related to the power of stakeholders and their impact on the RE process [5].

Software is regarded as high-quality when it fulfills stakeholders' expectations and is developed within the allocated resources and budget [5]. However, creating such quality products is a complex task, as it involves coordination among multiple stakeholders throughout the development process [5][6]. A stakeholder serves as the driving force behind any product, as the development of a product is primarily guided by the stakeholder's needs, goals, or interests [7]. It is a challenge to build software without stakeholders' interest, and stakeholders' involvement is important throughout the complete SDLC.

Developer and stakeholder interaction impacts the overall RE process. Requirement Engineering is an essential phase of SDLC. The success of any software is directly proportional to understanding requirements, analyzing needs, validating specifications and meaningful requirements, clearing ambiguities, and implementing requirements that are supposed to be fulfilled. [1][5] Human-based activity-like. Developers' and stakeholders' active involvement at this phase is more critical than at any other phase of software development. However, the involvement of several humans makes this phase more challenging [8]. Analysts cannot obtain clear and comprehensive requirements merely by asking stakeholders about their needs and expectations. Eliciting high-level requirements is a complex and challenging task; therefore, developers must identify and engage the most appropriate stakeholders for effective requirement elicitation and negotiation [8]. Although analysts are responsible for selecting stakeholders, the literature identifies several challenges associated with this process. Stakeholders often possess diverse personalities and come from various professional and cultural backgrounds, leading to significant differences in their knowledge, communication styles, and levels of understanding [6][9].

There are several personal, professional, and environmental challenges associated with them, like; conflicts between them, politics between them, lack of direct communication [10], coordination issues, cultural issues, and language problems [11], inactive participation or absence of stakeholders [12]. These challenges significantly complicate the Requirement Engineering (RE) process and can result in project delays, budget overruns, or, in severe cases, complete project failure [12]. Therefore, active participation of all stakeholders during the Requirement Engineering (RE) phase is crucial for the success of a project. However, this involvement is often compromised due to various underlying factors that must be identified and addressed. The primary motivation of this study is to explore and uncover the challenges stakeholders encounter throughout different stages of the RE process.

Literature Review:

RE is the very first phase of SDLC and consists of several activities. RE is a human-centered activity and requires more human interaction than any other phase of SDLC, which

makes this phase more critical [2][3][4]. For the successful implementation of user requirements, stakeholders must work carefully and ensure that all requirements are clear, unambiguous, and complete [1][5]. Different techniques are used to elicit requirements; stakeholders cannot elicit requirements by simply asking customers about their needs or expectations [8]. Elicitation of requirements is always a difficult task due to various challenges like poor understanding of requirements, lack of face-to-face meetings, conflicts, and delays in meetings [13][14]. Poorly elicited and inadequately validated requirements negatively impact both the prioritization and negotiation of client needs, making it difficult to determine which requirements should be addressed in a specific release [15].

The success of any project depends on several factors. The most important and challenging one is the human factor. Human nature varies from person to person, and it is very difficult to resolve all challenges associated with stakeholders involved throughout the development phase [8][16]. Shared understanding of user requirements, Absence of a product manager [17], lack of active participation of stakeholders [12], language and communication, cultural differences [10][18], different political views, diversity in personal interest [19] are some challenges that lead to software development in different dimensions.

Unlike other phases of the Software Development Life Cycle (SDLC), the Requirement Engineering (RE) process demands greater interaction and concentration, as it involves the highest level of stakeholder communication and engagement [8]. All these challenges affect the RE process badly and impact other phases as well [10][11][12]. In this literature review, namely categorized into personal, professional, and environmental challenges.

In [16], the influence of human aspects like motivation, domain knowledge, attitude, communication skills, culture, gender, demographic distribution, and personality traits during the Requirement Engineering phase in the software industry is being investigated based on different data collected from the software industry. A systematic review is conducted in [16] to identify the effect of the human aspect in the Software industry and based on the results from existing literature as well as views from software practitioners. It has been identified that limited motivation, insufficient domain knowledge, varying attitudes, and weak communication and interpersonal skills among stakeholders create significant challenges in the Requirement Engineering (RE) process. Therefore, it is essential to emphasize the correctness, clarity, and completeness of requirements, along with fostering effective collaboration among diverse stakeholders during RE activities. Another Systematic Literature Review (SLR) was conducted to identify primary research studies that examine the influence of human factors on the Requirement Engineering (RE) process and their impact across its various phases. A total of 74 primary studies were analyzed to assess the impact of stakeholders during the Requirement Engineering (RE) process. The research identified several human aspects, such as personality, emotions, motivation, communication, culture, gender, and geographic distribution, as influential factors. Among these, communication issues were found to be the most widely prevalent challenge during the RE phase.

Requirement engineering and the role of stakeholders are very important and necessary in GSD, like DSD and other software development approaches. An SLR with 25 practices is conducted to improve the effectiveness of software project management. The increasing globalization of software development has introduced new challenges, especially concerning communication, coordination, and project management due to geographical, time zone, and work culture differences According to [18], in GSD, challenges such as language differences and time zone differences cause significant barrier during requirements collection and thus need of effective project management increase more and more to handle challenges of GSD. Requirement change management poses a significant challenge for stakeholders. Differences in time zones often lead to delays in communication and coordination. Additionally, language

barriers between vendors and clients can hinder effective communication, resulting in reduced interaction and misunderstandings during the development process. There is a need for high collaboration between different types of software engineers and requirement engineering. RE is dependent upon demographic views, use of different technologies, whereas communication, collaboration are helpful in working style and demographic views. According to the findings presented in [7] based on a Systematic Literature Review (SLR), factors such as motivation, domain knowledge, and communication skills significantly influence Requirement Engineering (RE) activities. The study emphasizes that RE requires a high level of collaboration among various roles in software engineering (SE), including requirements engineers, stakeholders, developers, and others involved in the development process. Their demographic views, understanding of technologies, working styles, personality, emotions, culture, communication, and collaboration capabilities make RE highly human-dependent.

Personal Issues:

Stakeholders are key factors in the success of any project and organization. From requirement elicitation to maintenance of the product depends on stakeholders' interests and needs. Stakeholders focused and active participation plays a key role in requirement elicitation; however, the absence or lack of active participation of stakeholders affects this phase [12][17]. Human behavior is inherently complex and varies across different situations. Individuals tend to think and respond differently based on their experiences, perspectives, and roles. As a result, each person may hold unique opinions and interests regarding a particular task or scenario, often leading to conflicts among stakeholders during the requirement elicitation process [12]. These conflicts directly impact the RE process and later other phases as well [12]. Analyzing and prioritizing requirements helps in understanding and managing important functional requirements and resources.

The prioritization of functional requirements is largely influenced by the interests of stakeholders [20]. However, conflicts and differing interests among stakeholders can create challenges, leading to misunderstandings and confusion among developers. Stakeholders' diverse interests and opinions lead to development towards failure [12]. Domain knowledge is essential for all stakeholders involved in a project, as it enables a clear understanding of the system and the formulation of relevant requirements. When stakeholders lack contextual knowledge, it often leads to frequent changes in requirements, disrupting the development process. Change in requirements at the initial level is easy to accommodate but sometimes requirement changes very late and at that time changes are very difficult to implement which makes this process more challenging. Different stakeholders resist positive change and do not understand the significance of change required at any level due to political conflicts, lack of contextual knowledge, or diverse interests that lead the project toward failure [19].

Professional Issues:

Although multiple stakeholders may collaborate on the same project, their professional attitudes can differ significantly. Variations in working styles, skill sets, interpersonal behavior, political views, levels of knowledge, individual interests, and loyalty to the organization can all contribute to differences in how each stakeholder approaches the project [12][19]. Any organization's policies, managers' influence, promotion issues, and jealousy between colleagues are some challenges due to these reasons; conflicts between stakeholders arise, and they do not agree with one another and do not trust each other [21].

Table 1. State of the art

Paper ID/ year	Contribution	Methodology	Results	Challenges Identified
[16]/2023	*Current* industry perspectives on the influence of human aspects on RE-related activities, specifically focusing on motivation and personality, by targeting software practitioners involved in RE-related activities	Survey	Software practitioners consider motivation, domain knowledge, attitude, communication skills, and personality as highly important human aspects when involved in RE-related activities.	Constant requirements changes, Communication issues
/2020	The Effects of Human Aspects on the Requirements Engineering Process: A Systematic Literature Review"	SLR	Human aspects such as personality, human values, communication, motivation, gender, emotions, and culture are identified.	Linguistic Issue
[18]/2020	Practices for Effective Software Project Management in Global Software Development: A Systematic Literature Review	SLR	Communication issues are the most widely spread issue among the stakeholders during the RE process.	Cultural and linguistic challenges
[7]/2023	Bridging the Gap Between Stakeholders and Software Products: A Review of Software Requirement Engineering Technique	SLR	Time, Budget, and composition of the team must be considered to achieve the desired outcome and he satisfaction of stakeholders.	Demographic views, understanding of technologies, working styles, personality, emotions, culture, communication, and collaboration capabilities

During development, stakeholders face difficulty in requirement negotiation and association due to their limited knowledge and poor communication skills. As a result, crucial requirements may be poorly elicited or, in some cases, elicited but ultimately not implemented in the final product [17][22]. Requirements are volatile, stakeholders are not fully sure about their requirements at the initial level when requirements are elicited, and then later, requirements are changed. In certain cases, changes are essential and must be carefully planned and managed. However, conflicts, lack of trust, and differing stakeholder interests often create resistance to change. As a result, critical changes may go unnoticed or unimplemented, potentially leading to project failure [23].

During software development, different tasks are assigned to different stakeholders. The selection of potential stakeholders is necessary to get the desired results. For the success of a project, the role of each stakeholder, especially the project manager, is very important. Without a product manager, many stakeholders who are involved in the project do not take ownership of any task and make mistakes [24].

Environmental Issues:

Environmental factors can also influence stakeholder participation during the Requirement Engineering (RE) phase. Language plays a crucial role in communication, serving as the primary tool for expressing ideas, needs, and interests. Effective communication and, thus, meaningful stakeholder involvement rely heavily on the accurate and appropriate use of language [10]. However, language can become a significant barrier when stakeholders come from diverse cultural and linguistic backgrounds. Misinterpretations and communication gaps may arise, hindering the effective exchange of ideas and reducing the overall efficiency of the Requirement Engineering (RE) process [18].

Unambiguous and updated documentation can be helpful for all stakeholders at each phase. Documentation should be clear and verified, but language and communication problems lead to poor documentation that causes several issues during and after development [15].

Requirement understanding is also more problematic due to communication and cultural challenges [25]. The change in requirements results in system modification; usually, modifications are minor but significant [26]. These modifications often disturb components by establishing new dependencies between components [26]. Even a minor mistake in the process of requirement elicitation makes the system unacceptable to the stakeholders and requires a lot of variations and time [27].

Sometimes stakeholders located in different regions and work remotely. In different regions of the world time zone differs. A time zone is also a challenge in the RE process, as there are limited chances for face-to-face communication for stakeholders and few overlapping working hours that lead to communication and feedback delays [2]. Due to this challenge, it is difficult to communicate actively on time, which leads to confusion, misunderstandings, and delays, and indirectly affects development [18]. All these stakeholders' issues directly affect project progress and success.

Methodology:

This research adopts an exploratory qualitative methodology to investigate the multidimensional challenges encountered by stakeholders during the Requirement Engineering (RE) phase of the Software Development Life Cycle (SDLC). The methodology is grounded in socio-technical systems theory, which posits that software systems are shaped not only by technical requirements but also by the social, cultural, and organizational contexts in which they are developed. A qualitative literature-based synthesis was conducted by reviewing secondary data from different systematic literature reviews, empirical studies, and academic publications focused on stakeholder engagement in RE. Data was manually reviewed and categorized under three primary themes:

1. **Personal Issues**: motivation, personality traits, resistance to change, conflict of interest.
2. **Professional Issues**: domain knowledge gaps, political influences, poor communication skills, weak negotiation.
3. **Environmental Issues**: cultural diversity, language barriers, geographical dispersion, and time zone issues.

Each theme was critically analyzed to understand its influence on the RE phase and its interrelation with other factors.

Findings and Discussion:

As previously mentioned, humans are the asset of any organization. Human forces play a vital role in the successful development of any product. There is a need to identify the challenges and problems of stakeholders. Based on the three primary themes, the challenges are identified. The three broader level challenges include personnel issues, Professional issues, and environmental issues. To achieve the desired goal, all stakeholders agree on objectives. Coordination and Teamwork of all the stakeholders will result in the success of any software product. Active participation of relevant participants at the early stages of development ensures the success of a product. A literature review performed in this study highlights that stakeholders cause several challenges during development. These challenges affect the overall progress of any product that is under development. The findings are represented in Figure 1.

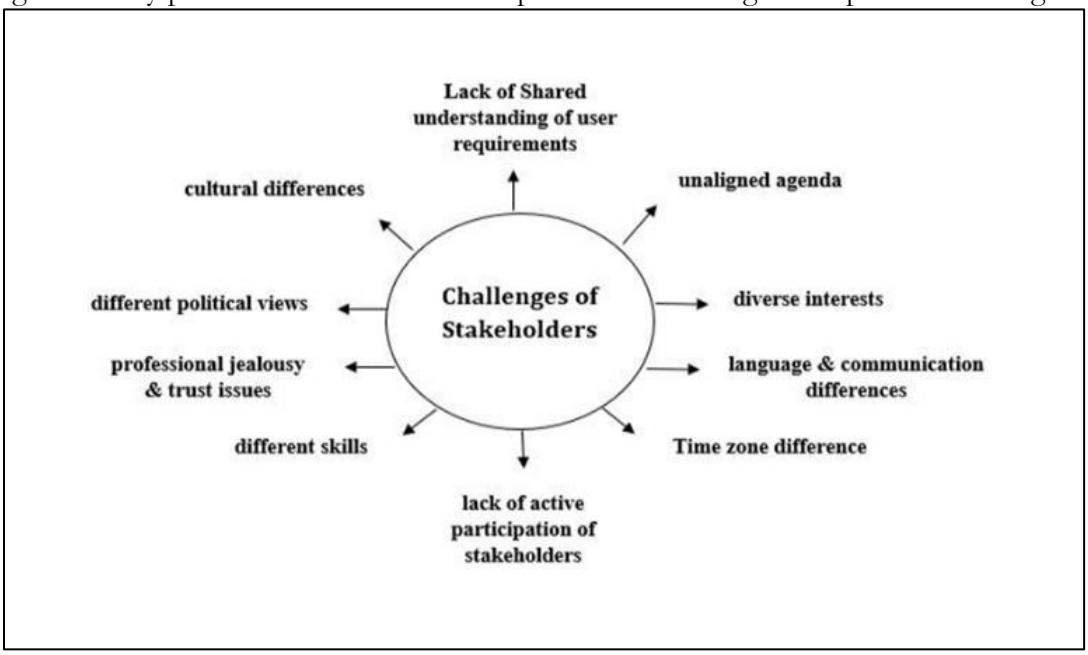

Figure 1. Challenges of Stakeholders

Conclusion & Future Work:

The success of any product depends on certain factors. One of the most important factors is stakeholders. Stakeholders contribute throughout the development activity of the software process/ system with their skills by playing different roles. Stakeholders' active participation is necessary for speedy development. However, several challenges are associated with stakeholders at different levels of development. RE needs more stakeholder involvement in their active participation, communication, and coordination among them. Through literature study, we have found that stakeholder challenges are difficult to resolve completely, especially during the RE phase. On one side, we found that active participation is necessary, but on the other side, the more stakeholders are involved, the more conflicts arise. Stakeholder belongs to different cultural and organizational backgrounds their political views and objectives are different. These differences cause conflicts and misunderstandings. Professional

jealousy prevents them from helping each other. Time zone, cultural, and language differences are barriers in a way of effective communication. The consequences of these challenges are catastrophic, leading to conflicts, misunderstandings, delays, and failures. All these challenges need to be resolved in the early phases to develop software smoothly and achieve the desired goal. In the future, more challenges will be identified, and best practices to resolve stakeholders' challenges will be provided.

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