Practitioner’s Perspective on Motivators of Agile in Global Software Development

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Abstract
In modern software development world, experts are trying to provide the best solutions to their clients. To achieve this, the organizations opt for the agile software development process as it enables them to develop and deliver the product in-time and as per client’s expectations. Consequently, in software engineering industry, the Global Software Development (GSD) is the most widely considering software development paradigm as it offers significant strategic and business gains. Seeking the benefits of GSD, the European software engineering organizations are outsourcing their development activities in developing countries. Considering the criticalities of agile adoption in GSD, this work empirically studies the motivators that could positively influence the execution of agile-based GSD in European software industry. A quantitative survey was conducted and data from 139 practitioners working in agile and GSD based projects was collected. The collected observations were further analyzed using Smart-PLS (3.0). The results show that the identified motivators are important to consider by industry experts to successfully apply the agile practices in GSD context.

Keywords: Agile, motivators, global software development, empirical study

1. Introduction
Global Software Development (GSD) is carried out by teams of knowledge workers located in various parts of the globe developing commercially viable software for an organization [1]. These knowledge team workers communicate and coordinate virtually, and carry out their activities regarding software development [1]. An idea of software development through geographically distributed team members was given quite earlier than word GSD. For example, in early 1970, a technique known as “contract programming”[2] was used and different software development companies had all components of a system but outsourced to third-party for development. The majority of software companies in the west (client) begins software development outsources to vendor companies in the east due to different problems such as deficiency time, sources, cost of development, and trained workers [3, 4]. Strategic and economic advantages are main aspects to encourage software industries towards globalization [5-7]. The Standish Group surveyed and documented that 20% western (client) software development companies outsourced software projects to eastern (vendors) companies worldwide [5]. The key reasons behind the possible increase in software development outsourcing to eastern
countries are due to low cost, access to international market, availability of round the clock development time, better quality of products and skilled labour force etc [1, 6].

Currently, in Europe the GSD trend is becoming more popular[3, 8, 9]. Studies showed that only in Europe, 21 countries have gained the rank of ideal countries for GSD, however; some other are trying to inaugurate and start GSD [5]. Europe could provide advantage to other software development firms in east that are pursuing fast growth; by outsourcing their projects due to multiple reasons such as government support, developed infrastructure, economic incentives and collaboration [3, 10]. However, challenges such as temporal, socio-cultural and geographical distances are causing hurdles regarding adaptation agile in GSD [7, 10-12]. In addition to these challenges, customer satisfaction, system quality, business and market needs, tight project deadlines and frequent feedback [7, 13] motivated the various software development organizations to impose agile methods in field of GSD [5, 14, 15]. The integration of GSD and agile methods would help the software development companies towards better quality product and speedy development [5].

Agile software development (ASD) is a lightweight software development technique comprised of a set of methods and practices that are quick, easy and have dynamic change under uncertainties, time and pressure [16]. The dynamic systems development method (DSDM), SCRUM, lean, Kanban, XP (extreme programming) and FDD (feature driven development) are the agile frameworks and widely used in the world [17]. The manifesto of ASD depends on fast product delivery, instant feedback collaboration of customers, dedicated teamwork, simplicity and dynamic changes according to requirement [16-18]. The main points of agile manifesto are developed by group of software development and professionals, which have understanding and knowledge about agile ideas [18, 19].

Although, there are many benefits of ASD but in GSD domain, the scaling agile methods are challenging and could cause complications for development activities [11]. Along with coordination, proper informal communication between software professionals is required to control intense situation of agile process in GSD environment. (Paasivaara and Lassenius [20], [21]. In Europe, the differences in socio-cultural values and standards and linguistic barriers make difficulties in scaling agile practices [22]. Due to difference in cultural norms and language, there is less coordination and control and more chances of miscommunication. Studies showed that among different barriers, language is the main barrier in agile practices [23]. In Europe, the majority of customers are doing work in their primary language and/or English as a first language [14, 23]. Likewise, communication style is another important barrier after language barrier. Most of the vendors belonging to European country communicate directly and in concise way, while in north peoples express or deliver their messages by using various stories and analogies [14, 15, 23].

Thus, it is clear from above discussion that there are several risks that European GSD industry facing concerning to manage the agile activities as concepts simply depend on close coordination and communication. Therefore, it is very important to handle or manage the main problems challenged by agile team members during performing their activities in GSD domain and connections with clients or organizations worldwide. Seeking the importance of successful agile execution in GSD context, this study empirically explores the motivator important to manage the
agile activities in GSD context. This in-depth study will serve as a body of knowledge to industry practitioners and research community to revise or develop the new strategies for successful execution of agile methodologies in GSD context.

2. Literature Review and theoretical hypothesis

2.1 Literature Review

Different frameworks and models have been used in large scale organizations for scaling agile methods. These models includes Disciplined Agile Delivery (DAD) [24], Agile Process Maturity Model (APMM) [25] and Scaled Agile Framework (SAFe) [26]. Although, these types of models are used in larger organizations effectively but they do not clearly address diverse domain of GSD projects [27, 28]. Paasivaara and Lassenius [20] shared the results of case study in which agile transformation was used in large organization. They highlighted importance of agile methods distributed globally and discussed the requirement of commonly used framework and its implementation in GSD to scale agile methods [29, 30]. In addition, they also highlighted the deficiency of effective management strategies that might be undertaken to alter the agile methods in GSD situation. However, previous studies did not discuss in detail the agile methods’ scaling strategies because the execution of agile method is more challenging in GSD condition rather than collocated (single site) software development [31-33]. Furthermore, modern studies have also not concentrated on the development strategies that could be implemented to scale agile method in Europe GSD industry [14, 15, 34, 35]. We have identified the following motivators by reviewing the literature.

2.1.1 Organizational Management

*Executive body support (M1):* It is very important in distributed worksites to have a team member as a leader [36]. Leader of a team will ensure and give all the possible support to team members at worksite. The team members will update and communicate with each other working on different sites of project and will ensure that all project progress and update are accurately provided for smooth running of project [36, 37].

*Hypothetical statement: based on the above discussion, leadership support could positively influence the execution of agile in GSD paradigm by software industries.*

*Arrange social activities (M2):* It is also important to initiate the social activities for helping and developing the agile scaling mind-set. The teams can share the facts and figures to identify new working methods [38, 39]. Agile attractive activities can bring motivation in team members to adopt agile practices. Social media activities are now being used as a tool for developing the relations among management, team members and customers [40, 41].

*Hypothetical statement: Literature shows the arrangements of social events play a positive role in the adoption of agile in GSD domain.*

*Communication and control (M3):* Different issues of communications and control emerge during scaling agile in geographically distributed development environment [25, 42]. Organization, harmonization and boundary spanning are three main constituents which considerably affect the efficiency of communication and coordination [25, 43]. Further, the collaboration of customer with agile team is important and also mentioned in agile manifesto [41]. Collaborative culture can develop understanding between teams, continuous integration
and monitoring, identification of main barriers and selection of suitable collaboration tools for distributed teams [43, 44].

Hypothetical statement: according to the literature, effective communication and control is an important element to make the agile successful in GSD context.

Knowledge acquisition (M4): knowledge awareness in team members is important during agile practice because that will help to scale agile methods appropriately in distributed environment [45]. Team members commonly follow the non-agile practices due to deficiency of coaching classes, trainings and knowledge about new practices [46]. Thus, it is very essential to involve the agile teams in external training sessions and workshops events to improve the knowledge and understanding.

Hypothetical statement: knowledge acquisition positively influences the software industries to successfully implement the agile in GSD.

Hypothesis (H1): the organizational management could significantly contribute to make the agile successful in GSD context.

2.1.2 Team

Agile champions and change agents (M5): They are main catalytic agents that develop changes between the teams and management [47]. They are highly significant for scaling the agile methods on larger scale and they could change culture of organizations. There should be strong considerations and good decisions to scale agile in GSD domain [48]. The agile scaling should develop ripple which may not go in hands of few stakeholders; thus, it is duty of agile agents or champions to speculate and maintain supportive environment with top management.

Hypothetical statement: Software development organizations need to focus on agile champions and change agents for successful adoption GSD context.

Customer Involvement (M6): The participation of customers greatly affects agile scaling procedure [38]. Active customers cooperation and risk tolerance can enhance ability of the teams in agile transformation [39]. Customers participates in different activities and should help the agile teams with their feedbacks [39]. Both the customers and agile team members come together and play active role for success of agile scaling process.

Hypothetical statement: actively participation of customer could play a positive role in the adoption of agile in GSD context.

Creating self-organizing teams (M7): Suitable architecture, products design and requirement come due to self-organising team [19], because members of a team take part the important responsibilities of project without external effects [47]. The team members are controlled by manager of the team, and they internally choose the duties and responsibilities during working on projects. In self-organising development, motivation, collaboration, trust, responsibility, teamwork and ownership [49] are the important principles that increase the success of team, better product delivery along with customer gratification.

Hypothetical statement: according to the literature, developing self-organizing teams plays an important role for adopting agile in GSD.
Training and coaching (M8): In GSD domain, scaling of agile methods brings considerable transformation in organizational settings [50]. Training of teams significantly enhances scaling abilities by encouraging motivation of agile team. It enables the people more optimistic, confident and increase their knowledge about new culture and working environment [51]. Non availability of training and coaching may result in improper scaling process through agile techniques. Agile coach brings the focus more towards agile principles rather than tools. The agile practices either the bottom-up or top-down directions are important. The management of organization involves in both the situations and offer education or training facilities to agile teams at all levels from executives member to common agile team member [49, 51]. As skilled human resources have a significant importance in scaling agile methods in GSD domain. Higher authority (management) and agile team members should possess the professional qualifications and experiences in agile or related subjects [46]. They also possess capability of GSD and agile project that would help them to understand the issues occur during scaling of agile and skillful and experienced experts could handle the these problems [38].

Hypothetical statement: literature indicated the training and coaching as an important aspect to make the agile successful in GSD context.

Continuous learning environment (M9): Learning environment could attain creativeness, capability and enhance the knowledge of workforce and customers working in organizations [40]. Organizations could arrange the continuous learning atmosphere for agile revolution by bearing in mind the most important points as:

- The members of team at bottom and top level must seek and prepare themselves for the improvement and transformation of organization according to continuous changes occurring in the world.
- The management of organization should encourage the workers and staff of the organization to develop and explore new ideas for future value addition.
- Enterprise must give the attention on regular improvements in agile practices and revolutionary methods.

Hypothetical statement: Based on the literature discussion, continuous learning environment is important for agile adoption in GSD context.

Hypothesis (H2): effective team organization could positively impact the execution of agile practices in GSD context.

2.1.3 Technology

Engineering excellence (M10): sustainable engineering culture is essential to scale agile methods because inadequate engineering practices could considerably affect the performance and productivity of team and outcomes in poor quality of products and their delivery [41]. Low and interrupted products delivery can cause technical obligations that need to be resolved otherwise product quality will be affected significantly [41]. It is responsibility of GSD organizations to assure the engineering excellence by developing DevOps culture, organizing tests, cooperation with each other and among the distributed sites, and visually observe situation to monitor products quality and progress[52, 53].

Hypothetical statement: Engineering excellence is an important factor for software industry to successful implement the agile in GSD context.
Tools and infrastructure (M11): There is a need of investment on latest infrastructure and tools used in GSD. The related organizations should invest in this regard for proper agile scaling process. Complexity increases in software development processes when the agile team members do the development activities across their geographic locations [47]. The modern software related to infrastructure and engineering tools such as cloud native platform, strong integration and automatic testing process are main elements of agile scaling. It is essential to get advanced tools and techniques to improve and enhance the agile practices worldwide [54]. Hypothetical statement: is an important factor for the implementation of agile in GSD by software development organizations.

Maturity model for agile transformation (M12): It is still a challengeable task for scaling agile and its integration in conventional GSD domain. The prevailing frameworks like SAFe, DAD and Large-scale Scrum (LeSS) etc. are prepared for large scale agile. But well-structured model with specific puppetries that can control agile practices in GSD domain is the basic need of the hour [55, 56]. GSD and large-scale organizations are two different domains, and it is not necessary that large scale organization should be distributed worldwide. This problem can only solved applying a particular agile maturity model, which can measure scaling competencies of a GSD and give suitable development practices [56]. Hypothetical statement: according to literature, the consideration of maturity model for agile transformation is important in GSD context.

Hypothesis (H3): intime and appropriate technology consideration could play a positive role for agile adoption in GSD context.

2.1.4 Process
Communities of practice (CoP)(M13): An organized groups of people who show similar interests to specific business or technical domain [41, 46]. They cooperate and share information with each other regularly to enhance their skills to overcome challenges in specific domain. CoP are common for the ScrumMaster (SM), DevOps and agile testing [48]. The main individuals in CoP offer frameworks and assistance for agile team members to sustain the regularity across the team members [46]. Hypothetical statement: Communities of practices are important for software development organizations to make the agile successful in GSD context.

Selecting and customising the agile approach (M14): Various agile methods are working under diverse geographical distributed environments however, each team possess its specific characters and needs particular agile technique [47]. For example, Kanban, Scrum and XP approaches are used by particular teams but not by all teams. Thus, it is essential to modify agile methods by following environment of organization that might need particular development and procedures [47]. Hypothetical statement: literature elaborated that the selection and customization of could contributed towards the adoption of agile in GSD.

Workflow transparency (WT) (M15): In agile environment, transparency of work shows positive activities and deep understanding of project [42, 57]. WT makes easy to monitor the progress of projects including running tasks, future projects and their time frames, and barriers that affect the
agile teams during working particular activities [43, 50]. WT can help to control agile team effectively.

*Hypothetical statement:* researcher indicating the workflow transparency as an important factor for implementing agile in GSD.

**Instant feedback (M16):** Agile is a collaborative and consistent approach to satiate stakeholders and customers via constant supply of useful software systems. For more improvement in agile practices, continuous and collaborative feedback is essential, and team should give attention to feedbacks by customers [58]. Regular feedback between agile teams distributed through the world and customers will encourage practitioners to emphasis on suitable system features [59]. Furthermore, it will result in an easy transformation supervision process, particularly when new requirements are needed by clients.

*Hypothetical statement:* literature shows that the instant feedback plays an important role to make the agile successful in GSD.

**Create a single and via product backlog (M17):** Backlog comprise of all of the ideas and work items that should be considered in product [60]. In backlog, features or items are characterized and prioritized depending on their importance [39, 61]. Each component of backlog is labeled with a particular code number. It is very important factor when agile team performs its working activities from different sites across the globe. It gives outlines of all the elements of product and its characters to product customers and agile team as well [61]. The idea is to start with minimum viable that emphasizes the impact of learning on new product development [62]. The main advantage of minimum viable product is to understands about interest of customers in the products by observing the customer feedback [47, 63]. It is an iteration progression which supports products improvement works by decreasing gap between agile teams and business shareholders [62].

*Hypothetical statement:* Create a single and via product backlog is important to make the agile successful in GSD context.

**Planning and usage of large-scale agile framework (M18):** There are different types of agile scale frameworks such as DAD and SAFe. The important thing is choose the most suited framework, which could fulfill the needs of an organization [64]. Each framework has advantages and disadvantages and there is not a single one, which might have all characters and fit organization. Thus, it is essential to select the suitable framework that increase the team communication, performance, production of quality end products with suitable cost [51, 60]. The main objective of organization can be achieved if the organization efficiently plan the scaling approach [65, 66]. In any framework, the main indicators such as definite roles and responsibilities, balance in bottom up and top down coordination, customer satisfaction and adaptation of new practices should be present [39, 51].

*Hypothetical statement:* The use of large-scale agile framework is important to consider for the successful adoption of agile in GSD context.

**Hypothesis (H4):** to successfully manage the agile in GSD, the consideration of an appropriate process is important.
2.2 Theoretical basis for the proposed framework

To develop the theoretical framework for this research, we used the theory of critical success factors (CSFs) [67]. A key success factor is a causal relationship. It expresses a relationship between the competitive advantage a business enjoys in a market, in terms of perceived value and relative costs, and the causes of that competitive advantage, in terms of certain skills and resources.

The idea that there are a few factors which are decisive for the success of the organization, and that these factors can be ascertained, was first introduced by Daniel [68] and later mainly elaborated by Rockart [69]; Bullen and Rockart [70] in the context of designing management information systems. Finding that top management rarely used management information systems, they argued that such systems must be structured according to the needs of the system.

In CSFs theory the concept in the management information systems and strategy literature is traced, and a new view is presented, which defines key success factors as skills and resources with high leverage on customer perceived value and relative costs of a business. The key success factors are distinguished from core, slack, and auxiliary skills and resources. Perceived are distinguished from actual key success factors, and it is argued that empirical research on key success factors should address both. The CSF theory define the success factors as:

- Key success factor is a skill or resource of the software development process; it is always actionable.
- Key success factors are organization specific, but they transcend strategic groups in a development process.
- Key success factors present the core areas of an organization. This implies that there may be markets where there are no key success factors, but only many small contributors to success.
- Key success factors imply a causal relationship between a skill/resource and perceived value and/or relative cost. They are hence not directly related to performance measures like return of investment. This may be an advantage, since the relationship between perceived value/relative cost and return of investment may be intricate, and perceived value/relative costs are better indicators of competitive advantage.

In this study, we considering the concept define by theory of Motivators and develop the research framework (Figure 1, Table 1).
Figure 1: proposed research framework

Table 1: Proposed hypothesis

| Categories | Sub-categories (Motivators) |
|------------|-----------------------------|
| H1 | Organizational Management: *(The organizational management could significantly contribute to make the agile successful in GSD context)* | Executive body support (M1) |
| | | Conduct social activities (M2) |
| | | Communication and control (M3) |
| | | Knowledge acquisition (M4) |
| H2 | Team: *(effective team organization could positively impact the execution of agile practices in GSD context)* | Agile champions and change agents (M5) |
| | | Customer Involvement (M6) |
| | | Creating self-organizing teams (M7) |
| | | Training and education (M8) |
| | | Continuous learning environment (M9) |
| H3 | Technology: *(intime and appropriate technology consideration could play a positive role for agile adoption in GSD context)* | Engineering excellence (M10) |
| | | Tools and infrastructure (M11) |
| | | Maturity model for agile transformation (M12) |
| H4 | Process: *(to successfully manage the agile in GSD, the consideration of an appropriate process is important)* | Communities of practice (CoP) (M13) |
| | | Selecting and customizing the agile approach (M14) |
| | | Workflow transparency (WT) (M15) |
| | | Instant feedback (M16) |
| | | Create a single and via product backlog (M17) |
| | | Planning and Usage of large-scale agile framework (M18) |
3 Research Methodology
Data will be collected and analysed based on the literature survey and industrial empirical study conducted with the agile practitioners working in Europe GSD industry. By nature, the present study is quantitative in nature. To collect the empirical data from the industrial practitioners, the questionnaire survey approach was adopted. The data was collected from the practitioners working in European GSD organizations. For data collection process, the used steps are discussed in the sub-sequent sections:

3.1 Sampling
For data collection, we have approached the 13 European software development organizations working in the context of GSD. In approached software development organizations, around 550 practitioners are directly dealing with agile in GSD. All the participants were approach for data collection purpose via invitation letter. Before going to collect the data, we developed the survey instrument based on the motivators reported in the literature (section 2). The developed questionnaire was structured in four different sections. Where’s first section contains the questions related to the bibliography of survey participants. Second section contain the details of participants related organization. Third section was based on the identified motivators. To assess the motivators, five scale Likert program (strongly agree to strongly disagree) was used. The last and forth section was open-ended which allows the practitioners to add their additional remarks in the questionnaire. For data collection process, we adopted simple random sampling technique. The survey instrument and the data collection process were hosted on Google Form.
For the collection of appropriate data, the understanding of survey instrument is important. Thus, before starting the data collection process, we done a pilot study with experts. The initial developed questionnaire was sent to five experts working in software development organizations. They highlighted some important modification. For example, they suggest presenting variables of section 3 in tabular form. They also suggest to add some questions in section 2 to get the size of organizations. Considering all the suggestions, we update the questionnaire, and the updated form of questionnaire was used for data collection.

The data collection process was performed during December 2021 to March 2022. During data collection process, we get responses from 153 practitioners. The received responses were manually reviewed and cleaned the data set by deleting the incomplete responses. During cleaning, we also take care of robot answers (e.g., a person who gave same answers for all survey questions), but we did not find any robot answer. However, we found some incomplete responses and by removing the incomplete responses, 139 complete responses were considered for final analysis.

3.2 Survey data analysis
Structural Equation Modeling (SEM) approach of Partial Least Square (PLS)[71] was used to analyze the collected responses concerning to achieve the subject of this study. Therefore, to evaluate the implication of the developed theoretical model and hypothesis from H1 to H4, the analysis work is divided into three steps. As a first step, we performed the normal distribution and parametric statistical tests were executed. In this step, we used the parametric statistical method, and the Pearson correlation of coefficient was determined for tests with a one-tailed t-test for the proposed hypothesis i.e., H1 to H4.
The PLS is a more effective approach to analyses the data compared with traditional techniques e.g., regression. The PLS, like other SEM techniques, enables the researchers to simultaneously model the relationship between multiple independent and dependent variables and respond to the research questions in single, systematic, and comprehensive analysis [89]. In addition, PLS is appropriate for this research work as it gives the structural model that is complicated to analyze a large set of relationships among variables [72, 73]. Various other conducted studies in the domain of software engineering use the same technique [74-77].

4. Results and discussions
This research work aims to explore the factors that could positively influence the European software development organizations to successfully implement the agile practices in GSD context. To come-up with study objectives, we identified the 18 motivators that are important for agile adoption in GSD reported in literature. Based on the literature findings, we developed a research model (hypothetical framework, Figure 1). The proposed hypothetical framework shows the positive effect of identified motivators on software development organizations for agile adoption in GSD context. To check the applicability of identified motivators in European software development organizations, we have visited 13 organizations for getting the opinions and perceptions of practitioners. Through questionnaire, we get 139 complete responses form practitioners. Next, we used the Structural Equation Modeling approach of Partial Least Square (PLS) for data analysis. The PLS analysis were performed in both form, measurement model evaluation and structural model evaluation [78]. In structural model analysis, significance structure path, coefficient of determination (R^2), and estimate one of path coefficients were employed.

4.1 Measurement model evaluation

4.1.1 Demographic profile
To get the appropriate insight of the practitioners, the targeting of appropriate population is important. Thus, in this study, we have collected data from European software development organizations working in the context of GSD. For data collection, we have developed the survey questionnaire, that was sent to 153 practitioners. During data collection process, we only received 139 complete responses. The majority of the received responses are from Finland, Norway and Spain, and Germany. The detailed bibliographic analysis of respondents is presented in Figure 2, that shows the appropriability of the collected data concerning to the objective of this study.

Finstad et al.[79] underlined that the opinions of experts varied with respect to the designation of participants. Niazi et al.[80] highlighted that a survey participates could only give appropriate response if they deal with the situation or problem frequently. According to bibliographic data, majority of the respondents were either software developers or requirements engineers (Figure 2). In addition, we checked the bibliographic data concerning to the organizations size of the survey respondents. The frequency shows that out of 139 responses, majority of the respondents 41% are from medium size organizations. Furthermore, 35% were from small organizations and 24% were from large scale organizations.

The bibliographic data was also analyzed concerning to determine the experiences of the survey participants. The results are presented in Figure 2, the respondents experience ranged between 5
to 25 years. By calculating the mean and medium (6.5 and 6 and respectively), shows a good experience pool of participants. Similarly, out of 139 participants 76% were male and 24% were female, and this shows that male community still dominating in software development organizations.

![Demographics of survey participants](image)

**Figure 2:** Demographics of survey participants

### 4.1.2 Frequency analysis

The respondents’ opinions were collected using the 5-point Likert scale from strongly disagree to strongly agree. The collected responses were further classified as positive, negative, and neutral. Positive category contains the information about the survey Participants who are agree as the enlisted motivators against each category has positive influence on agile in GSD context. The result of negative category shows those respondents who are not agree with the identified factors as motivator for agile in GSD context. Moreover, the result of neutral category shows the respondents frequency who are not sure about the impact of motivator on agile in GSD context.

The frequency-based analysis against the motivators of each category is presented in Figure 3. According to the frequency analysis highest frequency of responses of each category is positive (strongly agree and agree). This elaborated that majority of the respondents agree as the identified motivators are important for the successful execution of agile practices in GSD domain. The results render that to make the agile practices successful, the organizational practitioners need to consider the highlighted motivators. Figure 3 shows M10 (Engineering excellence), M12 (Maturity model for agile transformation), M2 (Conduct social activities), M5 (Agile champions and change agents, and M9 (Continuous learning environment) are the highest score motivators reported by experts for successful agile adoption in GSD context. Thus, by considering the highest frequency of responses in positive category, we performed the further analysis.
4.1.3 Correlation among core process areas

We studied the correlation among organizational management, team, technology and process areas in order to check the relationship between the core areas of GSD process improvement. We used the Spearman correlation approach as it is an effective technique to calculate the strength of both linear and non-linear association among more than one variable [81].

The determined Spearman correlation results indicated in Figure 4 and the results render the significant positive correlation among all organizational management, team, technology and process areas. Besides, we also noted a slight negative correlation ($r_s = -0.11$) between team and process areas. This shows that team and process are loosely coupled but in rest of the combinations all the process areas are tightly coupled. To summarize, the correlation results indicated that to make the agile practice successful in GSD, there is a need to close collaboration among the organizational management, team, technology and process areas, instead of two areas i.e., team and process.
4.1.4 Data normality
We used Skewness and Kurtosis test to determine the data normality. Determined results of skewness and kurtosis, shows approximately normal distribution of the collected data. According to George and Mallery [82], the values ranging from 1 to -1 and 2 to -2, indicates the normal and satisfactory data, respectively.

4.1.5 Internal consistency
To determine the internal consistency, we used the Cronbach’s Alpha and Composite reliability test. According to the results, all the variables (M1 to M18, section 2, Figure 1) of this research work are consistent. According to Henseler et al.[83], the value 0.70 or above is considered as satisfactory internal consistency. To determine the internal consistency, all the variables were considered in personality traits scale.

| Variables          | Cronbach’s Alpha | Composite Reliability | Original No. of Items | Final No. of Items |
|--------------------|-------------------|------------------------|-----------------------|-------------------|
| Organizational Management | 0.788             | 0.835                  | 4                     | 4                 |
| Team               | 0.856             | 0.862                  | 5                     | 5                 |
| Technology         | 0.897             | 0.826                  | 3                     | 3                 |
| Process            | 0.801             | 0.821                  | 6                     | 6                 |

4.1.6 Indicator reliability
The outer loading scheme was used to check the indicator reliability and analyzed results are given in Table 7. If the calculated value $0.70 \geq$, it shows the outer loading satisfactory [83]. The determined results given in Table 7, shows satisfactory concerning to indicator reliability testing.

| M1 | Organizational Management | Team | Technology | Process | Agile in GSD |
|----|---------------------------|------|------------|---------|--------------|
|    | 0.815                     |      |            |         |              |
The multicollinearity between more than one variable are calculated using regression equation and it is elaborated using VIA values. The value of VIA $10^{\geq}$, shows the multicollinearity issue\[84\]. According to the calculated VIF values presented in Table 8.

### Table 8: Multicollinearity Values

| Independent Variables            | Agile in GSD Intention | Agile success in GSD |
|----------------------------------|------------------------|----------------------|
| Organizational Management        | 3.667                  |                      |
| Team                             | 2.791                  |                      |
| Technology                       | 2.577                  | 1.000                |
| Process                          | 3.247                  |                      |

### 4.1.8 Validity analysis

The convergent and discriminate validity analysis were used to determine the data validity. The average variance extracted (AVE) was used to calculated the convergent validity values; where’s the AVE>0.5 considered as satisfactory [83]. The determined results given in Table 9, which indicates that all the variables attain the satisfactory values for convergent validity.

### Table 9: AVE Values variables

| Variable                      | AVE  |
|-------------------------------|------|
| Organizational Management     | 0.679|
| Team                          | 0.781|
| Technology                    | 0.741|
| Process                       | 0.767|
We further performed the discrimination validity test using the Forner-Lorcker criterion PLS, and the results are presented in Table 10. According to Forner-Lorcker [85], If the square root AVE of a variable is greater compared with correlation of the variables, renders the acceptable discriminant validity of the data set [83, 86].

The results presented in Table 10 shows the satisfactory discrimination validity value for all variables. The square roots of the corresponding variables are shown by the diagonal value in green shape, and the value below the square root represents the correlation between variables. The diagonal values should be greater than the values below the diagonal values, in layman’s terms.

Table 10: Fornell-Larcker Criterion for Discriminant Validity

| Variable (P)   | P1  | P2  | P3  | P4  |
|----------------|-----|-----|-----|-----|
| Organizational Management (P1) | 0.757 | -   | -   | -   |
| Team (P2)      | 0.796 | 0.768 | -   | -   |
| Technology (P3)| 0.872 | 0.753 | 0.747 | -   |
| Process (P4)   | 0.719 | 0.768 | 0.852 | 0.736 |

4.1.9 Model fitness
At first step, PLS offers SRMR, NFI, and rms_Theta test to check the model fitness. Table 11 displays the determined findings for these models. PLS's Standard Root Mean Square (SRMR) based on bootstrap is equivalent to other approaches' chi-square [87, 88]. In SRMR, a value greater than 0.1 causes a difficulty with model fitness [87]. Based on the data in Table 11, the determined value of SRMR is less than 0.1, indicating that the suggested model is fit. It's also worth noting that the NFI is higher than 0.50 and closer to 1, implying that the proposed model is a strong fit. We also saw that the value of rms Theta is closer to 0, indicating that the model is in good shape.

Table 11: Model Fitness

|         | Saturated Model | Estimated Model |
|---------|-----------------|-----------------|
| SRMR    | 0.076           | 0.078           |
| NFI     | 0.583           | 0.574           |
| Rms_Theta | 0.189         |                 |

4.2 Structural model evaluation
At second step of PLS analysis, the proposed hypotheses were tested to check their implication on study objective. We used the bootstrapping method to determine the degree, significance (P Values and T-statistics) and R^2 evaluations of the structural model [87]. If the determined value of T-statistics is greater than 1.96. (at significance level 5%) or 1.65 (significance level 10%), it is considered significant. In subsequent sections, we analyzed each relationship using the parameters estimates (beta values) and T- statistics. The structural model evaluation results are presented in Table 13. The results of causal structural model are presented in Figure 4.
4.2.1 Organizational management and agile success in European GSD industry
The results presented in Table 12 shows organizational management is an important area to consider concerning to make the agile successful in GSD context in European software development industries (P-Value: 0.000; T-value: 4.160). We further noted the positive relationship between the motivators of organizational category (Beta value: 0.234). To summarize, The HI is accepted, and this renders that the consideration of motivators of organizational management category is important to make the agile successful in GSD context by software industry.

4.2.2 Team and agile success in GSD by European industry
The analyzed results (P-Value: 0.000; T-value: 18.054), Table 12 shows a positive relationship among the team category and agile success in GSD in European industry. The beta values 0.689 present the positive relationship between variables with team category. Therefore, according to the results, the H2 is supported by the opinions collected from real-world practitioners.

4.2.3 Technology and agile success in GSD by European industry
The calculated results (P-Value: 0.000; T-value: 4.046) given in Table 12, indicated the strong positive relationship between technology and agile success in GSD. The calculated Beta results (0.472) present a significant positive relationship between the identified motivator of technology category. According to the results, H3 is accepted. Finally, the results shows that technology is an important area that need to be consider for the successful agile adopting in GSD context in Finish industries.

4.2.4 Process and agile success in GSD by European industry
The results show the acceptance of H4. This indicated that there is a positive relationship between process areas and agile success in GSD. In additions, the Beta value=0.381, T-
Value=7.437, P-value=0.000); indicated the strong positive relationship between the motivators and process category, and the process category significantly contribute to make the agile success in GSD in European industry.

Table 12: Bootstrap Results for Causal Structural Model

|                         | Parameter Estimate | Sample Mean | Standard Deviation | T Statistics | P Values |
|-------------------------|--------------------|-------------|--------------------|--------------|----------|
| Organizational Management → Agile-GSD | 0.234          | 0.238       | 0.062              | 4.160        | 0.000    |
| Team → Agile-GSD        | 0.689          | 0.789       | 0.039              | 18.054       | 0.000    |
| Technology → Agile-GSD  | 0.472          | 0.268       | 0.076              | 4.046        | 0.000    |
| Process → Agile-GSD     | 0.381          | 0.487       | 0.061              | 7.437        | 0.000    |

4.2.5 Coefficient of determination for the endogenous latent variables

We calculated the coefficient of determination ($R^2$) to analyze the varied effects that independent factors had on the dependent variable, and the results are provided in Table 13. The $R^2$ values between exogenous variables (organizational management, team, technology, and process) and the endogenous variable (agile success in GSD in European industry) are significant and substantial, with $R^2=0.785$ and $T=27.621$.

This means that the successful accomplishment of organizational management, team, technology, and process in European software development industry account for a large (78.5 percent) for agile success in GSD. Senapathi and Srinivasan [74] stated that if $R^2 \geq 0.75$ is measured substantial.

Table 13: $R^2$ value for endogenous latent variables.

|                               | Original Sa | N   | SD   | T Stat | P Val |
|--------------------------------|-------------|-----|------|--------|-------|
| Agile-GSD                     | 0.785       | 0.800 | 0.024 | 27.621 | 0.000 |

5. Discussion

5.1 Organizations management and agile success in GSD

Hypothesis (H1): (The organizational management could significantly contribute to make the agile successful in GSD context)

According to the results, H1 is accepted as industry experts reported that the identified motivators against organizational management category are important for scaling agile process in GSD context. Senior agile leaders play an important role in shaping the agile culture, the collocated development mindset, and behaviors to GSD context; as it is critical for top management to oversee and make the frequent communication possible with overseas teams; considering multiple development sites, levels, and different time-zones [89].

Identifying communication gaps and resolving conflicts among overseas teams via agile lenses, there are some good ways for sensible senior management to address the existing organizational pain points[90]. The GSD management of an organization needs to focus on creating the synergy of teams, and improving effectiveness doing the right things, and solving the business problems.
It could have potential conflicts between how organizational management perceive agile and how the overseas development team understands it because they are often in the different, culture, time-zone, language, and position to look at the things from different angles [91].

The development overseas teams are more efficiency driven or detail oriented, and the management team is more strategic driven, and principle focused [92]. In fact, the problem the overseas teams facing may not be the problem for a top management, similarly the risks top management is handling may not be the most important one for the teams [92]. For example, the goals for top organizational management might be to ensure that there is a consistent way for the business to measure the efficacy of communication amongst and between overseas teams. Consistency could be more important to the organization than efficiency; if that's the case, the most efficient solution for two GSD teams may not be the right one. Therefore, mutual understanding, frequent and two-way communication are important to build trust between organizational management and overseas GSD teams.

5.2 Team and agile success in GSD

Hypothesis (H2): (effective team organization could positively impact the execution of agile practices in GSD context)

The statistical results show the acceptance of H2, and this renders the effective overseas teams’ organizations have positive influence on the scaling execution of agile in GSD context.

Agile software development methodology in GSD context needs overseas agile minded teams. The teams that think differently and work in ways that support responsive delivery. An agile mindset, and a set of shared values, principles, and often agile tools, help Agile teams succeed[93].

Agile minded GSD team refers to a cross-functional group of people that is self-contained to the point that the people in the group can deliver the product (or the next iteration of it) without requesting to draw on skills outside the group. Li and Alexander [94] indicated that the agile teams aren’t solely developer resources, they are not a matrix team either. Furthermore, the GSD based agile overseas teams are dedicated groups of people who do not move between products or teams just because there’s a demand in a different area of the business on the running project. Therefore, they become a close-knit and trusted group of colleagues, to deliver product on time. Each overseas group of team members working on a project is treated as a whole team, where’s they don’t need anyone or anything else to get things done. Anita et al.[95] highlighted the importance of agile overseas team management. For example, if an organization is using Scrum, then, the Scrum master should be educated with GSD ethics, manage time zone differences, take care of cultural norms etc. Hence, to make the agile successful in GSD context, the identified motivators are important to consider by the practitioners.

5.3 Technology and agile success in GSD

Hypothesis (H3): (intime and appropriate technology consideration could play a positive role for agile adoption in GSD context)
The hypothesis testing results shows the acceptance of H3, and this indicate that the technology is an important factor to consider for the agile success in GSD context. Today, the agile software development is not only human dependent but also about technology. To get the business return, there is a need to integrate and manage technologies in GSD environment. The agile in GSD, is a widely considered software development paradigm that need the adoption of appropriate and effective technologies to make the software development process more innovative, collaborative, real-time, and productive [96]. In this era, GSD is also branded as distributed workforce rather than co-located teams. A continuous cycle of development, integration, and deployment is the ideal way for a geographically distributed agile teams to collaborate and innovate that directly linked teams with technology. While using agile in GSD, the basic challenges that most overseas teams and service providers face are related to time, cost, quality and the risk of not using appropriate technologies [97]. Khan et al. [98] indicated the engineering excellence, tools and infrastructure and maturity model for agile transformation as the core areas that need to be consider by the practitioner to make the agile successful in GSD context.

5.4 Process and agile success in GSD

Hypothesis (H4): (to successfully manage the agile in GSD, the consideration of an appropriate process is important)

According to statistical analysis results, H4 is accepted, and this renders the importance of a concrete process for executing the agile practices in GSD context. The implementation of agile practices in GSD environment is a complex activity, as the agile is communication and coordination-oriented methodology and is the core challenge of GSD paradigm. To make the agile based software development scaling successful in GSD context, there is a need of a comprehensive process. The process should define the roadmaps and activities that need to be followed by agile and GSD practitioners to develop the software according to the need and expectation of the client and vendor.

In GSD the development teams belong to geographically distributed areas and the language, cultural and time zoon differences are the core inherited problems. Tatiane et al.[99] indicated that to manage the software development activities in GSD context, the agile based software development organizations should follow strategies to prioritize the project management activities. Begel and Nagappan [100] mentioned that the practitioners of agile based paradigm feel delays in response from overseas GSD sites, which negatively impact the overall software development activities. Another important challenge reported by Niazi et al. [101] is that a number of clients endorse agile in GSD context with their vendors prior to testing the maturity of their project management in geographically distributed context. Thus, the project management is an important area that need to be focused for the successful agile practice’s execution in GSD context.

6. Threats to validity

Internal threats to validity:
Like any other human actions, the present research inherits some threat to validity. First and foremost, the present research attempts to under-stand the impact of the motivators of agile success in GSD. 18 motivators were explored reported by the literature and there is a chance of missing some related literature, which causes the missing of some motivators. Hence,
considering other existing studies, this omission is not systematic [1, 80, 102, 103]. Furthermore, to address this threat, we added and open-ended section in survey questionnaire, where’s we requested the survey participant to add additional motivators. But we did not find any motivator reported by the survey participants, and this evident that the identified motivators cover the core aspects of agile in GSD context.

The second step of this study is to get the insight of industry experts to determine the acceptance or rejections of proposed hypothesis. For experts’ data collection, the questionnaire survey method was used. To check the construct validity of survey study, the pilot study was conducted, and survey instrument was assessed with 5 experts, before starting data collection process. Based on the experts’ suggestions, the questionnaire was modified; and the accepted questionnaire was used for data collection. This gives the acceptable internal validity of data collection instrument.

**Construct validity:**
In empirical investigation, the construct validity is concerned with the measuring scales and whether they accurately represent the attributes being measured in a questionnaire survey. A possible threat is that the survey- participants might have problem while interpreting the variables. To address this threat, we have conducted meeting with some of the respondents via Zoom and WhatsApp, Team and Skype; also, the email address is clearly stated on the questionnaire survey invitation to reach-out the research team. However, we did not receive any email from respondents, and this shows the used survey instrument is clear for every survey participant.

**External threat:**
The sample size is also one of the major threats toward the generalization of study results. The collected complete sample size of this study is n=139 and based on the statistical rules (n=5) and based on the other studies [1, 102, 104, 105] this is a representative data set for generalizing the study results. In addition, the study results are also applicable for all size of organizations. As in empirical study, there is a representative set of participants from small, medium, and large size organizations.

**Ethical threats:**
As the data collection was performed in two different ways i.e., via physical visit and through online questionnaire survey. For physical visit, we signed a contract of understanding of terms of research which defines the researcher’s framework, parties’ rights, responsibilities, and damages, in case not to compromise on data quality. The researcher has an important role and responsibilities not to disclosure of respondent’s personal information and his firm identical information. For online data collection process, all the participants are invited via invitation letter, and they were assured that the collected data will only be used for research purpose and will not be disclosed for other circumstances. Furthermore, we also get permission from ethical research board of LUT University by explaining them the objective and hypothesis of our empirical study.

**Theoretical threats:**
This refers to the research-teams’ concepts and the theorized relationships in the context of the proposed theoretical model. The critical concern is whether the researcher has provided an
accurate theoretical explanation of the developed theoretical model. It is believed that the investigated motivators for agile scaling in GSD context are relevant with each other to develop a theoretical model.

7 Study Implications
The result of this study has implications for both research community and industry practitioners.

For researchers:
The study results give the insight of state-of-the-art literature published in mainstream research body and explore the motivators concerning to agile adoption in GSD context. The researcher can consider the explored list of 18 motivators for future research on agile adoption in GSD environment. Secondly, the motivators were classified into four major areas of GSD process improvement that give the insight to research community to develop effective strategies to fix each area of agile scaling in GSD domain. As this study explore the important motivators against core four areas of software development process improvement. It encourages the researcher to conduct studies with the intent to identify the critical barriers and their best solution. Moreover, the results of empirically hypotheses testing serve as of body knowledge for researchers to understand the impact of different factors on agile scaling in GSD context. And what do practitioners really think about the identified motivators of agile implementation in GSD environment. In addition, the study has also extended the use of success factors theory in software engineering domain, which gives the understanding to software engineering research community to use this concept in their future research.

For Practitioners:
The results and analysis of this study are useful for practitioner in several ways. Practitioners can use the list of identified motivators as a knowledge base to plan agile activities in a GSD project. Organizations can use the explored motivators to enhance their project management capabilities by developing training opportunities to target areas where further skill development is needed. Practitioners will also find it helpful to focus on the four core process areas to better plan agile process in a GSD project. Organizations can use the list of motivators as an indicator to hire software engineers with these specific skills as a risk mitigation strategy for agile based GSD projects. The study findings provide GSD organizations with the ability to check their existing list of process areas they are focusing and could improve them based on the list of identified motivators of our study. The study findings would help the practitioners to focus on the weak and specific areas that gives the opportunity to develop the effective strategies before going to implement agile activities in GSD context. To conclude, the findings of this study will serve as guideline for GSD organizations to better plan agile activities for the successful and quality project development.

For Future work:
The technological revolution changes the world in a global village, and the software development industry get its fruit in the form of global software development paradigm. In global software development paradigm, the practitioners are from different geographically distributed environment (over the globe) with different time zone, languages and cultural norms and ethics. This diversity in GSD teams is one of the major problems. In future, we will conduct systematic study to understand the core ethical problems of GSD teams and their solutions. We
will also conduct empirical study to understand the real-world problem and best practices using by GSD organizations to fix the ethical issues of overseas teams.

8 Conclusion
Technology is all around us, and it is integrated into our daily lives. Regular tasks now have a faster and more efficient way of doing them. Software is truly powering the world; it enables the functionality of our business, healthcare, smart cities, power plants, communication, and combat equipment. We can safely say, software give hand in all aspect of the world, and it depend on software to operate effectively and efficiently.

To the development of quality and efficient software, the software organizations continuously looking the ways to improve the software development process. Agile is one of the most widely adopting software development approach. To improve the agile practices in global software development, this study elaborates the 18 important motivators relating to the core areas of GSD process improvement, reported by the research community. Considering the concept of theory of success factors, we conducted a questionnaire survey study to understand the impact of motivators and their core categories on agile successfulness in GSD domain. The findings of this study indicated that organizational management, team, technology, and process are the important areas that could positively influence the agile scaling in GSD context. Moreover, the identified motivators are important to consider to effectively address the organizational management, team, technology, and process areas. We also noted that there is a strong correlation among organizational management, team, technology, and process areas to execute the agile practices in GSD environment. Moreover, the frequency analysis results presented that according to industry practitioners, the highlighted motivators against each process areas of GSD are significantly important to consider to agile success in GSD environment. We believe that this in-depth study gives an important insight to readers concerning to the important areas that need to be focused for agile adoption in GSD.

Appendix: Used survey questionnaire, raw data, and data in the form of PLS are given at: https://doi.org/10.6084/m9.figshare.19740388

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