Challenges and Practices for Effective Knowledge Transfer in Globally Distributed Teams

A Systematic Literature Review

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Abstract: In the context of Global Software Development (GSD), team members face a number of challenges that needs to be solved. One of them relates to the transfer of knowledge needed to fulfil the required tasks. The knowledge transfer (KT) process may be organized and implemented in various ways, as companies use varying strategies to transfer knowledge from onsite to offshore sites. However, without effective knowledge management practices, success in GSD will be difficult. In this paper, we aims to identify the process activities of KT in globally distributed teams, challenges and suitable solutions for effective KT. In order to achieve this objective, a systematic literature review (SLR) of the existing KT literature is conducted. Our findings describing the process of KT in GDT, a set of challenges and recommended practices for effective KT. Finally, we conclude this study with a discussion of the directions for further and future research.

1 INTRODUCTION

Global software development (GSD) turned from an emerging trend in software engineering then into one of the important competitive advantages in the industry today. In GSD, virtual teams are based in different countries. These teams are referred to as Globally Distributed Teams (GDT). They pursue the same project goals while working from different locations (Oshri et al., 2008).

The shift from an industry economy to a global, decentralized knowledge-based economy has made knowledge increasingly more important for organizations that now operate, compete and collaborate worldwide (Hustad, 2014). Knowledge is no longer seen as just an object of competitive advantage but is the core of how an organization operates to meet the growing demands and requirements in this globally competitive and fast-paced business environment.

Identifying the knowledge that represents the organization's intellectual capital is a key point in Knowledge Management (KM). KM practices, including knowledge transfer (KT), are a major success factor for software development, influencing software quality and team performance (Perkins, 2006). While GSD success promises potential benefits, it failure to understand and manage risks, especially those relating to KT that can result in significant losses, including project failure (Verner and Abdullah, 2012).

The term "knowledge transfer" is used to encompass various communication activities to transfer knowledge. The communication model in Shannon and Wawer (1963) describes the information flow from information source to destination through an information channel. The information transmission is disturbed by "noise". We consider the "noise" as the origin of challenges for the KT in GDT. In the context of GSD, the result of the KT is that the information receiver has new knowledge that he/she did not understand or know before to be able to create the software as desired.

This work present the findings of a Systematic Literature Review (SLR) in the field of KT in GDT in order to identify the KT process, challenges, and suitable practices for effective KT. Subsequently, we classify the challenges according their origin to get a solid basis for their mitigation. As a result, we provide a structural literature analysis and directions for further and future research.

2 RESEARCH METHODOLOGY

We conducted a SLR, following the guidelines defined by Kitchenham and Charters (2007). Next, we describe the research method and all steps taken in designing and conducting this study.

2.1 Research Questions

GSD has been practiced in industry for quite some time, and KT has been carried out even longer than that. Based on the perceived need for conducting a SLR in this research field, the research questions for this study are as follows:

- *RQ1: How the KT is processed in GDT?*
- *RQ2: What builds up the "noise" in the KT?*
- *RQ3: What are the recommended practices for effective KT in GSD projects?*

2.2 Data Sources

We searched studies through five digital libraries (see Table 1) with a period range from 1990 to 2016.

Table 1: Papers selection.

Digital library	Results found	Not selection	Final selection
IEEEXplore	45	21	24
ACM	243	230	13
Wiley InterScience	252	239	13
ScienceDirect	35	31	4
SpringerLink	99	86	13
Total	674	607	67

2.3 Search String

The main terms were included in the search string in order to identify as many relevant papers as possible. The search was conducted using the *boolean* search expression as follows: *("globally distributed team" OR "distributed software development" OR "global software development" OR "global software engineering" OR "distributed software engineering") AND ("knowledge transfer" OR "knowledge sharing" OR "knowledge exchange" OR "distributed knowledge" OR "knowledge engineering" OR "information transmission")*

2.4 Studies Selection

After the data search, we came up with 674 papers. Papers were first selected based on the title followed by the abstract. For the final selection, authors read the full papers to assess their relevancy and significance to the research. The final number of papers was then reduced to 67, as listed in Table 1.

2.5 Inclusion and Exclusion Criteria

The process of extracting information from the primary studies followed an inclusion and exclusion criteria. Primary studies were included according to the following criteria: Written in English, available online, published between 1990 and 2016, and have reported explicitly a KT research topic related to GDT. Studies were excluded if they are: duplicate studies, not directly related to the objective of the research, posters, white papers, editorials, prefaces, summaries of tutorials, panels, or having an academic teaching and learning study focus.

2.6 Validity of the Process

The main threats to the validity of the process are the paper selection, inaccuracy in data extraction, incorrect classification of studies, research methods and types, and potential author bias. In order to ensure that process of selection and inaccuracy in data extraction were unbiased, authors followed Kitchenham and Charters (2007) recommendations. Related to terms used to search studies, no consolidated definition for KT was assumed. Regarding the study's classifications and findings, at least two authors discussed each paper. In case of disagreement, the issue was discussed until a consensus was reached. Therefore, there is a possibility that the extraction process may have resulted in some inaccurate data.

3 RESULTS

To answer RQ2 and RQ3, we limit ourselves to list the challenges and practices found associated with their number of occurrences due to the lack of space to discuss each of the items in depth. The detailed reference for each study (S) cited in this section can be found at https://docs.google.com/document/d/1fnftp04vBuitivPYVXQcrmcSIsnjL6sxJBsPzc_loo/edit?usp=sharing.

3.1 KT in GDT (RQ1)

KT in GDT can be done by structured and unstructured processes. Structured KT is a formal, planned and intentional transfer process, such as workshops and technical presentations. Unstructured KT is an informal, unplanned and spontaneous transfer pro-

cess, which occurs during daily work, such as chats and email (Chen et al., 2013). These KT processes are carried out in different activities of the software development life cycle. We adopted a categorization based on these activities to report our findings and answer RQ1. The result of the categorization and activities identified through the SLR are summarized in Table 2. Altogether there are five categories: (1) Agile projects, (2) All Project Phases, (3) Initial Project phases, (4) Development and (5) Requirements. The number of studies referring each activity is written in column "Studies". The column "Reference" points the references for each study that are cited in this section.

The "Agile projects" category represents the activities related to KT in agile software development. Agile software development tends to focus on implicit knowledge and traditional development on explicit knowledge (Betz et al., 2014). We found that in globally distributed agile projects, team members share and transfer project-specific knowledge through agile practices such as release and sprint planning, customer collaboration, cross-functional teams, daily scrum meetings and project retrospectives, etc.

The "All project phases" category represents the activities of KT conducted during the all software development process. We found 16 activities in this category. A great number of studies report the adoption of communication channels and tools (7 studies), the establishment of a common database (6 studies), and informal and improvised communication (4 studies) for KT in GDT.

Some KT activities are developed only in the beginning of the project or to support newcomers. The "Initial project phases" category represents those activities that are developed for KT to take place. We found 7 activities in this category. The majority of studies report site visits and rotation (7 studies). In such activities, teams spend time together to interact and communicate with each other. This interaction and communication meant that team members with different levels of experience could transfer their tacit and explicit knowledge to other team members individually through shared experiences (Chen et al., 2013).

Table 2: KT evidenced in the literature.

ID	Category	How the KT is processed in GDT? (Studies)	Reference
1	Agile projects	Adoption of agile practices (2)	S42, S62
2	All project phases	Through communication channels and tools (7)	S3, S36, S42, S43, S62, S63, S64
3		Establishment of a common data base (repository) (6)	S29, S34, S43, S62, S63, S64
4		Informal and improvised communication (4)	S33, S43, S47, S48
5		Email (3)	S43, S47, S61
6		Online meetings (2)	S43, S62
7		Social events (2)	S34, S48
8		SharePoint-based knowledge portal (Intranet) (2)	S64, S65
9		Technical discussion forum (2)	S62, S63
10		Electronic media (2)	S62, S63
11		Online conferences (video conferencing) (2)	S42, S62
12		Wiki (2)	S42, S64
13		Dynamic interaction between individual (1)	S29
14		Externalization process bridged the group and the organizational levels (1)	S29
15		Magazines (1)	S65
16		Team meetings and on-demand meetings (1)	S62
17		Phone calls and personal contacts (1)	S64
18		Through people previously involved in activities of the SDLC (1)	S33
19	Development	Establishment of a handoff process (1)	S31
20		Knowledge codification and socialization processes (1)	S32
21	Initial project phases	Site visits / Rotation (7)	S29, S43, S45, S47, S57, S62, S63
22		Company training program (4)	S29, S34, S45, S48
23		Pair programming (3)	S42, S62, S63
24		Initial on-site job training entailing pair work (2)	S34, S45
25		Technical presentation (2)	S62, S63
26		Bringing the offshore developers onto the customer premises (1)	S36
27		Observation of work practices (1)	S36
28		Workshops (1)	S62
29	Requirements	Written documents / written text (3)	S33, S43, S60
30		Recording detailed knowledge (1)	S34

The categories of "Development" and "Requirements" represent software development phases in particular. Each activity found in these categories implements KT for a specific context. In "Development", knowledge is accomplished by the process of handoff. The goal of handoff is to communicate the work completed during particular time (Gupta et al., 2011). We also found that knowledge is transferred between individuals through knowledge codification and socialization processes. Knowledge codification refers to the procedures and shared meanings established through encoding processes, while socialization refers to the interpretation and the use of labels attached to the transferred knowledge during the storing process (Oshri et al., 2008).

In "Requirements", three studies report that GDT adopt written documents or written text for KT. Knowledge is captured in a requirements' specification document using a written format and shared in an informal manner through conversations among and between stakeholders (Gea et al., 2013). Another study reports the adoption of recording data on-site (Wieandt, 2008).

3.2 KT Challenges (RQ2)

We found 30 challenges to perform KT in GDT. We mapped these challenges in three categories: Coordination (see Table 3), Communication (see Table 4), and Cultural (see Table 5). We consider the KT challenges as "noise" in the communication model presented in Shannon and Wawer (1963).

Further, we categorize challenges in two groups: Type 1 and Type 2 challenges. In Type 1 challenges the origin of the challenge is in the fact that the teams are globally distributed located. These challenges cannot be overcome without eliminating the team distribution. The Type 2 challenges may be eliminated or mitigated while not changing the team distribution. Instead, they may be relieved by the participating organizations or teams by eliminating or by mitigating the challenge. For example, the

Table 3: Coordination challenges.

ID	Challenge / Description	Freq/ Type	References
1	**Temporal distance:** Due to time zone differences, teams do not have enough common working time or synchronous meetings.	13/1	S19, S29, S30, S32, S35, S38, S39, S40, S41, S42, S44, S46, S51
2	**Diversity of organizational environments:** Process mismatches, differing technical and domain vocabularies, incompatible environments and conflicting assumptions can be problematic in the GSD.	12/2	S3, S30, S32, S36, S37, S39, S44, S41, S51, S52, S54, S55
3	**Geographical distance:** Inter-organizational boundaries get blurred and relationships become complex. This makes collaboration and KT between the parties difficult.	9/1	S30, S32, S35, S36, S41, S42, S44, S48, S56
4	**Infrastructure to support KT:** Systems did not always support project-level KT. It may have negative impact on training and KT.	8/2	S19, S32, S41, S42, S48, S55, S59, S60
5	**Expertise in applying the knowledge and level of experience:** Differences in skills, expertise, infrastructure, tools and methodologies hinder KT. In addition, the lack of prior experience of working together and changes in team membership hinder KT.	7/2	S32, S32, S35, S45, S54, S55, S61
6	**Lack of awareness and control:** The client has minimal awareness of the status of KT and, therefore, no basis from which to manage it.	5/2	S35, S40, S46, S47, S48
7	**Coordination and integration of multiple knowledge sources**: Different locations and departments use different terminology and tools, making KT across departmental boundaries a challenge.	5/2	S36, S49, S50, S51, S61
8	**Content, location and use of knowledge:** In GSD, many people are involved in the development activities, and thus organizations tend to have problems in terms of content, location and use of knowledge.	4/2	S32, S42, S57, S61
9	**Staff management:** Cross-site coordination of roles and responsibilities of the team members can hinder KT between GDT.	4/2	S37, S19, S51, S59
10	**Costs management:** Costs of KT are not known.	4/2	S19, S30, S40, S51
11	**Unwillingness to communicate:** The fixed organizational routines and rigid structure caused, to a certain extent, an unwillingness to share the vital knowledge.	3/2	S36, S47, S48
12	**Structure of the development network does not nurture KT**: The "tacitness" and stickiness of knowledge cause problems for KT.	3/2	S36, S42, S59
13	**Changing vendor:** Lack of clients' operational knowledge needed by the change of a long-time vendor to a new one vendor.	1/2	S19

challenge "Diversity of organizational environments" may be eliminated, for example, by the unification of the organizational environments. However, the needed activities might be not desired or not possible to conduct. Thus, suitable novel KT strategies fitting to the organizational needs and possibilities are needed, to overcome the challenges.

3.2.1 Category Coordination Challenges

In the category "Coordination" we found 13 KT challenges. The Type 1 challenges, temporal distance and geographical distance, are depending on natural circumstances that cannot be relieved directly. For their mitigation arrangements mitigating the consequences of the challenge are needed whereby the reason of the challenge cannot be eliminated. However, they are both seen as important to get solved with altogether 22 references. The rest of the coordination challenges are Type 2 challenges that are possible to eliminate, whereby the fundamental organizational differences (e.g. challenge IDs 2, 7, 9, and 11) make the elimination difficult.

3.2.2 Category Communication Challenges

We identified 11 challenges in the Communication category. Some of them occur mostly only in multilingual GDTs in which the team members have no common spoken language or only limited knowledge in the project language (e.g. ID 1).

Type 1 challenges occur altogether in 30 references whereby the Type 2 challenges occur in 22 references. The "language difference" seems to be hard to overcome – thus we categorize it as Type 1 challenge. Personal attributes, like in challenges (IDs 2, 6 and 8) are difficult to overcome, as personal attributes are difficult to change. The ID 9 is founded with the complexity of the information. We argue that complex information stays complex and it may get simplified through suitable presentation.

3.2.3 Category Cultural Challenges

In the category Cultural challenges we found 6 challenges. The frequency of Type 1 challenges is in the references much higher (21) than the frequency of Type 2 challenges (6 times). The "cultural diversity" is considered as Type 1 challenge, as face-to-face meetings are an exception in distributed teams. In the cases that the social rules are an issue in GDTs, they are hard to get eliminated as the implementation of new cultural rules and habits is a difficult endeavour. Also the challenge ID 6 is hard to eliminate or to mitigate in a GDT, as the political systems are far above the possibilities to make a change in a team.

Table 4: Communication challenges.

ID	Challenge / Description	Freq/ Type	References
1	**Language differences:** Information may be written or spoken in a language that is a foreign language for the team members and thus will be hard to understand. The information may be also represented from different perspectives than expected leading to misunderstandings.	15/1	S19, S29, S30, S32, S35, S36, S38, S39, S42, S44, S45, S47, S48, S48, S50
2	**Poor communication:** The effectiveness of KT in virtual organizations is limited because people tend to simplify knowledge when using technology as a communication media, and communication messages can lose richness in these settings.	13/2	S19, S32, S35, S36, S37, S38, S41, S42, S46, S49, S50, S52, S53
3	**Mental models:** Differences in absorptive capacity between knowledge provider and recipients (personal attributes).	7/1	S19, S29, S30, S32, S42, S52, S55
4	**Lack of appropriate tools:** A few tools support KT in GDT and some of them were not developed for KT purpose.	4/2	S19, S36, S40, S59
6	**Knowledge types and needs:** Knowledge needs vary from person to person.	4/1	S37, S47, S48, S56
7	**Poor or lack of documentation:** Documentation is an important means to share and transfer information, and its quality is essential for success.	3/2	S3, S19, S36
8	**Transfer technological knowledge:** Technological knowledge between the different organizational units is particularly challenging when employees have to delegate sophisticated individual software development tasks to offshore workers, which requires constant communication and adjustment processes.	3/1	S34, S45, S51
9	**Complexity and stickiness of knowledge**: The diversity of contexts exacerbates the 'stickiness' of information.	1/1	S36
10	**Inadequate understanding of the customer's business:** The shared understanding may not reflect the original needs.	1/2	S36
11	**Loss of knowledge in project hand-off processes:** Different locations and departments use different terminology and tools in handoff processes making KT across departmental boundaries a challenge.	1/2	S3

Table 5: Cultural challenges.

ID	Challenge / Description	Freq./ Type	References
1	**Cultural diversity:** Cultural barriers negatively affect face-to-face interaction, communication and collaboration.	17/1	S19, S29, S30, S32, S33, S36, S38, S39, S40, S41, S42, S43, S44, S45, S46, S47, S48
2	**Social rules:** Cultural rules, habits and subconsciously accepted rules affect offshored business process and IT outsourcing.	3/1	S29, S47, S51
3	**Trust and motivation to transfer and share knowledge:** Knowledge source may be not trustworthy, and trust affects co-operative learning.	3/2	S19, S29, S47
4	**Incentives and Priorities:** Incentives and priorities for taking the necessary time to engage in the KT.	3/2	S37, S48, S56
5	**Climate:** Working conditions and physical surroundings in GSD projects.	2/2	S29, S44
6	**Political philosophy:** Political issues cause rigidness and routine in the operating models.	1/1	S29

3.3 Practices for Effective KT (RQ3)

We identified 43 practices for effective KT in GDT. The practices are sorted according to the challenges in the KT.

- Practices for Coordination Challenges

- **Use of enabling technologies:** different technologies must be employed to successfully ensure that various offshore sites can efficiently share knowledge resources (Gupta et al., 2011).
- **Transactive memory system:** it can be developed and maintained to support KT through the propagation of certain rules and standardized work that can overcome differences in local contexts, skill levels and work routines (Manteli et al., 2011).
- **Adoption of common platforms and tools among sites:** the organizational unities should provide a common infrastructural platform, which makes use of different project-specific and generic environments in which members of projects can interact using collaboration tools (Clerc, 2008).
- **Adoption of personal coordination mechanisms:** mechanisms such as routines that encourage personal interfacing have a direct influence on KT effectiveness (Chen et al., 2013).
- **Mitigation of project issues:** project guidelines should define the teams' participation in requirements elicitation and mapping during KT and weekly meetings (Nidhra et al., 2013).
- **Share point-based knowledge portal:** it provides specific information to all employees (Apte and Hofmann, 2012).
- **Development of guidelines and handbooks:** describes architectural solution, quality conformance rules, configuration tools (Zahedi and Babar, 2014).
- **Project knowledge:** all the knowledge generated in the project should be made as accurate, complete and updated as possible (Gea et al., 2013).
- **Promote staffing motivation:** individual motivation stimulation, mentoring and shadowing, and credible knowledge sender (Nidhra et al., 2013).
- **Increase personal attributes:** education in business processes, technology management and interpersonal skills (Nidhra et al., 2013).
- **Mitigation of project issues for requirements:** conducting oral and written tests/quizzes, reverse presentations for requirements validation, support simulation, playback or replay sessions (Nidhra et al., 2013).
- **Mitigation of project processes:** understanding the organizational learning sub process, leveraging knowledge base and experience of peers, dynamic navigation aids to search information, modularization, use of outside expertise, joint collaboration, personal identities at work (Nidhra et al., 2013).
- **Requirements understanding:** for newcomers is important to experiment with the system than to have up-to-date and complete documentation. Newcomers need to have ways to find and access relevant documentation (Nidhra et al., 2013).
- **Adoption of traditional mechanisms:** coordination and control frameworks, combined with appropriate integrated voice, data and video communication technologies could be effective methods and tools for KT in projects (Wongthongtham et al., 2005).
- **On-site customer:** when customers are working on-site with the team, collaboration can be enhanced through effective participation in release planning, daily meetings, review meetings and retrospectives (Dorairaj et al., 2012).
- **Jointly modelling processes:** it can be an appropriate solution to enhance KT if the effort is not too big in comparison with the project itself, which can be the case, especially if the involved companies

are not process driven (Betz et al., 2014).

- **Team set up and adjustment:** it is obtained through the learning of agreement roles, responsibilities and authorities, definition of an explicit statement of the project goals, communication about the design rationale, management of resources and aligning teams (Parviainen and Tihinen, 2014).
- **Team synchronizing:** definition of clear and fixed requirements, a common shared understanding of the architecture and information about the performed tests and test results, the compatibility of the partners' development tools and environments, and the identification of cultural differences (Parviainen and Tihinen, 2014).
- **Implementation of virtual environments to develop competences:** if individuals possess more of a certain type of competence, they will be able to achieve higher performance (Wang and Haggerty, 2009).
- **Define responsibilities:** it includes asking directly when problems occur, asking emergent people, when required (Kwan and Damian, 2011).

- Practices for Communication Challenges

- **Communication tools:** it includes document management, video conferencing, e-mails, wikis and instant messaging can support communication (Nidhra et al., 2013).
- **Awareness improvement:** frequent meetings can improve awareness among distributed sites (Wende et al., 2013; Gea et al., 2013).
- **Face-to-face interaction:** it facilitates effective KT between team members (Razzak and Mite, 2015).
- **Explicit KT:** it can be successfully transferred in the form of documentation and data (Wende et al., 2013).
- **Informal communication:** the offshored teams should continually have on going informal conversations with onshore teams (Kristjánsson et al., 2012).
- **Adoption of a centralized communication structure:** it can help new teams to remain aware, whereas a decentralized structure decreases communication (Gea et al., 2013).
- **Community of practice:** define a community of practices to share common interests and have face-to-face meetings (Nidhra et al., 2013).
- **Social media tools for urgent requests:** adoption of social media tools provides services for distribution of information as an urgent request mechanism for KT (Apte and Hofmann, 2012).
- **Discussions:** it facilitates openness and communication between teams in different locations. Discussions with subject matter experts on specific issues faced in the teams provide opportunities to refine, reprioritize, and generate requirements and solution (Dorairaj et al., 2012).
- **Information though magazines:** monthly quality magazines to disseminate best practices (Apte and Hofmann, 2012).
- **Communication between remote teams:** remote team members shall find a way to socialize, interact virtually and perhaps even simulate a shared space for creating and exchanging tacit knowledge (Razzak and Mite, 2015).
- **Email lists:** e-mail lists are characterized by frequent discussions and questions on a specific topic related to project. These topics are not further structured, but allow for fellow practitioners to share experiences and respond to questions (Betz et al., 2014; Clerc, 2008).
- **Implement a knowledge repository:** a centralized knowledge repository shared by client and vendor is considered important for successful KT (Betz et al., 2014).
- **Group problem solving:** it is obtained through the adequate communication means and information sharing and management of collaboration related risks (Parviainen and Tihinen, 2014).
- **Division of work and responsibility into smaller units:** minimizing communication-related problems is to decrease communication needs and contact points to a minimum by splitting the project into smaller, independent units managed by a local manager. If no local project manager can be appointed, at least a contact person should be named for answering questions and acting as a contact point (Komi-Sirviö and Tihinen, 2005).

- Practices for Cultural Challenges

- **Cultural bridges:** cultural bridges can be established by creating collectivist culture, onsite visits and replay sessions, and cultural workshops (Nidhra et al., 2013).
- **Visits:** GSD teams should visit other members in different locations when and as needed to gain better understanding of critical situations through face-to-face interactions that offer rich communication and effective KT (Dorairaj et al., 2012).
- **Rotation:** rotation of team members between different locations, often between 3-6 months, promotes the distribution of the business and domain knowledge across the teams (Dorairaj et al., 2012).
- **Creating a common culture:** to create a common culture, one needs to choose a specific, common language that is to be used within the organization (Gea et al., 2013).
- **Establish relationship among team members:** the success of implicit KT is further moderated by the quality of the relationship among group mem-

bers. If knowledge recipient and source do not have a trusting relationship, willingness to transfer background information and implicit knowledge is inhibited (Wende et al., 2013).

- **Promoting trust:** understand the language and business culture of the clients, reinforce communication, pay attention to client relationship management, frequent travelling, and private contacts (Nidhra et al., 2013).
- **Mentoring technique:** mentoring has been identified as one of the leading success factors in expanding the organizational culture (Casado-Lumberas and Colomo-Palacios, 2015).

4 DISCUSSION

The results of this review have given us useful insights into KT in GDT. First, KT process in GDT includes different activities. There are activities that are for specific phases of the software development life cycle and others are performed over the project development. What is interesting to observe is that agile practices promote KT in GDT. Since, agile development is becoming more popular in literature and in the software industry, we consider further investigate agile software development for effective KT in GDT and the transition of knowledge between collocated teams and GDT.

Second, we found the relationship between practices and challenges. The practices to eliminate or to mitigate the challenges in KT are focused mostly on Type 2 challenges as they may be eliminated or mitigated while keeping the team distribution upright and because they are easier to implement with concrete and clear actions. However, a significant part of the referenced challenges belong to the group Type 1. They are difficult or not possible to address directly with commonly used practices. Thus, novel concepts are needed to address those challenges.

As aforementioned, the term "knowledge transfer" is used to encompass various communication activities to transfer knowledge. In GSD it is important that the information receiver has the required knowledge to be able to fulfil his/her part in the software development process. A number of various practices can be applied to perform KT. However, as shown in this paper, a number of challenges are still unsolved.

We propose to consider the KT as a teaching process, in which the sender teaches the information receiver. In this, e-learning practices may be used for the KT in GDTs. The material that is to be taught needs to be prepared adequately, to be suitable for the e-learning environment.

5 CONCLUSIONS

In summary, a number of conclusions can be drawn from this study as follows:

Conclusion 1 - *The temporal, geographical and socio-cultural distance of GDT may limit KT:* Our review has revealed that there are several contextual factors of a project that may impact on the KT in GDT. Some of the factors are identified as challenges in the reviewed studies as shown in Tables 3, 4, and 5.

Conclusion 2 - *Agile practices can promote effective KT in GDT:* Based on results of our review, agile practices are helpful to support KT in GDT. However, the differences between software development processes for KT in collocated teams and GDT still not clear. KT can be approached in a different way in GDT.

Conclusion 3 - *There is no one size fits it all solution to solve the KT challenges in GDT:* Our review has revealed that there is a number of KT challenges in GDT. However, additional research is needed to define, when and which KT practices may be seen as best practices for GDTs.

Conclusion 4 - *A deeper understanding about the characteristics and the effects of Type 1 and Type 2 challenges is needed for GDT is needed:* The results of this review provide information that can be useful for GSD practitioners' understanding of the various challenges that may impact KT in distributed settings. However, the difference between the two types of challenges is needed to be able to develop suitable strategies to mitigate them.

Findings from this study present a key start for further research in this area. Finally, the evidence found in literature about the identified mitigating strategies is very low. Therefore, it is difficult to offer any specific advice to practitioners solely based on this review. There is no one fits it all solution in this field. Much more, there is a set of various practices that may be installed in a specific situation to make KT effective in GDT.

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