Global Software Development and the Early Stages of Offshoring

Bachelor of Science Thesis in Software Engineering and Management

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Abstract— **Global Software Engineering (GSD) is becoming a more common practice as increasingly more companies seek to establish offshore offices. Previous studies have identified several effects that are attributed to GSD, including suggestions on how to attain the positive effects and mitigate the negative. This study aims to uncover which effects and management strategies are evident during the early stages of offshoring by conducting a case study at a software company that is still in the first two years of establishing offshore offices. The results identified GSD effects in four primary categories; social, organisational, cultural and temporal. The company had implemented strategies for most of these effects, including organising face-to-face meetings for distributed team members to support better relationships between co-workers, and encouraging the growth of company culture to address cultural gaps. Effects that took longer to emerge were also identified, such as lacking standardisation. Although attitudes towards GSD were positive, people's experiences were often negative.**

I. INTRODUCTION

Software is increasingly developed in global projects [1]. Global Software Development (GSD), and by extension offshoring, is therefore a prominent concern for the industry as many companies are still striving to increase the effectiveness in global software development projects [1]. GSD is defined as occurring when the distribution of the members of a distributed software development team exceeds the frontiers of a country [2]. Similarly, offshoring is the process of re-locating certain aspects of a business to another country [3]. GSD has been seen to have both positive and negative impacts on practitioners, where the former includes reduced development costs [4], increased proximity to target markets and customers [5] and access to a larger skills base [4]. However, there are also disadvantages related to GSD which previous studies have divided into three primary areas; communication, coordination and control [4]. The fundamental cause of these problems arises from distance [4], which is considered from temporal, geographical and socio-cultural perspectives. Temporal distance refers to the experienced dislocation in time due to differences in time zones or work schedules. Since overlapping work hours decrease as temporal distance increases, the ability to communicate synchronously and in a timely manner decreases also. Geographical distance reflects the physical separation between actors and is best measured in terms of ease of relocating from one site to another rather than in kilometres [6]. Lastly, socio-cultural distance is a measure of the actors' understanding of their respective cultural values and practices.

The effects of GSD are broadly documented, both beneficial and otherwise, however the issue of how these effects manifest during the initial process of offshoring is seldom considered. For the purpose of this study, an office is considered to be in the early stages of offshoring if it is less than 2 years old. The objective of this paper is therefore to study the impacts of GSD during the early stages of establishing a global software site, with the intention of answering the following research questions.

RQ1. What are the effects of Global Software Development that emerge within the early stages of offshoring?

RQ2. What strategies are used to address the identified effects of Global Software Development?

II. RELATED WORK

Global Software Development (GSD) features in a considerable body of literature, including special issues of IEEE Software and the ICSE International Workshop on Global Software Development. Several case studies have also been performed at various global companies to further investigate the effects of GSD [7] - [11]. Ågerfalk et al. [12] present a framework which characterises the issues of distributed software development which includes a matrix demonstrating the relationships between the GSD problem areas of communication, coordination and control, and temporal, geographical and socio-cultural distances. Ågerfalk et al. [6] further present a summary of the challenges of GSD regarding their earlier framework. Yet the art and science of global software science is still evolving [13].

A. State of the Art

Several effects of GSD have been identified by previous studies on the topic, with most research focusing on the negative impacts. Communication issues are a recurring concern throughout the literature, particularly how communication decreases as the geographical distance between co-workers increases. This was observed by Herbsleb and Mockus [14] who found that the frequency of communication generally drops off sharply with physical separation among co-workers' offices and that the sphere of communication is surprisingly small. Temporal distances further affect communication, significantly reducing the time-window for effective synchronous communication [15]. Socio-cultural distance has also been seen to cause problems, with studies indicating that distributed teams that are culturally divided may not be as cohesive, and this may lead to poor cooperation [15].

The problems caused by globally distributed development are currently managed using a variety of methods. Ebert and De Neve [8] present a series of Lessons Learned which suggest that teams should agree and communicate at project start the respective project targets, and

provide sufficient communication means. Contrastingly, [16] proposes that solutions to GSD challenges may be obtained by adhering to architectural rules. Most current solutions assert the importance of face-to-face meetings at the beginning of a project [17, 18] as this often facilitates more effective communication later when teams must use other communication methods, such as conference calls and instant messaging services. The use of liaisons, people who regularly travel between sites, is also considered a viable method to increase effective communication [17]. Herbsleb and Mockus [14] further suggest splitting work across sites in a manner optimised to the structure of the organisation.

B. Potential for Improvement

Not only is the field of research on GSD still immature [19], the current approaches to solving GSD problems do not consider the initial stages of establishing a global site. By studying the process of establishing a new site we could determine which problems emerge during this phase of the offshoring process. The current solutions could then be improved as a result of these insights.

III. METHODOLOGY

The research methodology was conducted over three phases. Firstly, related literature was collected and reviewed to establish and explore the state of art within the industry. The aim of this process was to determine the conclusions that previous studies in the field had reached, the extent to which certain topics had been researched, and which areas were lacking information. The second phase consisted of conducting interviews to collect raw data, which was analysed during the third phase.

A. Research Context

Centiro is a software company based in Borås, Sweden. Founded in 1998, they specialise in cloud-based delivery management and logistics systems and currently employ over 150 people with customers and users in over 100 countries. Centiro has adopted a flat organisational structure where employees work in teams of on average 7 people, and are divided in terms of their respective industries. The primary roles within the company are delivery manager, applications specialist and developer.

Centiro currently consists of the head office in Borås, an office in Pune, India which opened in October 2015, and a new site in Boston, USA which opened in March 2017. At this point in their offshoring process Centiro is an ideal environment in which to observe the effects of GSD during the early stages. By considering the three offices it is possible to view the development of a new site within a software organisation at multiple stages, and consequently which GSD related challenges begin to arise during this process.

B. Research Strategy

This paper presents an exploratory case study that aims to observe the nature of GSD challenges by looking at the company Centiro. Interviews were used as the primary investigation method, as exploratory studies benefit from the collection of qualitative data [20]. The interviews were semi-

structured since this would lead to a better understanding of the topic by adding relevant questions spontaneously [21], and followed the time-glass model. The inclusion of multiple open-ended questions encouraged the subject to speak candidly about the topic, whilst the addition of probing questions was used to gain further insights from close-ended questions.

The interview questions were organised into three sections. The first consisted of introductory questions which aimed to ease the subject into the interview and to build a climate of trust. This is the recommended practice if the interview contains personal or sensitive questions, such as opinions about colleagues or why things went wrong [20]. These questions were used to establish the subject's background, work experience and their role within the company. The second section included questions that focused on temporal, geographical and socio-cultural distance. The aim of these questions was to assess whether problems, or even benefits associated with GSD and distance were present, how their effects manifested and what current solutions were being implemented. In the final section the aim was to uncover any notable experiences the subject had had with distributed development as this could give further insights into events that the subject may have overlooked or were not covered by the previous questions. The subject was also encouraged to share their opinions about the offshoring process, both what worked well and what they would have done differently.

A pilot interview was conducted before beginning the actual interview process, with the intention of assessing the quality of the questions. The phrasing was evaluated to determine whether each question was suitably neutral and avoided leading the subject, while still providing enough information to elicit a detailed response. Questions that did not meet these criteria were amended.

C. Data Collection

Interviews were conducted either face-to-face or over the phone, depending on the subject's location. Subjects were selected from the offices located in India and America, and from those at the head office in Sweden who associate with the overseas offices using the convenience sampling method. A face-to-face interview was possible with those working in the Boston office, and Skype for Business was used to contact subjects at the Borås and Pune offices. The interview subjects cover three of the various roles within Centiro and as a result of the structure of the company, there is no hierarchical order to these roles. Table 1 shows the order in which the interviews were conducted, the role of the subject and their location.

TABLE I
INTERVIEW SUBJECTS

ID	Role	Location
01	Applications Specialist	Sweden
02	Developer	Sweden
03	Developer	India
04	Applications Support	India
05	Applications Specialist	North America
06	Applications Specialist	North America

Each interview lasted between 25 and 45 minutes, depending on the length of the answers to open-ended questions and how many spontaneous questions were added during the interview. One interview differed noticeably, lasting only 10 minutes. The reason for this could be a language barrier as the subject was not a native English speaker, and seemed to struggle with understanding and answering some of the questions. Spending more time on introducing the topic and creating a less formal atmosphere may have resulted in more detailed responses.

The interviews were recorded and then transcribed by the interviewer, as further insights could be made during this process [20]. In addition, unusual responses or contradictions in the data, such as members in the same team giving significantly different responses, were noted and considered during consequent interviews.

D. Data Analysis

An inductive coding approach was used to analyse the collected data. The process involved creating categories which captured the key aspects of the themes in the raw data [22]. Firstly, the interview transcripts were read through in detail to familiarise the researcher with the data. Categories were then extracted from the research questions and through in vivo coding, a process which uses words or phrases taken directly from the data as categories. Relevant portions of text and words were then coded and organised under each category. Finally, the categories were refined by introducing subtopics and merging or linking related categories.

The following is an example of how the inductive process was performed; A subject from the North America office gave this answer to a question about the office culture. "*Everything is team based and I really like that approach. I think it's good for the office environment and you can actually build very good relationships with your co-workers.*" Three phrases were highlighted from this response, namely "team based", "office environment" and "building relationships". The latter were both then assigned as categories while "team based" was organised under "office environment". The same process was applied to the following response; "*It definitely slows the process down because right now it's a 3-hour time difference and because usually you finish stuff near the end of your work day and when that happens it's dislocated, it gets delayed an extra day.*" The keywords "time difference", "dislocated" and "delayed process" were extracted, with the former becoming a category which "dislocated" and "delayed process" were classified under.

E. Threats to Validity

The criteria for validity were determined using [23] as a foundation.

1) Construct Validity: The capacity for misinterpretation of theoretical terms is addressed by construct validity. As this study includes qualitative data, there is a risk that different researchers could interpret or analyse the data contrarily. For instance, "language barriers" was interpreted as a social issue in this study as it was translated as miscommunication. However, a different researcher may interpret this as a cultural issue as a person's language reflects their background. In order to mitigate this threat, the interview transcripts were read multiple times to ensure that the same results were derived each time. Furthermore, a pilot interview was conducted to confirm the quality of the interview questions.

2) Internal Validity: Whether the design of the study and the derived results are appropriate is determined by internal validity. Providing anonymity to the interview subjects allowed them to answer more candidly without having to be concerned about repercussions, which increases the authenticity of the results and how accurately they reflect the state of the industry. Furthermore, the interview questions were structured to be neutral and to avoid leading the subject. This was achieved by conducting a pilot interview to evaluate the formulation of the interview questions and whether any restructuring was necessary.

3) External Validity: Determining if the results are representative of the industry is accomplished by addressing the external validity of the study. The interview subjects cover various roles including developer, applications specialist and applications support so it is reasonable to generalise the derived insights as they reflect multiple perspectives. However, there is the risk that certain company characteristics that are not generalised within the industry could impact the results, making them less representative. Traits such as the company structure or which countries their offices are based in may affect which problems are present.

4) Reliability: The replicability of the study is determined by its reliability. Following the same methodology, other researches would presumably see equivalent results. However, if certain factors where different, such as the nature of the interview questions or the length of time since the original study, the results may be affected. For example, if the new researchers posed questions that were not neutral or were less probing then the subjects' answers may differ. Furthermore, if a significant amount of time has passed the results may also vary due to changes that could have evolved naturally within the company or were purposely implemented.

IV. RESULTS

This section presents the findings of the data analysis process.

A. Perception of GSD

Each subject was asked about their familiarity with the term Global Software Development, how they would define it, and their experience with distributed development. None of the interviewees were familiar with the term so their definitions are completely personal and original. Overall, the subjects defined GSD in a positive tone that focused on collaboration and sharing knowledge and resources on a global scale. An applications specialist defined it in terms of a cost-effective method of outsourcing software development, stating "*Nowadays there's a shortage of developer manpower so to speak. So this is a trend, globally, to try to get more developers by sourcing them from low-cost countries*". Both developers had similar interpretations, defining GSD as "*development of collaboration with different countries and different sites*" and "*knowledge sharing, how we're working and how we're*

developing and on which technology we are working" respectively. Globalisation was also viewed as an advantageous consequence of GSD, described by one subject as *"It's good in the sense that you're expanding your market and opening the door to new clients and profits."*

The subjects' experiences with distributed development were more varied. Miscommunication was identified as one reason for negative experiences, with one developer stating that *"the collaboration did not work well and that kind of affected the project and the members. The person who was doing the requirements was not clear with all their expectations to the developer and that created issues".* Cultural differences were also attributed to creating communication problems, however working in a multicultural environment was also viewed as a positive experience. This was asserted by one applications support who explained that, *"For me, working in a global company I get to interact with other people from the different areas. So basically, I know how to interact with the different kind of people at different levels… It's a good opportunity to learn different things because we have really good international clients."*

B. Effects of GSD and Implemented Strategies

Four principal categories under which the observed GSD effects could be organised were derived from the data collection process. Various strategies had been implemented to manage these effects, primarily on the individual level as opposed to on a managerial level.

1) Social: The impact of distributed development on social aspects manifested within the company in several ways. The most widespread problem, identified by subjects in all three offices, was difficulties in building relationships with colleagues in other offices. As stated by subjects from the office in Sweden, *"…you don't really get to know your other colleagues that well when they're in another office",* and *"you need to fill in this gap right, that you don't actually know those people that you're interacting with, you've never met them in the flesh."* Certain employees had their own methods to promote improved social interactions amongst colleagues. An example from an applications specialist in Sweden was, *"My approach is that I'm trying to build a rapport and getting to know this person. Breaking the ice in the beginning and trying to talk about something else than work during those phone conversations that we're having."* One applications specialist attested to the importance of building social connections for communication purposes, stating *"Now that I've built a relationship with these people so I don't feel like I'm bugging them or that I have to be so formal."*

Face-to-face meetings were deemed greatly important in promoting better personal relationships. Subjects from both the India and North America offices described the benefits of travelling to the head office in Sweden, stating that *"Being at the head office for a couple weeks and actually being around everyone was really nice because you actually build a relationship with your colleagues"* and, *"I think now after having actually been at the head office I have a lot more understanding of the company instead of someone just telling me how it is. I didn't understand the vibe they have there and within the company until I actually went there."* Face-to-face

meetings were also described as being a more efficient form of communication, as asserted by an applications support; *"We have to communicate with everyone with this Skype but I think sometimes that if it was face-to-face then it would be more efficient."* This was reiterated by an applications specialist who stated that *"Meeting people face-to-face makes it so much easier to communicate. For the first month, it was harder to communicate because we'd never met."* Face-to-face meetings were therefore identified as a management strategy for problems with using communication mediums, but also for problems with building relationships with distributed co-workers, as shown in Table 2.

Communication methods that were not face-to-face were often described as inefficient and lacking. *"Sometimes with email I feel that I am not able to elaborate the whole issue that I want to address to that employee"* was an example from a developer in India. Furthermore, asynchronous communication was considered inadequate for certain situations; *"So we communicate mostly through email, but if the issue is urgent, we communicate through phone."* However, asynchronous communication was deemed advantageous when managing language barriers. As explained by one subject, *"It's easier just not to challenge them too much, forcing them to speak English. So, I'm just writing them on Skype for Business, it's smoother sometimes."* The subject noticed that their colleagues who were not confident with English preferred writing over speaking, speculating that *"sometimes maybe it's easier to sit and gather your thoughts and put something in English".*

Social isolation was identified as a problem for those who were not located at the head office, described by a subject from the India office; *"Someone who works in the head office, the management is there so they have more information and know exactly where it is that Centiro is going. Right now, we don't get that many updates about what is going on."* However, there were strategies in place to improve social links between the offices; *"We have an event calendar so I can see, for example, that there is a conference going on and if I'm interested I can register for that. So that's a good thing that Centiro is doing for the colleagues who are not working in Borås."*

TABLE 2
SUMMARY OF SOCIAL EFFECTS AND RELATED STRATEGIES

Effect	Strategy
Difficulties building personal relationships	Providing opportunities for face-to-face meetings
	Building a rapport with colleagues
Inefficiency due to communication mediums	Initial face-to-face meetings
Language barriers	Asynchronous communication
Social isolation	Event calendar

2) Organisational: Effects linked to the company structure or environment were categorised as organisational effects. A major positive impact observed by all offices was the absence of rivalry within the company which was attributed to the flat structure. Described by subjects from the India and

North America offices respectively; *"There's no kind of hierarchy, that is the best thing because then we don't have much competition in the company"*, and *"One of the things I really like is that everyone is very team-orientated. There's no competitiveness or any hostility. There's not that general hierarchy so if you have questions you can go to whoever you need to."* This outlook was shared by subjects in Sweden who stated that, *"your colleagues are doing their best to help you, so there's no competitive behaviour. When you ask for their help, they're going to help you and you help them back."* As shown in Table 3, both the flat structure and team-oriented mentality were strategies for creating a non-competitive atmosphere in and between the offices.

Standardisation across the multiple sites was identified as an issue, however, described by a subject from the Sweden office; *"There is a need of standardisation because code can be written in different ways."* The issue was repeated by a subject from the India office who stated that, *"Right now we are struggling with information sharing. It would be nice to have the same standards for the US office as the Sweden office because we are struggling with having the same quality."* Although no official standardisation practices were identified, it was suggested that liaisons, employees from the head office who travel to the other offices and work there for some months, were highly beneficial. Not only did they promote the presence of the company, but also helped to establish proper company routines.

The impact of the environment of each office was broached by an applications specialist from the North America office, who stated that *"Right now it feels very much like a start-up, which isn't necessarily a bad thing, but you forget that we're actually a part of a whole company. You don't see that side of it with the office the way it is at the moment."* The subject further discussed the benefits of emulating the appearance of the head office at the offshore offices; *"When you have a company it's better to have just one representation that all offices follow, so that the company has that one unique approach that they're known for. Whereas if all the offices have their own different style, it's not necessarily a bad thing, but it would not be as easy to work at a different office. You wouldn't get that sense that you're still at Centiro."*

TABLE 3
SUMMARY OF ORGANISATIONAL EFFECTS AND RELATED STRATEGIES

Effect	Strategy
Non-competitive atmosphere	Flat company structure
	Team-oriented organisation
Lacking standardisation	Liaisons
Disparate office environments	-

3) Cultural: The assumed responsibilities of employees' roles appeared to differ between offices, which was attributed to cultural differences. As explained by an applications specialist; *"There was this cultural difference. For example, the Swedish software developers were challenging what they were being asked to develop and were coming with constructive feedback while the Indian developers were* expecting to get very good requirements and then just develop whatever was needed without questions." A developer from the same office reiterated this, stating that *"People have different images of what their role is supposed to do in a certain setting."* The same developer also explained how this impacted negatively on collaboration efforts; *"The problems it creates is that the design is not always good, but it gets implemented anyway and that takes additional time to fix later when you discover it than if you had seen it in a previous stage."* This issue was addressed by one developer who encouraged their colleagues to share their opinions more openly; *"I try to ask more questions and get more ideas from the other office. I explicitly ask, 'what do you think?'"* Cultural differences were seen as having some of the most substantial impacts, with one developer stating that, *"I don't think the communication or the method is any problem. I'd say the biggest challenge is the cultural differences."*

When asked about the company culture, however, the responses were more positive. Responsibility was a recurring theme that was brought up by subjects in both Sweden and India who described Centiro culture as *"very focused on you and your responsibility, and you get lots of opportunities, but you also are responsible for the work you do"* and *"Centiro's motive is that every employee should have similar kind of rights or similar kind of possibilities... We are responsible for our work. We are more like a family and we accept our colleague as they are"* respectively. The company culture was viewed favourably by those in the offshore offices in comparison with the other cultures they had experienced in their own countries. A subject in the North American office described the difference they noticed when starting at Centiro, stating that *"I feel like with most American companies every person is just another cog in the machine whereas with Centiro there's definitely the sense that everyone is appreciated and it's understood how each person makes a contribution in the company. There's not a sense that people are expendable."* A subject from the India office reiterated this view; *"Centiro's culture is much better than other offices I've worked at, because I used to report everything to a project manager but here it's more informal. There's no kind of hierarchy."* Additionally, the culture within the company was attributed to closing culture gaps and supporting good relationships amongst colleagues, which was described by a subject from the North America office; *"Centiro is so against that corporate America mentality, it's clearly a very core thing. Everything is team based and I really like that approach. I think it's good for the office environment and you can actually build very good relationships with your co-workers."*

The company culture was also observed to be growing in the offshore offices. Subjects from each office attested to this, stating that *"I visited the office in Sweden so there is definitely a different culture there I would say. But we definitely have the Sweden culture a little bit in our work and I think the culture is actually growing"* and *"Now that they've been working there for some years some of them are more into the Centiro culture and that's starting to spread to everyone who works there and all the new employees."*

4) Temporal: The effects attributed to differences in time zones were classified as temporal effects. These were viewed

TABLE 4
SUMMARY OF CULTURAL EFFECTS AND RELATED STRATEGIES

Effect	Strategy
Misconception of responsibilities	Improved communication
Cultural gap	Encourage growth of company culture

as exclusively negative impacts, with one applications specialist stating that *"maybe I'm a little bit negative here but I don't see any advantages"* when asked about the positive effects of having offices in multiple time zones. The general opinion was that different time zones caused processes to become dislocated; *"It definitely slows the process down because right now it's a 3-hour time difference and because usually you finish stuff near the end of your work day and when that happens it's dislocated, it gets delayed an extra day."* This was supported by an applications specialist who explained how their daily process was affected; *"When you're setting up requirements for the developers in India you have to make sure you do that the day before right, or even earlier than that because you know they're starting their working day 3.5 hours earlier than we are doing here. We should make sure every time that there is a pipeline for it to be done."*

The process of fixing problems was particularly affected by the temporal differences, which was seen to decrease process efficiency. One comment from the India office explained that *"whenever there is any kind of issue, we are often not present at the office, so basically they have to wait 8-9 hours to get our reply"* while a subject from the North America office stated that *"after 11:00am they've gone home for the day so if I would have any questions then I would need to reach out by email but if they were in the office it could be a simple as a quick IM back for them to explain it. Instead I could be waiting around for a couple of hours until I hear back."* This was reiterated by those at the head office who summarised the issue by saying; *"If there's a problem then you have to get past the time difference."* There were no official strategies for mitigating temporal difficulties. However, some subjects had their own ad hoc methods for managing the time differences. For example, one applications specialist stated that *"It's all about planning right. So planning needs to be improved and you have to have this in the back of your mind, that we're in a global company now."*

TABLE 5
SUMMARY OF TEMPORAL EFFECTS AND RELATED STRATEGIES

Effect	Strategy
Process dislocation	Improved planning
Longer time to solve problems	

C. Summary of GSD Effects and Strategies

Effects of GSD were identified in four primary categories, namely social, organisational, cultural and temporal. Social effects included difficulties with, and

importance of building personal relationships with colleagues, and the social isolation that can occur as a result of having geographically distributed offices. The company has implemented strategies to manage both effects, including organising for new employees to travel to the head office in Sweden and establishing a company event calendar. Employees had also adopted their own ad hoc solutions, such as attempting to build a rapport with their offshore colleagues while working. The importance of face-to-face meetings was stressed by subjects from all offices. Not only did this support better relationships between colleagues, but it was also regarded as the most efficient form of communication. Language barriers, however, were better managed by using asynchronous communication methods, such as email or IM platforms.

Organisational effects were not managed to the same extent as the social effects. The strategy of implementing a flat organisational structure had successfully limited, if not eliminated competitive tendencies between offices and co-workers. However, the lack of standardisation did not appear to have been addressed, neither in terms of office environments nor work quality.

Cultural effects were addressed, however, including both the differing conceptions about responsibilities and the cultural gaps between offices. The former was spontaneously managed by employees who supported other colleagues to be more open with their opinions. Growing the company culture within the offshore offices was seen to close cultural gaps.

Temporal effects included process dislocation, that is, the perceived disorder of a traditional working day caused by collaborating with colleagues in different time zones. There were no official strategies in place to manage this, however several employees stated that planning was essential and should be improved company wide. Generally, temporal differences resulted in processes such as bug fixing taking longer to complete. There were no observed strategies to address this besides the suggestion to improve planning.

V. DISCUSSION

This section presents a discussion of the results documented in the previous section. It aims to answer the research questions by considering the results with regards to previous related works.

The identified effects were grouped into four categories which were derived from the inductive data analysis process. Social effects emerged from problems in communication and geographical distribution of employees. Effects resulting from the structure or environment within the company were classified as organisational effects, whereas cultural effects were caused by cultural differences. Lastly, temporal effects developed as a result of offices being in different time zones. Table 6 shows which effects were present in each office.

A. Social Effects and Strategies

1) Difficulties building personal relationships: Employees struggled to connect with their colleagues in other offices on a personal level. Due to teams being distributed across multiple offices informal communication was limited, if

not non-existent, which restricted their ability to build closer relationships. This issue was also reported by previous studies, which found that people find it far more difficult to identify with distant colleagues and communicate effectively with them [24]. Similarly, employees at Centiro identified the negative impact that shortfalls in building personal relationships had on communication. The consensus was that improving personal relationships by building a rapport with their co-workers resulted in easier, more informal communication. Confirmed by previous research, the goal should be to promote the development of an informal network of ties that can overcome the constraints that formal communication paths established [25].

Meeting colleagues face-to-face was viewed as the most effective strategy to manage this issue, however. Centiro provided new employees from the offshore offices with the opportunity to travel to the head office in Sweden, which was considered a highly beneficial experience and crucial in building better relationships between distributed co-workers. The effectiveness of this solution has also been observed by previous studies; In meeting face-to-face, the aim is to get to know each other and to create social networks that can generate trust, respect and commitment and in the long term facilitate development work across various geographical sites [26].

2) Social isolation: Previous research has stated that a major challenge is how to create a feeling of 'teamness' among distributed project members [26]. These results were in agreement with the results of this study, where employees in the offshore offices expressed a sense of social isolation. Although the literature did not suggest mitigation strategies for this issue, Centiro had implemented a company event calendar. This allowed employees from all offices to see the events happening within the company which increased their sense of inclusion and improved social connections.

3) Inefficiency due to communication mediums: Face-to-face communication was deemed the most efficient method of communicating with colleagues. Communication mediums were sufficient for most scenarios, however urgent issues required synchronous communication as asynchronous methods such as email did not allow for enough elaboration. The general opinion was that these mediums were lacking in some respect. This assessment was also made by Illes-Seifert, et al. [24] who stated that "face-to-face communication cannot be replaced by any technology". Although missing face-to-face communication is a specific communication barrier and it is seen as indispensable even when technological support for synchronous or asynchronous communication is available [24], the general opinion at Centiro was that using communication mediums was simply unavoidable within a global company. Holding initial face-to-face meetings, however, resulted in more efficient consequent use of communication mediums.

4) Language barriers: As Centiro is a global company, employees come from diverse backgrounds and as such, speak different native languages. It was observed that language barriers affected face-to-face and synchronous communication as some employees were not as comfortable speaking English as others. This effect was managed by using asynchronous communication such as email or instant messaging when possible. This was also identified as a strategy by previous studies, who claimed that asynchronous tools are seen as crucial for communication and coordination, and as enablers for non-native English speakers to reflect before answering a question [26].

B. Organisation Effects and Strategies

1) Non-competitive atmosphere: Emphasised by employees from all offices was the highly supportive, non-competitive environment within the company. This effect was particularly strong in the offshore offices, who found that the organisational structure varied greatly from what was typical for their respective locations. This deviated from the results of previous research, which found that there was initially little trust between people at different locations, and little sense that they were partners [25].

2) Lacking standardisation: Previous studies have suggested that companies should focus their solutions mainly on the need for work standardisation [27]. This issue was also observed at Centiro, where standards for work quality differed between offices. Although Centiro did not appear to have implemented any documented standardisation practices, they had successfully used liaisons to assist with establishing the new offices. Previous studies similarly expressed the benefits of utilising liaisons, describing how these employees were key actors in guiding initial standardisation initiatives including of infrastructure, office spaces, and technical know-how [28].

3) Disparate office environments: Since sites were separated by large geographical distances, it is understandable that the office environments were different. Employees felt that emulating the ambiance of the head office would increase their sense of inclusion and perceived company presence, consequently leading to improved collaboration between offices.

C. Cultural Effects and Strategies

1) Misconception of responsibilities: There were varying understandings between offices of the responsibilities of certain roles, which was attributed to cultural differences. One office expected developers to challenge requirements and provide constructive feedback, whereas in another office the developers expected to receive satisfactory requirements and did not question their quality. This led to the implementation of poor designs which the development team believes could have been avoided by improving communication. More frequent communication was also suggested as a possible solution. Likewise, Illes-Seifert, et al. [24] explained how it was proposed to communicate more often.

2) Cultural gap: Increased diversity within the company due to global expansion resulted in larger cultural gaps. However, the office culture at Centiro was viewed favourably by employees from offshore offices who preferred it over the office cultures that were typical of their respective countries. Encouraging the growth of, and embracing the company culture appeared to reduce the cultural gaps as it established a common working mentality across all three offices.

TABLE 6.
OVERVIEW OF LOCATIONS WITH RESPECT TO IDENTIFIED EFFECTS

Category	Effect	Location		
		India	North America	Sweden
Social	Difficulties building personal relationships	X	X	X
	Inefficiency due to communication mediums	X	X	
	Language barriers			X
	Social isolation	X	X	
Organisational	Non-competitive atmosphere	X	X	X
	Lacking standardisation	X		X
	Disparate office environments		X	
Cultural	Misconception of responsibilities	X		X
	Cultural gap	X	X	X
Temporal	Process dislocation	X	X	X
	Longer time to solve problems	X	X	X

D. Temporal Effects and Strategies

1) Process dislocation: The traditional order of the work day was disrupted as there were a limited number of overlapping working hours between offices. Consequently, processes became dislocated if they involved collaboration between employees in different offices. There were no formal strategies in place to mitigate this issue, however employees from all offices agreed that planning was effective when managing this issue. The company did not appear to implement follow-the-sun development, which was identified by Conchúir et al. [29] as an assumed benefit of GSD. In fact, the employees' opinions mirrored those from the abovementioned study, which found that companies view time-zone differences not as a potential benefit but as a negative side effect.

2) Longer time to solve problems: Temporal differences decreased employees' efficiency when solving problems. This occurred when office hours did not overlap and communication was therefore limited. This issue was also documented by previous studies, which found that the use of asynchronous tools over temporal distances increases the time it takes to receive a response [26]. Furthermore, it was determined that time differences meant that something that could be handled in a matter of minutes for a same-site development would often have to wait at least until the next business day [25]. Planning was again suggested as a mediation strategy however no formal management systems were implemented.

E. Summary

As demonstrated in Table 6, not all effects were present in each office. Both temporal effects, "process dislocation" and "longer time to solve problems" were identified in all offices, however only the "cultural gap" cultural effect appeared also in all three. "Misconception of responsibilities" was reported by subjects from the Sweden and India offices, which could suggest that, as the North America office is the newest, this effect takes longer to emerge. Likewise, the organisational effect of "lacking standardisation" was observed only at the offices in Sweden and India, which poses the same theory.

"Language barriers" was contrastingly only discussed by subjects from the head office. One explanation for this could be that offshore offices begin with the assumption that they will not be working in their native languages, whereas the head office has been located only in Sweden for the majority of the company's existence. Conversely, "social isolation" was identified by subjects exclusively from the offshore offices in India and North America. That upper management were all located at the head office was the given reason for this effect. Moreover, there is more informal communication between employees from different teams at the head office which does not occur between employees from the offshore offices. Centiro had implemented an event calendar which was successful in mitigating the effects of social isolation.

Many of the identified effects reflected what previous studies had observed. There were, however, effects described in the literature that were not observed during this study. For instance, it was documented by previous research ([12], [13]) that there existed a rivalry between distributed offices, however that was not the case at Centiro. Indeed, the identified effect was contrastingly "non-competitive atmosphere". It appears this is a consequence of the flat company structure which, if so, could be an effective strategy in managing the issue of contention between distributed offices. Furthermore, the effects of "misconception of responsibilities" and "lacking standardisation" were not observed at the North America office. However, the other offices in Sweden and India and previous studies ([24], [27], [28]) identified these impacts, which prompts the idea that such effects emerge later in the offshoring process.

VI. CONCLUSION

The objective of this exploratory case study was to identify the effects of GSD that emerged during the early stages of offshoring, and what strategies are being used to manage these effects. This was achieved by determining the effects and strategies that were present within the case company, which consisted of two offshore offices that had been open for less

than two years. Several effects were identified to varying degrees at the case company's three offices, which consist of a head office in Sweden and two offshore office in India and North America. The GSD effects were organised into four main categories, namely social, organisational, cultural and temporal. The strategies that the company had implemented to manage these effects were also identified and discussed with respect to other related research. It is apparent that the majority of issues uncovered during previous studies are also relevant during the initial stages of offshoring, as are the suggested mitigation strategies. There were some cases that did not conform to previous results, however. As there was no evidence of contention between the distributed offices, a phenomenon that was documented by multiple previous studies, it could be concluded that Centiro's strategy of implementing a flat, team- oriented organisational structure is successful in managing this effect. The importance of growing company culture early within offshore offices is also evident as it is effective in minimising the impact of cultural effects. The effects that were not observed at the newest office, but featured in both the literature and other offices motivated the notion that certain impacts of GSD are not immediate but instead occur later on in the offshoring process. Mitigation strategies should therefore be implemented before such impacts materialise.

VII. FUTURE RESEARCH

There are a number of areas within the field of GSD that would benefit from further research. We suggest that future studies observe how the effects of GSD evolve over a longer period of time than just one project, which is the standard in the current literature. Perhaps interviewing the same distributed teams multiple times over the course of a number of projects. Furthermore, research that observes and documents the success, or otherwise, of implementing specific management strategies would benefit all practitioners of GSD.

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Experience/General Intro
- How long have you worked for Centiro and what is your role within the company?
- What other work experience do you have?
- What does a normal working day look like for you?
- Do you/your team have any development processes that you use?

Communication
- How do you communicate with colleagues at your own office?
- How do you communicate with colleagues at the other offices?
- What differences have you noticed in how you communicate with different colleagues?
    - What do you think about these differences? Are there certain methods that you prefer/work better for you?
    - Have different communication methods ever affected you in a more positive or negative way?
- How have your communication processes changed since you started at Centiro?

Temporal distance
- Have differences in office time zones ever affected your work?
    - If yes, could you describe the impact(s) of this?
- Has this ever caused problems for you?
    - How did you resolve the problem(s)?
    - Have you noticed times when time zones caused more or less problems?
- Has working in different time zones had a positive effect on your work?

Geographical distance
- What experiences have you had with distributed development?
- Has being at a different site ever affected you in a more positive or negative way?
    - When did this occur?
    - If negative, how did you solve the problem(s)?
- Has your opinion of distributed development changed since starting at Centiro?
    - If yes, what do you think caused this change?

Socio-cultural distance
- What does Centiro culture mean to you?
- Have you noticed any differences between cultures at the other offices?
    - If yes, could you describe the difference(s)?
    - Has this ever caused problems? If yes, when did they occur and how did you solve them?
    - Have there been certain times when these differences were more noticeable?
- What positive effects have you noticed about working in a multicultural office?

GSD
- How familiar are you with the term "Global Software Development"?
- What does GSD mean in your words?
- Did you have any expectations of distributed development before starting this job?
- What experiences have you had with distributed development that stand out?

Next step
- What would you have done differently if you opened a new office?
- What would you do the same?
- Are there any points in time you feel are particularly important when establishing an office?

Extracted Text	Coding	Effects	Strategies	Area
"you don't really get to know your other colleagues that well when they're in another office"	• Difficulties in building relationships with offshore colleagues	Difficulties building personal relationships		
"you need to fill in this gap right, that you don't actually know those people that you're interacting with, you've never met them in the flesh."	• Difficulties in building relationships with offshore colleagues • Non-face-to-face communication is lacking			
"We have to communicate with everyone with this Skype but I think sometimes that if it was face-to-face then it would be more efficient."	• Face-to-face communication is more efficient	Inefficiency due to communication mediums		
"My approach is that I'm trying to build a rapport and getting to know this person. Breaking the ice in the beginning and trying to talk about something else than work during those phone conversations that we're having."	• Building a rapport with offshore colleagues		Building a rapport with colleagues	Social
"Now that I've built a relationship with these people so I don't feel like I'm bugging them or that I have to be so formal."	• Face-to-face meetings support building relationships			
"Being at the head office for a couple weeks and actually being around everyone was really nice because you actually build a relationship with your colleagues"	• Face-to-face meetings support building relationships		Opportunity for face-to-face meetings	
"I think now after having actually been at the head office I have a lot more understanding of the company instead of someone just telling me how it is. I didn't understand the vibe they have there and within the company until I actually went there."	• Face-to-face meetings support building relationships			
"Meeting people face-to-face makes it so much easier to communicate. For the first month, it was harder to communicate because we'd never met."	• Face-to-face meetings support building relationships			
"Sometimes with email I feel that I am not able to elaborate the whole issue that I want to address to that employee"	• Communication mediums are lacking	Inefficiency due to communication mediums		
"So we communicate mostly through email, but if the issue is urgent, we communicate through phone."	• Communication mediums are lacking			
"It's easier just not to challenge them too much, forcing them to speak English. So, I'm just writing them on Skype for Business, it's smoother sometimes."	• Language barriers • Asynchronous communication helps break language barriers	Language barriers	Asynchronous communication	
"sometimes maybe it's easier to sit and gather your thoughts and put something in English"	• Asynchronous communication helps break language barriers			
"Someone who works in the head office, the management is there so they have more information and know exactly where it is that Centiro is going. Right now, we don't get that many updates about what is going on."	• Sense of isolation in offshore offices	Social isolation		
"We have an event calendar so I can see, for example, that there is a conference going on and if I'm interested I can register for that. So that's a good thing that Centiro is doing for the colleagues who are not working in Borås."	• Event calendar		Event calendar	
"There's no kind of hierarchy, that is the best thing because then we don't have much competition in the company"	• No hierarchy • Limited competition within the company	Non-competitive atmosphere	Flat structure Team-orientated	Organisation
"One of the things I really like is that everyone is very team-orientated. There's no competitiveness or any hostility. There's not that general hierarchy so if you have questions you can go to whoever you need to."	• Team-oriented • No hierarchy • Non-competitive atmosphere			
"your colleagues are doing their best to help you, so there's no competitive behaviour. When you ask for their help, they're going to help you and you help them back."	• Non-competitive behaviour			
"There is a need of standardisation because code can be written in different ways."	• Need for standardisation	Lack of standardisation		
"Right now we are struggling with information sharing. It would be nice to have the same standards for the US office as the Sweden office because we are struggling with having the same quality."	• Information sharing • Need for standardisation • Struggling with quality			

Quote	Codes	Subtheme 1	Subtheme 2	Theme
"Right now it feels very much like a start-up, which isn't necessarily a bad thing, but you forget that we're actually a part of a whole company. You don't see that side of it with the office the way it is at the moment."	• Start-up atmosphere • Limited company presence	Different office environments/styles		
"When you have a company it's better to have just one representation that all offices follow, so that the company has that one unique approach that they're known for. Whereas if all the offices have their own different style, it's not necessarily a bad thing, but it would not be as easy to work at a different office. You wouldn't get that sense that you're still at Centiro."	• Better to have one office style/environment			
"There was this cultural difference. For example, the Swedish software developers were challenging what they were being asked to develop and were coming with constructive feedback while the Indian developers were expecting to get very good requirements and then just develop whatever was needed without questions."	• Cultural difference • Differing expectations of roles between offices	Misconceptions about roles and responsibilities		
"People have different images of what their role is supposed to do in a certain setting."	• Different images of roles			
"The problems it creates is that the design is not always good, but it gets implemented anyway and that takes additional time to fix later when you discover it than if you had seen it in a previous stage."	• Cultural differences impact collaboration	Cultural gaps		
"I don't think the communication or the method is any problem. I'd say the biggest challenge is the cultural differences."	• Cultural differences			
"I try to ask more questions and get more ideas from the other office. I explicitly ask, 'what do you think?'"	• More communication		Improved communication	Culture
"I feel like with most American companies every person is just another cog in the machine whereas with Centiro there's definitely the sense that everyone is appreciated and it's understood how each person makes a contribution in the company. There's not a sense that people are expendable."	• Company culture viewed positively		Grow company culture	
"Centiro's culture is much better than other offices I've worked at, because I used to report everything to a project manager but here it's more informal. There's no kind of hierarchy."	• Company culture viewed positively • No hierarchy			
"I visited the office in Sweden so there is definitely a different culture there I would say. But we definitely have the Sweden culture a little bit in our work and I think the culture is actually growing"	• Office cultures differ • Company culture is growing			
"Now that they've been working there for some years some of them are more into the Centiro culture and that's starting to spread to everyone who works there and all the new employees."	• Company culture is growing			
"maybe I'm a little bit negative here but I don't see any advantages"	• Temporal distance viewed negatively			
"It's all about planning right. So planning needs to be improved and you have to have this in the back of your mind, that we're in a global company now."	• Planning should be improved • Global company		Improve planning	
"It definitely slows the process down because right now it's a 3-hour time difference and because usually you finish stuff near the end of your work day and when that happens it's dislocated, it gets delayed an extra day."	• Slows processes down • Processes are dislocated • Delays	Processes are dislocated		Temporal
"When you're setting up requirements for the developers in India you have to make sure you do that the day before right, or even earlier than that because you know they're starting their working day 3.5 hours earlier than we are doing here. We should make sure every time that there is a pipeline for it to be done."	• Pipeline for requirements			
"whenever there is any kind of issue, we are often not present at the office, so basically they have to wait 8-9 hours to get our reply"	• Delays for addressing issues			
"after 11:00am they've gone home for the day so if I would have any questions then I would need to reach out by email but if they were in the office it could be a simple as a quick IM back for them to explain it. Instead I could be waiting around for a couple of hours until I hear back."	• Delays	Longer time to solve problems		
"If there's a problem then you have to get past the time difference."	• Time difference affects problems			