Electronic Research Archive of Blekinge Institute of Technology
http://www.bth.se/fou/

This is an author produced version of a journal paper. The paper has been peer-reviewed but may not include the final publisher proof-corrections or journal pagination.

Citation for the published Journal paper:
Title:
Lessons learned from transferring software products to India

Author:
Darja Smite, Claes Wohlin

Journal:
Journal of Software Maintenance and Evolution – Research and Practice

Year:
2012
Vol.
24
Issue:
6
Pagination:
605–623
URL/DOI to the paper:
10.1002/smr.550

Access to the published version may require subscription.
Published with permission from:
Wiley

Lessons Learned from Transferring Software Products to India

Darja Šmite and Claes Wohlin
Blekinge Institute of Technology
{Darja.Smite / Claes.Wohlin}@bth.se

Abstract

Globalization has influenced the way software is developed today and many software organizations have started to actively utilize resources from around the world. However, these endeavors are recognized as very challenging and they have attracted a lot of attention in software research in the past decade. Unlike many other research initiatives, which explore the complexities of distributed software development activities, the focus of this paper is on software transfers. Software transfers refer to activities that are moved from one location to another. The authors draw attention to the lessons learned from an empirical investigation of two transfer projects conducted at Ericsson. Both transfers were performed between a site in Sweden and a site in India. The observations outline a set of generic practices that have been found useful for transferring software development within a company. It also highlights a number of challenges to be addressed and a set of corresponding recommendations. Finally the paper emphasizes the need to identify software products that are suitable for transfers and the need to monitor the long-term effects of transfer.

Keywords: Global software engineering, global software development, software transfers, offshoring, offshore insourcing, case study

1 Introduction

Internalization of the companies leads to highly multinational partnerships with sites, branches and sub-contractors located in different countries. This is motivated by the intentions to tap into the competence in other countries; reducing costs for development and ensuring proximity to different markets. Globalization in terms of software development has meant that distributed development has become business as usual. Many larger companies, including the one at the focus of this study – Ericsson, have sites in different countries and hence there is an ambition to maximize the development capability. The latter includes both working jointly on different products across sites and transferring the responsibility and development of products between sites.

The results reported for global software development endeavors are very diverse, ranging from announcements of tremendous success to total failure. While many companies practice outsourcing of routine tasks and keep more interesting work for themselves, rapid growth markets, and India in particular, are often associated with high rates of employee turnover [1]. Therefore many companies are establishing their subsidiaries in different countries instead of just relying on outsourcing. One of the challenges with this is ensuring motivation through the availability of challenging work and a certain level of responsibility. Thus, transfer of work between sites has become a common practice.

Global software development is a major challenge for the software industry and hence also of major interest for researchers. However, most of the published research is still mainly focused on describing the problems rather than solutions related to globally distributed development [2] and primarily in relation to on-going development. To the best of our knowledge, research findings related to actual transfer of software work from one site of a company to another site of the same company (offshore insourcing), or a third party (offshore outsourcing) is limited. Consequently practitioners are forced to experiment and quickly adjust their tactical approaches for leveraging global software development risks [3].

This paper is an extended version of a case study published in [4], which pointed to a number of key challenges and recommendations learned from a transfer project between Sweden and India conducted in Ericsson, a large multinational telecommunication company. In this paper the authors further contribute with observations from an additional transfer project, explore the validity of the previously found recommendations in a similar context within the same organization and discuss the processes of transferring software work from a more holistic perspective.

In the next section we outline research findings related to our study. Section 3 discloses the context and methodology of the two transfer projects; followed by

the findings, software transfer challenges and recommendations in Section 4. The paper draws attention to a number of questions emerging from the findings in Section 5, where we discuss the suitability of different software products for transfer, long-term monitoring strategies, along with implications for research and practice. Finally a summary of the findings in the form of carry-away advice concludes the paper.

2 Related work

Transferring software work is a specific approach in global software engineering. It can be observed from either a management perspective, addressing decision-making challenges, or from an engineering perspective, addressing actual execution of a transfer. While "make-or-buy" decisions have been discussed in the research literature for decades [5], the literature focusing on actual transfers is scarce. Some exceptions exist, for example, Mockus and Weiss [6] discuss how to find suitable "chunks" of work to transfer to different sites. They have found that transfer by functionality including the ownership of e.g. a sub-system is the most commonly applied approach in Lucent Technologies [6].

In contrast to other engineering disciplines, transfer of software engineering activities is associated with substantial challenges in relation to the handover of the knowledge-intensive work. The scales associated with evaluating the success of a transfer include relative decrease in efficiency, and time and extent of recovery after the transfer is finished. These are illustrated in Fig. 1.

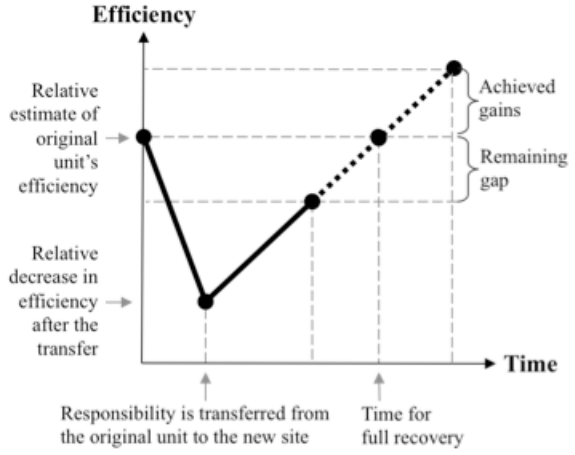

Fig.1. Transfer challenges [4]

2.1 Productivity decrease

Knowledge transfer is usually associated with a natural loss in efficiency of developers newly engaged in the project [10]. Examples of industrial experience provided by Carmel and Tjia [10] demonstrate that efficiency can decrease down to 20% of the relative efficiency of the original unit and rarely achieves full recovery. While companies strive to achieve gains in efficiency by relocating software work to offshore sites, in practice industrial observations suggest that the offshore site can be incapable of fully recovering, thus leaving gaps in efficiency after the transfer. The implication of this is that transfers may lead to employing more people in order to keep the same production volumes.

2.2 Time to climb up the learning curve

In their research Mockus and Weiss [6] point out that the learning curve of the new site takes time due to the substantial training required for those who are unfamiliar with the product. Lack of domain and product expertise is frequently referred to as one of the key challenges when starting global software development [7-9].

The time from transferring software work to achieving the same level of efficiency varies from one year for maintenance tasks in T-Corp [10] and 18 months for development work in Lucent Technologies [6] to more than five years for development in Philips [11]. Other experiences indicate that the learning curve can also be quite challenging after five years of collaboration [12]. The major concern here is that overcoming the challenges associated with switching the location of development to another site may also take longer than it takes to meet the objectives on the real capability front [13].

This indicates that achieving economical success with a transfer of software work is not trivial and organizations shall take decisions based on considerate analysis of capabilities rather than just a blind salary comparison. A consequent question that comes into mind is related to the ways companies overcome these challenges and ensure minimal decrease in efficiency, and ability of the new site to quickly recover.

3 Research methodology

3.1 Empirical background

The findings discussed in this paper are derived from two case studies conducted at Ericsson, a large international company headquartered in Sweden. Ericsson is one of the leading companies in the telecommunication market worldwide and is rapidly extending its operations in Asia. The company develops a wide range of products and solutions, including generic software products offered to an open

market and complex compound systems with customized versions.

During the past several years Ericsson has transferred a number of software products between different sites, including the site in India. Acknowledging the challenges of software product transfers Ericsson initiated a research project that aims to collect and document experiences for organizational learning. Two transfer projects between Sweden and India started at the beginning of research investigation, which motivated their selection as objects for the case study. Since global endeavors differ significantly dependent on the combination of partner locations, the choice of two projects involving the same locations ensures more homogeneity and thus possibility for generalization at least within Ericsson. In this research paper the authors present findings from two transfer projects, extending previously published findings from a single case study [4].

3.2 Research questions

The main objective of this paper is to broaden the existing knowledge around software transfer projects. In particular, the empirical investigation is driven by the following research questions:

RQ1: What were the challenges of transferring software work from a site in Sweden to a site in India?

RQ2: Which practices can be applied to mitigate these challenges?

RQ3: What can we learn from comparing experiences from the two case studies with a similar context?

3.3 Research overview

In order to ease the evaluation of applicability of the findings reported in this paper, the case studies are described as suggested by [14].

The context of this investigation is an industrial intra-organizational collaboration between two sites, namely Ericsson in Sweden and India. The authors conducted two case studies on the basis of two transfer projects of large software components from the same product family developed by Ericsson. Findings from the first case study (Project A) have been reported in [4]. The second case study (Project B) is conducted to validate the earlier findings in a similar context. The studied transfer projects are particularly interesting because they encompass similarities and differences. These projects were selected for the investigation because both were on-going transfers with a relative compact schedule that offered an opportunity to observe the entire process of transferring the work.

3.3.1 Project A

Transfer announced:	Q1/2009	
Transfer completed:	Q4/2009	
Transfer time:	In the middle of a release	
Reason for transfer:	To free up resources for other tasks and decrease the costs	
Product:	Complex, immature	
Product history:	Initially developed in Ireland, transferred to Sweden in 2007 and then to India in 2009	
Receiving site:	Involvement in the product from the beginning, engagement in all product areas, responsible for product customization since 2007	
Size of each site:	before transfer	after transfer
Sweden	54 members	5 members
India	46 members	80 members

This case study is particularly interesting due to its history. The transferred product component was initially developed by an external software company, which was bought by Ericsson. It was then transferred from the acquired company and has since been developed in a distributed way. Ericsson in India has been engaged in product customization tasks and later received full responsibility for handling the component, which was at the time regarded as complex and immature due to previous history.

3.3.2 Project B

Transfer announced:	Q1/2009	
Transfer completed:	Q4/2009	
Transfer time:	In the middle of a release	
Reason for transfer:	To free up resources for other tasks and decrease the costs	
Product:	Complex, mature	
Product history:	Developed in Sweden	
Receiving site:	Involvement in product customization since Q2/2006, for which responsibility was shifted by Q4/2008	
Size of each site:	before transfer	after transfer
Sweden	32 members	5 members
India	33 members	68 members

The second case study prescribed a relocation of a mature product component. It was built on a special technological platform and thus introduced substantial challenges in finding the people with the necessary technical skills. When the decision about the full transfer was made, the receiving site was, similarly to project A, already involved and later responsible for developing product customizations.

3.4 Data collection and analysis

The research reported here is a part of an exploratory study. Case study methodology has been selected as an appropriate tool for finding out what is happening in software transfers, seeking new insights and generating ideas for further research [15]. Herein findings from two case studies are reported based on interviews, email inquiries and expert group meetings conducted with Ericsson employees from Sweden and India and an analysis of the projects' documentation. The research was conducted in several steps and followed a flexible design that allowed implementation of changes during the course of the study. Observer, data source and methodological triangulation were performed to increase the precision of the findings as suggested in [15]. In particular, we have interviewed people with different roles and from different locations to obtain various perspectives. The findings from the interviews were then complemented with those from email inquiries, additional informal and group interviews, as well as project documentation.

Step 1: Initially the researchers conducted interviews with representatives from the two transfer projects and performed separate data analysis to derive the main challenges and recommendations from each case study.

The researchers conducted 14 interviews in total. In order to gain different perspectives, employees with different roles were interviewed. All interviews were conducted in Sweden. Therefore it was possible to interview only those Indian employees that were present in Sweden at the time of investigation; it was deemed infeasible to conduct interviews over the phone. A detailed overview of the interviews can be found in Table 1.

Table 1. Overview of the interviews

Site	Time	Roles	No
Transfer Project A			
India	Jun '09	Tech leads	2
Sweden	Jun '09	Dev. Manager /Tech leads	3
Transfer Project B			
India	Jun '09	Tech leads	2
		Engineers	2
Sweden	Jun '09	Dev. Manager /Tech leads	2
		Engineers	3
Total			
Total number of interviews			**14**

The interviewees were asked to name three major challenges they faced during the transfer and how these were or could have been addressed. All interviews were approximately one hour in duration. The conversations were not recorded but documented during the interview. The notes were then sent to the interviewees for approval.

Qualitative analysis techniques as proposed by Strauss and Corbin [16] were further used to derive quotations related to transfer challenges and solutions. In particular, open coding was used for labeling different expressions from the interviews and grouping these expressions into related categories (challenges and solutions). Axial coding was then used to identify the relationships between these categories. Challenges based on a single source were omitted to avoid individual bias and increase the generalizability of the findings. However the authors decided to keep specific recommendations suggested by a single source for further investigation.

Step 2: Comparison analysis started by identifying the characteristics of each case study. Additional email inquiries, informal interviews and group meetings were held to discuss transfer project characteristics and gain an understanding of the planning, risk management activities, and chronological development of events. For this reason, several artifacts were also collected and analyzed from the transfer projects studied.

Recommendations suggested by a single interviewee were brought up and discussed with the experts. Those confirmed to be important were kept for the final report.

The findings from each case study, containing challenges and recommendations associated with software transfers, were then compared and combined. Qualitative data analysis techniques were used again to identify the relationship among the challenges and recommendations from two case studies and derive a common phraseology. Differences and commonalities were traced back to the project characteristics and discussed.

Email interaction was used to finalize the findings and ensure the accuracy of the report.

4 Findings

The observations from the case studies suggest that the process of transferring software work from Sweden to India underwent similar phases in both projects:

1. **Pre-transfer:** In this phase the responsibility for handling the product is fully allocated at the sending site (in Sweden). The receiving site may be involved in product customization, maintenance, or even development tasks.
2. **Recruitment & Training:** The first transfer phase is focused on building the receiving site (in India) – ensuring the availability of human resources and their competence. Meanwhile the

sending site is dominant in handling the on-going development and product delivery.

3. **Trial:** In the second phase the receiving site is handing the development while the sending site is still providing active coaching and support.
4. **Post-transfer:** At the end of the transfer project the receiving site shall be capable of handling the development without coaching and support, and hence the responsibility of the sending site is handed over.

In the following sub-sections, observations and lessons learned from the two case studies are presented. The findings are organized as a set of challenges faced during the transfer and solutions that were applied to mitigate these challenges. Quotes from the interviews are used to illustrate the atmosphere in the projects. Table 2 provides an overview of the evidence supporting the challenges and recommendations to emphasize their relative importance. The figures given in the table represent the number of interviewees who selected these particular challenges as the major obstacles related to the transfer and listed proposed recommendations. The challenges are highlighted in bold and act as headings for specific recommendations related to each challenge.

It is worth mentioning that among the practices that were based on a single source only those that have been confirmed during the informal discussions and expert meetings were included in the paper. Due to the informal nature of these discussions and meetings, no additional quantitative evidence is demonstrated.

Table 2. Sources of challenges and recommendations

Challenges & Recommendations	**Project A**	**Project B**	**Total**
Overcoming cultural differences	**3**	**7**	**10**
↳ Early cultural awareness training	3	3	6
↳ Adjust processes to people		1	1
Transferring the competence	**2**	**6**	**8**
↳ Transfer people with the product	1	2	3
↳ Plan the scope of a transfer, roles and responsibilities	2	4	6
↳ Plan co-located hands-on training	3	8	11
↳ Focus on key roles/items	2	1	3
↳ Trial before the cut-off	1		1
↳ Support through coaching	2	3	5
↳ Motivate people who transfer the knowledge		1	1
↳ Motivate people who receive the work		2	2
↳ Ensure product documentation	1		1
Handling remote work	**4**	**3**	**7**
↳ Invest in efficient remote access and tools to support multi-site work		1	1
↳ Organize regular visits	1	2	3
Finding the right people	**3**	**3**	**6**
↳ Early and smart recruitment	3	4	5
↳ Promote people within the organization	1		1
Maintaining on-going development	**2**	**3**	**5**
↳ Don't underestimate the time required for a transfer	1	3	4
↳ Balance on-going development with the transfer	2	2	4
↳ Transfer activities step by step	3	2	5

The first case study (reported in [4]) is denoted Project A in Table 2. The case study resulted in five main challenges and 11 recommendations. The second case study (Project B) was conducted to seek confirmation and identify additional challenges and recommendations. In Project B we confirmed all five challenges and eight recommendations (from 11 in total), and identified three new recommendations. All recommendations are presented in Table 2 upon an approval from Ericsson representatives during informal discussions and expert group meetings. The recommendations obtained from Project A that were not confirmed in Project B relate to issues that were perceived as more important for the former project. However, it does not mean that such recommendations are invaluable. Similarly, several recommendations are added referencing Project A, which have not been previously published in [4]. These recommendations were supported by a single source, and gained more attention only after adding the second case study. In summary, it was decided that it was better to have a larger set of relevant recommendations than only having a subset, i.e. those mentioned by interviewees from both projects.

This reflects that all recommendations may not be useful for all projects. For example, product documentation may already be good enough and hence it does not make sense to stress the provision of product documentation, although it may be crucial for another transfer. Also the list of recommendations is not complete, more recommendations might be found through an extension of the current investigation with more transfer projects.

The numbers provided in Table 2 illustrate the support for each challenge and recommendation, which is one measure of perceived importance of the

challenges and recommendation. The numbers by no means represent the truth for all projects and hence the actual frequencies should not be used. The list as such is definitively more important than the numbers related to each challenge and recommendation.

4.1 Overcoming cultural differences

Most of the interviewees have noted the importance of acknowledging and understanding cultural differences. Some cultural misunderstandings occur when people use the same words to describe different things. The effect of cultural differences is not always easy to evaluate.

A Tech Lead from Sweden (Project A) said that although the cultural differences are now known, the consequences and required actions are not fully realized. He also emphasized that because of cultural differences corrective actions may not always work.

One of the challenges as pointed out earlier relates to how people from different cultural backgrounds learn and train.

According to a Development Manager from Sweden (Project A), the learning process can be affected by cultural differences. He noted that in Sweden people are expected to demonstrate initiative in finding solutions and it is common to learn by mistakes, while in other cultures people are used to be guided and may lose face if making mistakes.

Another frequently mentioned challenge relates to differences in problem resolution approaches. In particular, how Swedes with their informal culture and optimized authorities and Indians with formal culture and hierarchies[1] influence each other when working together. The interviewees from Project A state that there were misunderstandings due to unreasonable expectations that unavoidably caused time delays and required changing the strategies.

Solution: Several interviewees noted that things could have been much easier if the cultural differences were known in advance. Thus, cultural awareness is regarded as one of the important skills. A new Cross-Cultural Communication Course is organized for transfer project employees in Ericsson. The course brings together employees from the collaborating sites and opens up a dialogue about their diversity. It is worth emphasizing that it is important to maintain a mixture of sending and receiving employees to avoid dominance of the overly represented site and protectiveness of the other site. The benefit of attending this course has been acknowledged and it is further suggested to be a mandatory practice not only for managers, but also for the entire transfer team.

Recommendation: Early cultural awareness training

Solution: Interviewees indicated that it is easy to blame cultural difference. Nonetheless, in order to be efficient, a process should be adjusted to the needs of the people involved in the project. This implies taking cultural backgrounds into account rather than trying to fit people in the existing process.

Recommendation: Adjust processes to people

4.2 Transferring the competence

One of the essential objectives of a transfer is to ensure the capability of the receiving site to run the development after the transfer is finished. This recognizes that the receiving resources are less experienced and in particular have less product knowledge than the sending resources.

A Project Manager from Sweden (Project B) argued that knowledge resides in the developers' heads and generations of experience are cut with a transfer.

It is important to transfer implicit knowledge and product related history between the sites. Observations indicate that a list of factors determine how successful the competence transfer will be. The main factors are related to people experience and expertise, product documentation, training approaches and availability of resources for the after-support.

4.2.1 Dealing with implicit knowledge

As already mentioned, expertise plays the key role. However, previous experience with the product is even more important. This is not only related to technical knowledge, but also the history of the product itself that is often implicit. Several interviewees indicated that it is impossible to support a product without a complete documentation of decisions made during the

[1] This is also in line with Geert Hofstede's research on cultural diversity. According to Geert Hofstede™ Cultural Dimensions India has one of the highest Power Distance ranking – 77, while Swedish score is below 30. For comparison, world's average Power Distance Index is equal to 56.5.

product development. The decisions may relate to a certain architectural decision, for example. Such decisions may not even be logical or obvious, but due to certain reasons have been selected as being most effective way forward for the product at a specific point in time.

Ways of working is another example of implicit knowledge that is difficult to transfer.

A Tech Lead from Sweden (Project A) emphasized that it's hard to transfer experience, when it comes to explaining how one reacts in different situations, and what decisions are taken and sometimes also why certain solutions were chosen.

Related study also indicates that complexity of development for the new site increases due to the lack of involvement in the design and implementation of the functionality it maintains [6].

Solution: One of the solutions recognized as a best practice at Ericsson for overcoming the consequences of cutting the product history with the transfer prescribes transferring people with the product. Employees from the sending site are encouraged to move to the receiving site at least for a year or two. The positive effect of this practice has been noticed in other product transfers and was specifically addressed when the studied transfer projects were planned. In fact, in spite of pessimistic expectations from the transfer project management, six employees from Project A were ready to follow the product to India.

Recommendation: Transfer people with the product

4.2.2 Effective training approaches

Transferring people with the product, however, is not a long-term solution. The sending site shall find a good way to transfer the core competence and train the receiving site in handling product development. This nonetheless is not always a straightforward task.

Solution: First of all, the preparations shall start with planning the scope of a transfer, associated roles and responsibilities. Interviewees, especially from Project B, indicated that the preparations are important to avoid wasting the time allocated for the training.

Recommendation: Plan the scope of a transfer, roles and responsibilities

A Tech Lead from Sweden (Project B) complained about the misleading assumptions about one's competence if based just on a response to a question: "Do you know this?"

The observations indicate that some training approaches that are useful in Sweden did not work in India.

A Project Manager from Sweden (Project B) stated that he senses an attitude that training might solve all problems, which from his perspective is false. He suggests that only through working in a team, and facing a real problem one can make the best progress.

Solution: Interviewees from the studied case emphasized that knowledge needs to be transferred from person to person. Although it has been noted that global teams rarely meet due to high traveling costs, Ericsson best practices prescribe on-site co-located training for weeks or even months (up to half a year) to ensure efficient competence transfer.

But co-location as such is also not a long-term solution. The interviewees emphasized that it is easy to waste the time spent in the receiving site if not well planned in advance. Approaches, events and knowledge objects to be transferred shall be specified to increase efficiency. The experience also shows that competence transfer through documentation and theoretical training even in co-location is inefficient. Different training approaches have been tried out, but both sites recognized hands-on practical training as the most effective solution.

A Tech Lead from Sweden (Project A) *indicated that engaging the receivers in the daily work is the only way to learn how to bring the quality into the product and continue to maintain the quality after the transfer.*

Recommendation: Plan co-located hands-on training

4.2.3 Limiting the scope

Interviewees argue that transfers are never complete. It is impossible to transfer 100% of the knowledge about the product, or go through a complete training that covers every single situation. The interviewees note that some particular problems may take several years to experience and no training program can cover all possible situations.

Solution: Because of these challenges and tight transfer project schedules, it is suggested to focus on a

core team, core roles, and core documentation. While this may seem obvious, the observations stress the need for a proper plan. Otherwise there is a clear risk that it may not happen due to other commitments.

Recommendation: Focus on key roles/items

4.2.4 A helping hand

When the cut-off date comes, the receiving site finally receives the responsibility and their capabilities will be tested in real-life circumstances. The case studies indicate that there will be confusion and maybe even panic. This is natural. A key question is whether this process will affect the product and existing customers. Interviewees' reflections on the previous transfers suggest that when the transfer project comes to an end, the sending resources are often moved to other projects and can rarely support the receiving site.

A Tech Lead from India (Project B) said that the cut-off moment in a transfer could be compared with receiving a driving license. He emphasized that driving with an instructor and driving alone is different. And although one cannot have an instructor forever, after transfer support and ability to ask questions is crucial.

Solution: Lessons learned in previous transfer cases suggested to organize a trial period while still having the sending site available for coaching and support. In this way, the responsibility was handed over before the sending resources were released.

Recommendation: Trial before the cut-off

Solution: The interviewees noted that the main emphasis during this time should be put on coaching rather than helping by doing. Although it is easier and faster to do things yourself it will not increase the abilities or decrease the insecurities of the new product developers.

Recommendation: Support through coaching

4.2.5 Motivation

It is worth mentioning that the sending resources play a vital role in transferring the knowledge. Since transfers are often associated with fear and uncertainty about employees' futures, it has been noted that this might lead to a lack of interpersonal trust between people at onsite and offsite [17].

An engineer from India (Project B) recognized that the sending site representatives are emotionally associated with the product. He suggests that the management shall clarify the reasons behind a transfer and emphasize the benefits for the sending organization. This is necessary because people involved in a transfer shall have a clear mind to be able to transfer the knowledge.

Solution: In the cases studied the transfers were initiated to free-up resources. In Project A the new assignments for the sending resources were announced together with the transfer decision. This ensured the motivation of those involved in the knowledge transfer.

Recommendation: Motivate people who transfer the knowledge

The motivation on the other side is also important. With no desire to receive a product the sending organization is left with no other means as to push the knowledge, which is a troublesome approach.

A Development Manager from Sweden (Project B) emphasized that it is no fun to receive e.g. mature projects with no new development.

Solution: The case observations suggest that the employees from the receiving site are more enthusiastic about the challenging work, which in its turn ensures their proactive engagement in the transfer and reduces attrition at the end.

Recommendation: Motivate people who receive the work

4.2.6 Documentation

Although it is impossible to document all the necessary instructions on handling product development, documentation does matter.

Solution: Good documentation ensures easier maintainability and relieves the pressure from the sending site after the transfer is finished. Transfer project managers in Project A decided to compensate the gaps in documentation, which led to hiring a full time consultant for nine months.

Recommendation: Ensure product documentation

4.3 Handling remote work

While the transfer is not finalized, there is a phase when the receiving and the sending sites work together. The interviewees from both projects mentioned that in some cases remote access can be required even after the transfer is completed. This is said to be challenging due to communication lines and tools support.

A Tech lead from India (Project B) described that when the Indian site was working on a distance using the Swedish hardware, poor communication lines made it inefficient. However, when they introduced two different development platforms, they faced a challenge of integrating things developed in parallel.

Solution: Although the interviewee admitted that there is no optimal solution in the present time, he suggested that a common development center is the right way forward. This is planned to be developed in the future.

Recommendation: Invest in efficient remote access and tools to support multi-site work

Another challenge introduced by the distance is effectiveness of communication.

A Tech lead from India (Project B) emphasized that things can be solved easily when people reside in the same building. Distance, on the other hand, causes significant challenges, because speaking on the phone is problematic due to language issues and accents, and instant messaging might be problematic due to delayed responses while people are busy.

Solution: Although constant co-location is not possible, transfers and remote work both require regular travel to resolve the accumulated issues, which can be only solved face-to-face. Another interesting factor that was emphasized by several employees from India in both transfer projects relates to the importance of interpersonal skills for effective communication.

Recommendation: Organize regular visits

4.4 Finding the right people

Ability to find the right people with the right competence when building the receiving site is crucial. While finding resources in general for the receiving site may seem a relatively easy task, in particular considering the assumed opportunities offered by the Indian human resource market, the studied cases suggest that recruitment of resources for specific roles with specific competence at a specific point in time may be difficult. In particular, one of the main challenges is related to finding the domain expertise.

According to a Tech Lead from India (Project A), resources are the number one challenge. He stressed that finding a 1:1 mapping to replace the resources from the sending site with those at the receiving site is challenging because recruitment in India is tough nowadays.

Despite all the "head-hunting" activities from human resource management, the Project A manager was unable to recruit some key personnel with the right competence for some of the leading positions.

However, recruitment on the receiving site is not the only concern. Several interviewees emphasized the necessity of appointing experienced transfer managers who are able to foresee and skillfully address all possible challenges associated with transferring software work.

Solution: The recruitment process shall start early, i.e. before starting the actual transfer. If available, people with previous experience in software transfers shall be involved.

Recommendation: Early and smart recruitment

Solution: In case recruitment becomes a challenge, organizations may turn to an alternative solution. Instead of struggling with the recruitment process, in Project A the manager changed the strategy to promoting existing employees into the core team and recruiting new employees for positions related to development and testing. The downside of this approach relates to delayed competence transfer and additional training required as a consequence of promoting existing employees. On the other hand, Ericsson succeeded to reduce the turnover of their employees in India from 11% in 2008 to 4% in 2009 by engaging them in more challenging roles over time.

Recommendation: Promote people within the organization

4.5 Maintaining on-going development

Due to the market pressure a software product driven company nowadays cannot allow any product to be out of business for a longer time. This is why the transfers are required to be balanced with the on-going development. The employees from the sending site in both transfer projects reported that it is challenging to get the everyday job done while coaching and training. The receiving site representatives, on the other hand, confirmed that their peers in Sweden who are involved in everyday work and training at times are busy and cannot respond whenever needed.

A Development Manager from Sweden (Project A) stressed that running active development at the same time with the transfer is a challenge. He explained that a large number of customers demand their needs to be addressed immediately. Therefore, having continuous capacity and preventing the negative effect of a transfer becomes a must and the main focus of the management.

Solution: Several interviewees noted that a transfer takes time and it shall not be underestimated. This was especially urgent for Project B, which was less prepared for a transfer than Project A, where the receiving site was trained in all types of work under transfer.

Recommendation: Don't underestimate the time required for a transfer

It is worth emphasizing that many other employees mentioned that the demand of high-level management to have no impact during and after a transfer is not really realistic.

During additional discussions a Product Manager from Sweden (Project A and B) mentioned that, despite the good will and management requirements, everybody knows that transfers come with certain consequences.

Solution: The observations together with experience reported from other product transfers suggest that transfers definitely impact the on-going development activities. The same people cannot continue developing the product with the same capacity while coaching and training the receiving site. To alleviate the transfers, Product Managers suggest reducing the amount of requirements in the product releases that are developed in parallel with the transfer.

Recommendation: Balance on-going development with the transfer

Solution: Additionally, the employees at the receiving site advise that things shall not be pushed or rushed. A transfer requires time and it is better to approach transfers step-by-step, not overnight. For example, in the case projects the receiving site was gradually involved into product customization and maintenance tasks before the actual transfer of the product responsibility was performed. Although this means that the duration of a transfer project is longer, experience shows that the negative effect on the on-going development during and after the transfer can as a result be reduced.

Recommendation: Transfer activities step by step

5 Discussion

5.1 Organizing transfers

Both transfer projects studied were organized as separate projects that went through the same phases described above: pre-transfer phase, recruitment & training phase, trial phase and final – offsite operation phase. Case observations indicate that these phases are being organized for a reason. Despite the fact that in some engineering fields switching production from one location to another may be organized almost overnight, a transfer of intellectual work activities, such as software development, shall be organized step by step.

Transfer phases established at Ericsson can be illustrated by a different proportion of the employees between the sites and each of these aims at a smoother transition of responsibility from the sending site in the first phase to the receiving site in the final phase (see Fig. 2). Although several interviewees suggested that the duration of a transfer might differ dependent on a product and the maturity and readiness of the receiving organization, we believe that the phases remain universal.

The challenges described in the Section 4 indicate that an organization cannot expect the same productivity and throughput during and shortly after

the transfer. This is in line with the previous research conducted by Mockus and Weiss [6], in which the total time to reach full productivity required 18 months. Thus, a transfer of software development activities comes at a cost, and thus staff allocation to balance transfer activities and everyday work shall be considered and planned carefully in advance. This might require either reducing the number of requirements to be completed or allocating additional staff to support on-going development while experts are involved in coaching and training activities.

It is noteworthy that the same five challenges were identified in both transfer projects. Thus, it seems that the main challenges could be relevant across different transfers, although more studies are needed (preferably at other companies by other researchers) to corroborate the finding.

The recommendations from each project were to a large extend consistent although some recommendations were only mentioned in either Project A or Project B. This is only natural given that projects are different. It was decided to keep the superset of recommendations, since it is impossible to know which recommendations are most valid in a third project.

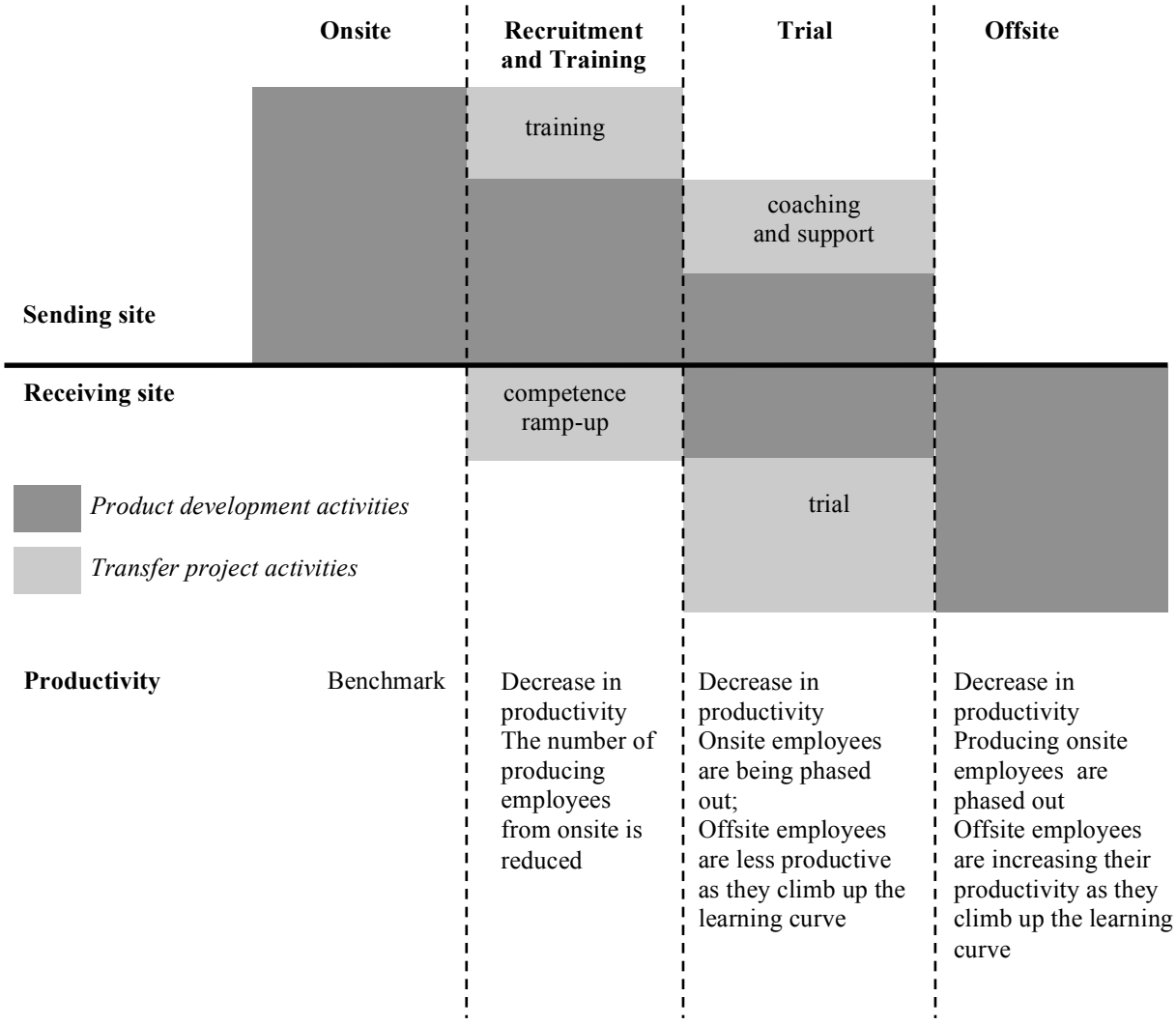

Fig. 2. Transfer activities and on-going development

5.2 Monitoring and measuring transfers

While analyzing success or failure of a transfer, the authors made an interesting observation: a transfer is a separate project that is not measured according to the same factors as the development project. The studied company measures the budget and schedule of a transfer project, and its effect on on-going development. The transfer project is finished when the

receiving site takes over the responsibility for the development. No further measures are collected in relation to the consequences of a transfer. This means that a transfer that finishes on-time and within-budget, and does not interfere with the on-going development is successful in spite of the further effect on the efficiency and quality of the actual continuation of product development. In addition, if Product Managers slow down the development during the transfer, it is difficult to capture the effect of the transfer with traditional measures since the amount of developed requirements is reduced.

The transfer projects reported here do not yet allow evaluating the further effect of the transfer on the product. Nonetheless, some of the interviews indicate that careful attention shall be paid on monitoring the life of the product after the transfer is finished. Looking at a transfer project, it is possible to observe that in the beginning there are certain risks that over time may turn into immediate effect (e.g. additional transfer costs for developing documentation and prolonging the experts as in case of Project A, and extra effort for training in Project B). When the transfer project is finished the next wave of consequences may appear. This is expected to have an effect on the product and after-transfer development (see Fig. 3).

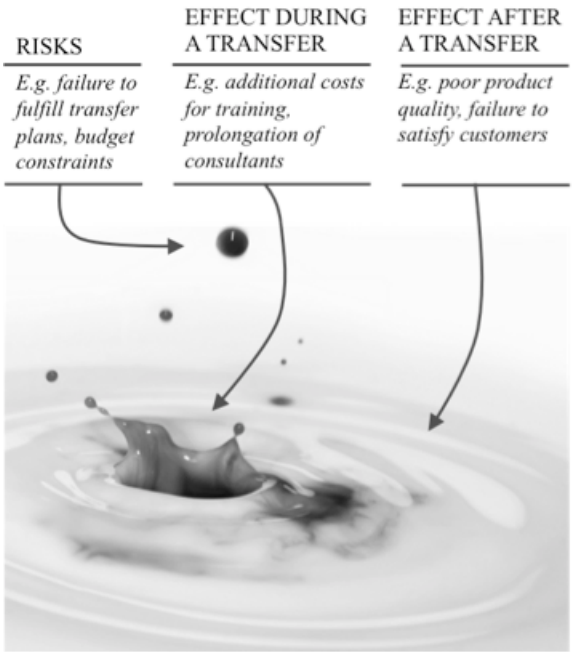

Fig. 3. Various effects of a transfer

The transfer projects studied succeeded in addressing many of the initial risks and hence they did not become a problem during the transfer. Observations illustrate activities that were taken and suggest that it is possible to accept certain risks, however, for a certain cost. An interesting observation can be made through a comparison of the studied projects. Although most of the challenges and recommendations were faced in both projects, the comparison suggests that certain steps were emphasized more in a certain situation. In particular, it can be observed that motivation related advice (the necessity of sufficient timeframe and a thorough plan) were stressed more in Project B. This is prompted by the pre-transfer situation and characteristics of the product component under transfer as such. First of all, employees from the sending site in Project B associated themselves with the product, which they have been working with for eight years prior to the transfer. Thus, they required additional motivation to stimulate their engagement. At the same time product maturity created an insufficient motivation at the receiving site. And finally the receiving site in Project B was less experienced with the product and required more training than initially expected. In contrast, an immature product, and thus challenging work was transferred in Project A. The sending site was involved in Project A for a short period of time only. Mockus and Weiss characterize the scope of such transfers as "undesirable to the primary site" [6].

These observations indicate that a thorough diagnosis of the situation shall be performed prior to the transfer in order to calibrate the duration of transfer activities for each transfer project.

Other effects will be possible to evaluate only after a certain amount of time of development at the receiving site. One of the main concerns in this respect is product quality.

A Tech Lead from Sweden (Project A) said that having experience allows improving the product. He argued that a product that is moved around would never get into a state where the product will continuously improve.

Such concerns are also observed by software maintenance researchers, who argue that behavior of new developers often leads to a higher product entropy, or complexity and unstructuredness [18]. Mockus and Weiss also emphasize the possibility of a decrease in quality and an increase in problem resolution intervals due to the lack of involvement in the design and implementation of the functionality to be maintained [6].

However, opinions about transfer consequences vary. A few interviewees from Sweden suggested that a transfer may have a positive effect on the product.

Software development, especially in case of a long product lifecycle, requires new people, new ideas, and different perspectives to ensure continuous improvement. Thus, a transfer may be beneficial for a product if the receiving site has the right incentives, competence and experience.

It is worth mentioning that the responsibility for measuring the status of a product after the transfer shall be discussed and assigned in advance since many stakeholders may leave the product after the transfer. In the studied projects the Transfer Manager and the Development Managers were assigned to other products when the transfers were completed, while Product Managers responsible for product evolution continued their involvement.

5.3 Selecting candidates for a transfer

A Project Manager from Sweden (Project B) is convinced that not transferring the products is not the solution to the challenges being faced. He emphasized that changes in some way can have a positive effect on the product, but it is important not to jeopardize the business. He suggested that transfers differ dependent on the product, as well as on the size and maturity of the receiving organization.

An important question is whether any product really is suitable for a transfer. The studied cases suggest that the answer is no. The majority of transfers are motivated by economical reasons. This means, that a transfer of a product shall be economically viable. Unfortunately, a transfer is a costly process itself. Both transfer projects described here led to additional costs for developing product documentation and educational material, re-training of the promoted employees, prolonging of the sending resources for a trial period and after-transfer support, and finally slowing down the development by decreasing the scope of deliveries in order to smoothen the consequences of the transfer. It is worth emphasizing that Project A was in a better position than Project B. The reasons for this are twofold. Firstly, the receiving site in Project A was already involved in all areas of the product at the time of the transfer. And secondly, the peculiarities of the development platform in case of Project B required a larger scope of training and coaching.

Similarly Mockus and Weiss report that significant training is required if the work involves knowing the fine points of legacy systems, and difficult maintenance problems that require the original site's expertise increase communication needs even after the transfer [6].

These are natural consequences of any transfer that shall be taken into consideration. The findings suggest that a product with a short remaining life cycle can therefore be economically unviable for a transfer.

A Product Manager (Project A and B) estimated that a full transfer (end of all questions to the sending site) takes five to six years, and therefore transfer decisions shall have intentions for at least a seven to eight years long period to allow reaching the economic benefits.

Besides these reasons, lessons learned from the two case studies suggest that some products are easier to transfer. Based on the experience from the on-going research collaboration with Ericsson, it has been concluded that the following items are important to consider, when deciding which product to transfer:

- Complexity and maturity of the product,
- Product documentation,
- Previous experience with the product and/or product domain on the receiving site.

A related study performed by Smite and Wohlin at Ericsson is reported in [19] and is based on several transfer projects from Sweden to India and China. The findings discuss people-related, product-related and process-related factors facilitating software transfers in more detail and contribute with a checklist of concerns for informative transfer decisions and implementation strategies.

6 Implications for research and practice

The reported findings are based on two case studies conducted in one company that transfers software work between a site in Sweden and a site in India. These recommendations have been also discussed with other managers who have been involved in similar transfers. They acknowledge the recommendations provided here as being important in successfully transferring software products between sites within a company. Thus, the given recommendations are expected to be valid more generally than for just the specific cases. The recommendations should be of value (at least as a starting point) for software companies involved in transferring work between geographically, temporally and culturally distant sites of the same company.

This study exemplifies the challenges that may be faced while transferring software work between two sites located in different countries, in different parts of the world with time differences and cultural differences. It serves as a building block towards an understanding of the nature of software product transfers and contributes with recommendations for overcoming the identified challenges.

The findings suggest that future research shall focus on providing a better support for offshore decisions, in

particular through quantitative evaluation and empirical evidence from different companies, locations and transfer strategies. Specifically, the authors encourage gathering and reporting evidence related to product evolution after transfers are completed.

Practical implications of this study suggest that, when a company considers transferring software work to another site, management shall pay deserved attention to selecting a product feasible for a transfer, planning the duration and approach of the transfer, balancing the transfer with on-going development activities, and ensuring after-support performance.

7 Conclusions

Transferring software work across geographically, temporally and culturally distant sites even within one company is not a straightforward task. Related research indicates that transfers are often associated with decreased productivity and lengthy recovery [6, 10-13]. Potential challenges discussed in this paper provide a deeper understanding of the reasons behind efficiency problems, highlighting cultural awareness, knowledge transfer, remote multisite connection, continuity of on-going development, and project staffing as the key ones. Although some of the given recommendations may seem obvious, Ericsson representatives indicate that these practices have emerged from experience with the previous transfers, and have been initially overlooked. Furthermore, it is practical to have the challenges and recommendation documented instead of rediscovering them in each transfer project.

Nonetheless, case observations suggest that if addressed, these challenges can be mitigated. The following recommendations that can be utilized for transfer project planning were found useful in Ericsson. For convenience for the readers the recommendations from Table 2 are arranged in the order of appearance within the corresponding transfer phase.

Before-transfer activities

- **Early and smart recruitment**. This means involving experienced transfer managers to handle the challenges and to recruit in advance. Searching for new employees with the right competence to fill the gaps during the transfer is too late and might endanger the deadlines and cause ineffective usage of time allocated for experience sharing.
- **Promote people within the organization.** This will help to exploit existing experience and prevent attrition.
- **Focus on key resources/items**. Transfers are never complete and it will not be feasible to teach everybody, or provide training for every possible task. Therefore, a core team and core tasks shall be selected and prioritized.
- **Plan the scope of a transfer, roles and responsibilities.** This is an essential step, which will help effectively address recruitment activities and plan the necessary training efforts.
- **Transfer activities step by step**. Similarly to iterative development, iterative transfer of work is recognized as more effective because it is easier to transfer clearly defined chunks with foreseeable schedules.
- **Balance on-going development with the transfer**. Training and coaching requires time and shall be prioritized. Thus, people involved in the transfer shall be provided with sufficient independence from the on-going development. Even if this means reducing the amount of development tasks.
- **Don't underestimate the time required for a transfer.** The challenges discussed here suggest that a software transfer takes time. If overlooked, these will require additional effort for e.g. recruitment and competence building.
- **Motivate people who transfer the knowledge**. Employees who are confused or threatened to loose their jobs will likely demonstrate non-cooperative behavior with their receiving counterpart. To avoid this, a clear vision of their future shall be communicated early for motivation.
- **Motivate people who receive the work.** In order to buy in engagement and interest from the receiving site, the work being transferred needs to be challenging.
- **Early cultural awareness training**. Culture has an impact on how people behave, learn, work, teach, etc. Therefore, selection of approaches shall be culturally informed.
- **Adjust processes to people.** Habitual and cultural peculiarities shall be taken into account when planning the transfer, in order to be efficient and prevent the hiccups.

Transfer activities

- **Organize co-located hands-on training**. Knowledge shall be transferred from person to person. Pair people and let them share experiences. Note that learning from documentation is recognized as ineffective; learning by doing strengthens the understanding of tasks through gaining practical experience.

- **Invest in efficient remote access and tools to support multi-site work.** Transition from one site to another prescribes a period of active cross-site cooperation, which might be ineffective or even impossible if the infrastructure is a handicap.
- **Organize regular visits.** Along with the on-site training of the sending resources at the sending site there will be issues requiring co-location to be resolved at the receiving.
- **Ensure product documentation**. Although it is not possible to document everything, core documentation will ensure continuity of previous development traditions and more independence of the new product team.
- **Trial before the cut-off.** This ensures the necessary experience for the new product team while being in a safety net of the sending resources.

After-transfer activities

- **Transfer people with the product**. Not all knowledge can be taught or documented. Keeping experts with the product alleviates contingency of the quality.
- **Support through coaching**. While experienced developers can resolve any problem within a short time on the behalf of the new product team, this will not support the learning.

Furthermore the findings suggest that a transfer does not end when the transition of product development is finished. A transfer can have immediate and long-term consequences. Therefore support and monitoring shall be continuously maintained to ensure efficiency and product quality.

The observations advocate that success of a transfer is also dependent on informed selection of the product for transfer. Therefore we suggest studying factors determining success or failure of software transfers. After analyzing several transfer projects at Ericsson from Sweden to India and China we have developed strategies facilitating such endeavors [19], which can be further explored in different contexts.

In summary in relation to the research questions, we have obtained the following:

RQ1: The same five challenges were identified in both projects included in the study.

RQ2: 18 recommendations were identified from the two projects. 11 of them are common for the two projects.

RQ3: We note that the five challenges are similar and the two projects have 11 recommendations in common. In addition, unique recommendations were obtained from each project, which is due to their unique characteristics. In particular, we draw attention to product-specific attributes, such as maturity, and site-specific attributes, such as prior experience.

As a future research direction we aim to quantify the costs associated with transferring software work from one location to another, to understand the feasibility of transferring software products. This will be done taking into account the lessons learned in this article. In particular, we aim at gathering evidence behind productivity decrease to ensure a fair comparison of value received for the money spent on salaries, and monitoring the long-term effect of a transfer.

Acknowledgements

We would like to thank Ericsson employees for their interest, active participation and support of this research. We also thank Sebastian Barney for valuable feedback and proofreading.

The research is funded by Ericsson Software Research and the Swedish Knowledge Foundation under the KK-Hög grant 2009/0249.

References

1. Conchuir E.O, H. Holmström, P.J. Ågerfalk and B. Fitzgerald, “Exploring the Assumed Benefits of Global Software Development”, In: Proceedings of the 1st International Conference on Global Software Engineering, IEEE Computer Society, 2006, pp.159-168
2. Smite D., C. Wohlin, R. Feldt, and T. Gorschek, “Empirical Evidence in Global Software Engineering: A Systematic Review”. In: the Journal of Empirical Software Engineering, 15(1), 2010, pp.91-118
3. Carmel, E. and R. Agarwal, “Tactical Approaches for Alleviating Distance in Global Software Development” In: IEEE Software, 18(2), 2001, pp.22-29
4. Šmite D. and C. Wohlin, “Software Product Transfers: Lessons Learned from a Case Study”, In: Proceedings of the 5th International Conference on Global Software Engineering, IEEE Computer Society, 2010, pp. 97-105
5. Lee, J.-N., M.Q. Huynth, R.C.-W. Kwok, and S-M. Pi, “IT Outsourcing Evolution – Past, Present, and Future”, In: Communications of the ACM, 46 (5), 2003, pp.84-89
6. Mockus A. and D.M. Weiss, “Globalization by Chunking: A Quantitative Approach”, In: IEEE Software 18(2), 2001, pp. 30-37
7. Herbsleb J.D., D.J. Paulish, and M. Bass, “Global software development at Siemens: Experience from nine project”, In Proceedings of the 27th International Conference on Software Engineering, 2005, pp. 524-533
8. Smite D., “Global software development projects in one of the biggest companies in Latvia: Is geographical

distribution a problem?", Journal of Software Process Improvement and Practice, 11 (1), 2006, pp. 61-76
9. Battin R.D., R. Crocker, J. Kreidler, and K. Subramanian, "Leveraging resources in global software development", In: IEEE Software, 18(2), 2001, pp. 70-77
10. Carmel E. and P. Tjia, "Offshoring Information Technology: Sourcing and Outsourcing to a Global Workforce". Cambridge University Press, NY, 2005
11. Kommeren, R., and P. Parviainen, "Philips experiences in global distributed software development", In: Empirical Software Engineering, 12 (6), 2007, pp.647-660
12. Boden A., B. Nett, and V. Wulf, "Coordination Practices in Distributed Software Development of Small Enterprises", In: Proceedings of the 2nd International Conference on Global Software Engineering, 2007, IEEE Computer Society, pp.235-246
13. Banerjee, A., and S.A. Williams, "Using offshore analytics to identify determinants of value-added outsourcing". In: Strategic Outsourcing: An International Journal, 2(1), 2009, pp. 68-79
14. Smite D., C. Wohlin, R. Feldt, and T. Gorschek, "Reporting Empirical Research in Global Software Engineering: a Classification Scheme", In: Proceedings of the 3rd International Conference on Global Software Engineering, 2008, pp. 173-181
15. Runeson, P. & Höst, M., "Guidelines for Conducting and Reporting Case Study Research in software engineering", In: the journal of Empirical Software Engineering, 14(2), 2008, pp.131-164
16. Strauss A, J. Corbin, "Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory", Sage Publications: Thousand Oaks, CA, 1998
17. Piri A., T. Niinimäki, and C. Lassenius, "Descriptive Analysis of Fear And Distrust in Early Phases of GSD Projects", In: Proceedings of the 4th International Conference on Global Software Engineering, 2009, pp. 105-114
18. Hanssen G., A. Fallas Yamashita, R. Conradi, and L. Moonen, "Software Entropy in Agile Product Evolution", In: Proceedings of the 43rd Hawaii International Conference on System Sciences, 2010, pp.1-10
19. Šmite, D. and C. Wohlin "Strategies Facilitating Software Product Transfers", accepted for publication in IEEE Software