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Virtual Software Teams: Overcoming the Obstacles

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Abstract

As a result of the sustained popularity of Global Software Development (GSD) many organisations are increasingly leveraging this strategy to establish virtual software teams. In this paper the results from research undertaken with two Irish based companies who both utilised a virtual software team strategy is presented. One company had partnered with an organisation located in the US to develop and maintain software. The other company was the Irish division of a US multi-national company who had partnered with a division in the Far East to undertake their software testing. We also describe particular cases of concern which both organisations experienced and discuss how they were addressed.

Following the research in both companies, and based on the results from both of these cases, the researchers developed a framework to support the management of virtual software teams. Given the importance of GSD to the software industry this experience should be of value to anyone interested in outsourcing and virtual team software development and maintenance.

Keywords

Global Software Development, GSD, Virtual Teams, Process Improvement, Process Re-engineering, Communication, Motivation, Culture, Outsourcing

1 Introduction

The software industry has been impacted by globalisation. The advent of the Internet, e-mail, Intranets, Extranets and improved and low cost international telecommunications has facilitated the development of virtual work groups and virtual companies [1]. These developments in communication have had a particular relevance to software development. The reality of software development today is that it is a globally sourced commodity [2]. This has led to the migration of software development and maintenance operations to geographically distributed locations. In some cases application development and maintenance is completely outsourced to remote third party organisations. In other situations multinational organisations have set up subsidiaries in low cost economies. Initially the trend was for software companies to outsource basic application and maintenance to third parties or subsidiaries based in Ireland and India. Currently the focus has shifted away from Ireland to Eastern Europe and the Far East. A large percentage of software outsourcing is currently centred in India.

Due to the level of complexity involved in software development, outsourcing is not a straightforward task. Some of the difficulties encountered include such issues as the problem of understanding requirements and the testing of systems [3]. These difficulties are compounded by cultural and language differences, lack of communication, distance from the customer, different process maturity levels, testing tools, standards, technical ability and experience. Organisations are embarking on a strategy of outsourcing to leverage the competitive advantage offered by globalisation due to labour arbitrage, which allows reduced costs; this facilitates competitive pricing which enables organisations to increase market share. The move to globalise software development has also been further facilitated by the availability, in large numbers, of well educated and technically competent software engineers in Ireland, Eastern Europe, India and the Far East [3]. Given the economic benefits offered by this, the current trend to globalise software development is set to continue. This fact is further illustrated by Indian software companies outsourcing projects to China, Vietnam, and the Philippines. The number of organisations globalising their software development continues to rise [2]. Ultimately this means that globally distributed software development will continue to have a significant impact on the software industry and world economy as a whole.

To globalise their software development process, many organisations are implementing virtual teams. So what is a virtual team? The virtual team is the core building block of the virtual organisation [4], [5], [6]. A traditional team is defined as a social group of individuals who are collocated and interdependent in their tasks. They undertake and coordinate their activities to achieve common goals and share responsibility for outcomes [7]. Virtual teams have the same goals and objectives as traditional teams, but operate across time, geographical location and organisational boundaries linked by communication technologies [8]. A virtual team may be formally defined as “A team whose members use the Intranet, Intranets, Extranets and other networks to communicate, coordinate and collaborate with each other on tasks and projects even though they may work in different geographical locations and for different organisations.” [1]. based

The virtual team is specifically categorised as differing from the traditional team in that it is distributed across geographical locations. Communication between team members is normally electronic and asynchronous with limited opportunities for synchronous contact, depending on time zones. The virtual team normally operate in a multicultural and multilingual environment, which may cross organisational boundaries [9]. The team may function on a permanent or temporary basis depending on the demands of the business environment in which it is operating. While it is recognised that organisations in many different sectors of the economy implement a virtual teams strategy the focus of this work is their operation in the software development environment. It is in this context and utilising the definition as outlined the term virtual team is utilised in this work.

2 Research Method

This research on which our work is based consisted of two stages. The first stage examined the establishment and operation of virtual software teams in an Irish based company who partnered with a US based organisation. The second stage focused on the testing environment in an Irish-based US multi-national company this company had distributed their testing to a Far Eastern organisation, which implemented a virtual team strategy that incorporated team members in both locations.

Onsite qualitative research was conducted, including document review, observation, interviews and questionnaire completion. The on-site aspect of the research allowed close observation of the teams and organisation in operation while being a non-participant in the day-to-day activities of the company. It also facilitated the development of a level of trust between the researchers and the staff and management of the organisation, which was reflected in the candid responses received to questions during interviews and the willingness to express opinions on what could be considered sensitive matters.

Based on an extensive literature review and the results generated from both studies key factors were identified which directly impact globally distributed software development and maintenance and have a specific relevance to virtual team operation. These variables have formed the basis for the development of a globally distributed software development framework. The objective of this framework is to outline the key variables and infrastructure which directly impact and facilitate successful GSD virtual team testing, thus providing the basis for the development of an effective strategy for establishing and managing virtual teams. The focus is on leveraging process, project management and infrastructure.

The case studies in this paper describe the issues observed during the research. Following presentation of the studies, we briefly present the framework as it has developed to date.

3 The First Case Study

The initial case study was undertaken with an Irish based company Software Future Technologies who had partnered with a large US financial organisation Stock Exchange Trading Inc. (both pseudonyms). The focus of this aspect of the research is the establishment and operation of virtual software teams in a global software development environment, which resulted from this partnership

Stock Exchange Trading Inc. had an on going requirement for the development and maintenance of bespoke financial software. Initially all development and maintenance activities were carried out in-house. As a result of continued expansion Stock Exchange Trading Inc. had an increasing demand for software development and maintenance, but their in-house IT strategy was becoming too expensive. The solution was to find an efficient alternative, which would leverage the experience of their existing IT department while maintaining the level of quality and support required at a cost effective price.

Initially a number of near shore outsourcing options were considered, but were rejected due to cost. Stock Exchange Trading Inc. had previously successfully outsourced their Y2K legacy code renovation to an Irish based company Software Future Technologies. The possibility of expanding this relationship was identified and explored. After extensive negotiations a four-year contract was agreed. The terms outlined that Stock Exchange Trading Inc. would partner with the Irish based Software Future Technologies and establish virtual teams to undertake the development and maintenance of all its software applications.

The rationale for adopting this approach included:

- Proven track record of co-operation between the organisations
- Availability in Ireland of highly educated and technically competent staff

- Low salary levels in Ireland compared to the US.

Furthermore development and maintenance time could be decreased, more extensive out of hours support provided and the use of hardware maximised by leveraging time zone differences.

The Irish based Software Future Technologies, while being owned by a US multinational operated as an independent profit centre and was wholly Irish managed. In GSD terms Ireland, while being geographically off shore, was considered near shore, because of language and cultural similarities to the US [2]. Given the continued success of the Y2K collaboration and the near shore status attributed to Ireland, the transition effort required for the establishment of virtual team software development and maintenance was under-estimated. In fact the management of both organisations considered it a straightforward task.

At the time the activities outlined in this paper were taking place neither organisation had knowledge of any research or published literature in the GSD field. The only experience Stock Exchange Trading Inc. had in this area was outsourcing their Y2K work. Software Future Technologies experience of being outsourced to was confined to the successful renovation of ten US based clients Y2K code. This experience, while relevant was limited and it proved inadequate for the development and effective operation of virtual teams. As a result both organisations had to embark on a steep learning curve, which required the re-evaluation and modification of how they both operated.

4 Establishing Virtual Teams

Initially a common sense approach was employed by both organisations based on their limited experience of outsourcing. A team structure was agreed and four separate cross-site teams were established. Each team consisted of twenty cross-site members; tasks were shared among team members regardless of location. The teams normally operated as separate units and each took responsibility for different development and maintenance projects. It was decided that a US based team leader and project manager would manage each team.

The need for an effective configuration management system was realised [10]. As a result one of the first activities undertaken was the identification and selection of an effective configuration management tool and a documented operating procedure was developed for its implementation.

Forty staff were selected from the existing IT personnel at each location based on their technical ability and levels of experience. Stock Exchange Trading Inc. had a well-defined and documented process and it was agreed that this would provide the basis for the virtual teams operation. Initially very little modification was made to the process to facilitate a virtual working environment. An Extranet [1] was established to facilitate remote access to process documentation. Conference calls and e-mail were selected as the main methods of communication. It was also agreed that direct telephone calls would take place with and between team members when required.

The Irish team members were accustomed to operating with a well-defined process and an initial task was to familiarize themselves with the US organisation's process and documentation. To this end a basic orientation course was developed and undertaken by the Irish team

members. The focus of this course was process centric and ignored such issues as cross-site cultural differences and possible communication problems. The US based team members were not offered any virtual team orientation or training.

Once basic orientation had taken place there was an unexpected demand, which required seventy percent of the Irish team members to spend six to twelve months working onsite in the US organisation. This was an unplanned emergency strategy and arose due to the need for Stock Exchange Trading Inc. to develop complicated bespoke software within a short time-frame following the winning of a large contract. When this arose the virtual teams were just being set up and the infrastructure for their operation was not yet in place. Moving as many Irish team members as possible to work on site with their US based team members on a temporary basis was the only solution in these circumstances.

This proved to be a good opportunity in a number of ways. It enabled seventy percent of the Irish team members first hand experience of following Stock Exchange Trading Inc. development and maintenance process. More importantly it allowed them to meet and develop working relationships with their US based Project Manager, Team Leader and fellow team members. This was initially successful and it provided a good base on which to build [10]. However it did not prevent the breakdown of those relationships when the full impact of GSD related factors were encountered.

Research has shown that it is difficult to integrate separate groups into one coherent team when they are remotely located [11]. The need for the development of trust in a GSD environment and particularly with virtual teams is paramount [12]. This is best achieved by face-to-face contact and interaction between as many team members as possible. The goal is the development of what has been described as “teamness” [10], which is defined as the ability of people to work together as a team. Effective team relationships are based on the development of trust and respect [13], which are very difficult to establish and maintain when team members and management are located on opposite sides of the Atlantic.

Given the near shore cultural status ascribed to Ireland [2] it was interesting to see just how differently both groups worked in a one to one development environment. There were clear cultural differences between the US and Irish team members. This was reflected in their behaviour, the way work was carried out and their attitude to authority and process. These differences became apparent to both groups and did not result in any problems being encountered while they were co-located. The experience was beneficial to a point as it allowed them develop a limited understanding and appreciation of each others culture and first hand experience of how the other group worked [14]. While both groups worked very effectively when they were co-located the experience postponed rather than prevented future problems.

5 Virtual Teams in Operation Lessons Learned

Once the urgent projects were complete the Irish team members returned home. Meanwhile the infrastructure had been put in place and the team members who remained in Ireland had successfully provided support to their Irish and US colleagues. Now the full virtual teams were established and work commenced. Initially everything seemed to be going well, but soon problems started to arise.

Research in the area has identified distance as being a major factor impacting GSD [14]. Distance introduces complexity which arises due to its impact on communication and co-ordination [15]. These factors are further compounded by culture [16], which all negatively impact on co-operation, motivation and trust [17]. Our experience would concur with these findings and within a short period of time their impact and effects were obvious. After what could be describe as a “honeymoon period“ where people in both locations endeavoured to work as single teams, working relationship started to break down. This directly impacted productivity and resulted in increased project time and costs. This threatened the partnership between Software Future Technologies and Stock Exchange Trading Inc. and urgent action had to be taken.

Following an extensive investigation it became clear people who worked together very successfully while co-located were now actively obstructing and blaming each other for all the problems that arose during projects. It was obvious that team members were now aligned by geographical location and there was a very clear “we verses they“ culture [13]. This was a totally unexpected outcome given the level of harmony achieved in the earlier co-site projects. Questions had to be asked - how had this happened? how could it be addressed? how could it be stopped from reoccurring?

5.1 Communication Issues

The misuse of e-mail was identified as a major contributing factor to the conflict, alienation, mistrust and lack of co-operation between locations. While e-mail was used to communicate, it was also being used as a weapon to publicly attack fellow team members. The practice of copying senior management on minor problems, which were caused by team members at the other location, was widespread. Both groups were equally guilty of employing this tactic. This activity had the desired effect of highlighting the problem, but it alienated the individual it was directed toward. It also had a negative impact on fellow team members at that location, who saw it as an attack on the group as a whole. This situation was further compounded by management reacting to these e-mails and getting involved with minor issues that the relevant team leader should have addressed. It was noted that management in their response normally took the side of individuals where they were located. This further alienated and added to the mistrust felt by people at the other site. It was clear that the “we verses they“ culture [13] was not restricted to team members and was prevalent between some levels of management as well.

This issue had to be addressed and a documented e-mail procedure was the solution. Clear guidelines were agreed stating when, how and to whom problems should be highlighted. This procedure was clearly outlined to team members at both locations. All minor issues were to be raised directly with the team leader and only with those directly involved. If and when it was necessary it was the responsibility of the team leader to inform the relevant project manager of issues that could not be addressed within the team. If the project manager was unable to resolve the matter it was their responsibility to raise the issue with senior management at both locations who would formulate a joint response. Interestingly, following the change in procedure very few minor issues were raised with the project managers and none, had to go to senior management for resolution.

Having addressed the immediate manifestation of the problem it was important to determine why it had arisen. It was realised that a number of factors were involved. Distance and the

lack of the opportunity for informal communication played a part. A five-hour time zone difference between sites meant the opportunity for direct contact was limited to three hours a day. No informal method of communication was available. At the time instant messaging was not seen as a business tool.

Further communication problems were also identified between sites. Both locations spoke different dialects of English. The English spoken in Ireland is based on the British dialect, which is in a number of areas different to that used in North America. This is reflected in the difference of spelling and in the use and meaning of words. One of the more serious problems encountered was when code written by a US based team member was peer reviewed in Ireland. The Irish reviewer commented in response that everything was fine and all the “full stops” were in the correct positions. On receipt of this review an irate response was received which stated “my code does not full stop!!” It took numerous e-mails and a telephone call to explain that what in Irish/British English is called a “full stop” in the North American dialect is referred to as a “period”. This highlighted the need for training for both groups on their use of English. As a result it was also stressed that thought should be given to all methods of communication to insure clarity and limit ambiguity. Local accent was also identified as a problem in telephone and conference calls. The need for people to speak slowly and clearly was stressed. If someone was unsure of what had been said they were encouraged to ask to have the statement repeated. This approach proved very successful.

5.2 Cultural Issues

Surprisingly, given their previous experience of working together cultural differences came into play. While the Irish and US culture appeared similar [2], distance highlighted their dissimilarity. The Irish attitude to authority and respect required that it must be earned rather than imposed. This manifested itself in the Irish tendency toward frankness, to question procedures, use of humour and work ethic. These attitudes were construed by the US staff as confrontational. The US based team members belief in their technical superiority, their view that the Irish team members were working for them, not with them and their sole ownership of the process were seen as naïve and arrogant by the Irish staff. These conflicting perceptions added to the mistrust and alienation felt by both groups and needed to be addressed.

5.3 Process Reengineering

The process while effective for single site development and maintenance proved inadequate for a virtual team environment. It was seen, as being imposed and the sole property of the staff of Stock Exchange Trading Inc. Team members based in Software Future Technologies while having relevant suggestions for process improvement were not consulted and any suggestions they made were ignored. This added to the alienation being experienced by the Irish staff. To address the process issues, the need for establishing common goals, objectives and rewards were identified. The process had to be totally reengineered to incorporate these issues. A common vocabulary with clear definitions of artefacts, deliverables and milestones was jointly formulated. These were incorporated into the development of a shared and agreed process, which specifically addressed the needs of the virtual environment in which it operated. The input of staff at both locations was encouraged and valued.

5.4 Motivational issues

These measures helped to facilitate team co-operation, built trust and relationships. While these addressed some of the problems experienced they did not fully explain the underlying cause. How had teams that worked effectively when they were co-located, deteriorated into opposing groups? This question needed to be answered to ensure that similar problems did not arise again. After extensive interviews motivation was identified as a major contributing factor. While the majority of the teams were co-located in the US the American team members did not comprehend the full implications of the virtual team strategy. Once the virtual teams were established the full impact on their day-to-day work, promotion and future employment prospects became clear. Management reinforced these negative aspects by utilising the strategy to justify maintaining salaries at their current levels. They also stressed the additional cost of US based staff and the need for them to be value adding to justify the extra expense. The effect was unmotivated people who directed their hostility toward their fellow team members in Ireland who they saw as a threat to their careers. This manifested itself in a lack of co-operation, alienation and on occasions outright obstruction when the opportunity arose. This was met with a similar negative reaction from the Irish side, who felt that if this was how the Americans worked it would be more effective to move the whole operation to Ireland. These attitudes were identified as a major contributing factor to the problems experienced and were compounded by the other issues outlined in this paper.

Once it was realised, the only effective strategy available was to make it clear to staff at both locations, if utilising virtual teams was not an option the only feasible economic alternative was outsourcing the whole operation to the Far East. The options had to be made clear, work as a team regardless of location, or find new positions elsewhere. This was a drastic approach, but the seriousness of the situation warranted it and there was no alternative if the virtual team strategy was to continue. This, along with the other measures outlined, helped to establish a productive working relationship between sites and facilitated the completion of projects on time and within budget for the lifetime of the contract.

On completion, the four-year contract between Stock Exchange Trading Inc. and Software Future Technologies was not renewed. It was agreed by both parties that the virtual teams had operated successfully, but, in the renegotiations, cost proved to be the deciding factor. The Irish Punt to Dollar rate had substantially increased making Ireland a less attractive location. The availability of more cost effective operations in the Far East meant that Software Future Technologies could not compete on price and the contract was lost. It is interesting to note that Stock Exchange Trading Inc. has continued to successfully utilise the virtual team strategy with its new outsourcing partners. Software Future Technologies was unable to attract similar type business due to cost and after a period closed.

6 The Second Case Study

The second case study was undertaken in the Irish division of a US multinational organisation who were implementing a virtual team strategy, which incorporated team members located in both Ireland and the Far East carrying out system and integration testing. The results produced by this part of the research proved to be very similar to those, identified in the first case study. In all cases the problems identified were of a similar but more severe nature than in the first case study. The reason for this difference in severity was recognised as due to the

extent of the geographical, cultural and linguistic differences of the participants. It was also clear that once the key variables and infrastructure identified in both studies were recognised and successful measures taken to address them a substantial improvement in the operation of the virtual teams could be facilitated. The next task was to identify the best method to implement which would facilitate the achievement of this goal.

7 Framework

Following the two cases researched, specific areas identified for inclusion in the framework include the requirement for organisations to realistically evaluate the risks involved when undertaking a GSD virtual team strategy. They should also select and implement a process which specifically addresses the requirements of the organisation and a virtual team environment. The development of project plans which incorporate and address the advantages and disadvantages of virtual team testing are important. A key aspect of this is the need for the implementation of policies and procedures to facilitate the development and acceptance of common goals, objectives and rewards (proportional to location) across teams and sites. Another key issue is the identification and operation of communication tools, infrastructure and procedures, which facilitates effective team development, and operation, while recognising the importance of communication, culture and fear in a globally distributed environment. Other issues include the need to provide clear definitions of managers and all team members roles and responsibilities. Facilitation of effective knowledge transfer and offering training to meet the specific requirements of the virtual team-working environment will also contribute to successful implementation of a GSD virtual team strategy.

8 Conclusion

The development of this framework is a first-step in supporting organisations who, in this competitive global environment have started, and will continue, to outsource software functions to other countries. Further research includes the implementation and refinement of the framework through an action research project in a virtual software testing environment. We also need to investigate whether the framework can be used successfully to implement other distributed software processes. We will continue to research and publish our findings in these areas

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