

Project Management within Virtual Software Teams

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Abstract

When implementing software development in a global environment, a popular strategy is the establishment of virtual teams. The objective of this paper is to examine the effective project management of this type of team. In the virtual team environment problems arise due to the collaborative nature of software development and the impact distance introduces. Distance specifically impacts coordination, visibility, communication and cooperation within a virtual team. In these circumstances the project management of a virtual team must be carried out in a different manner to that of a team in a single-site location. Results from this research highlighted six specific project management related areas that need to be addressed to facilitate successful virtual team operation. Organizational structure, risk management, infrastructure, process, conflict management and team structure and organization. Additional related areas are the sustained support of senior management and the provision of effective infrastructure.

1. Introduction

Globally distributed software development is an expanding trend in the software industry today. This has been facilitated by the development of the Internet, e-mail and low cost international telecommunications infrastructure. It has also been made possible by the availability of well educated and technically competent software engineers in low cost economies in Eastern Europe, the Far East and India [27]. This has resulted in software development becoming a globally sourced commodity [12]. Utilising this approach organizations are embarking on offshoring or outsourcing software development to leverage the perceived advantages offered by globalisation due to labour arbitrage and the

implementation of ‘follow the sun’ development strategies.

As organizations have discovered, due to the level of complexity involved in software development offshoring to remote divisions or outsourcing to other organizations is not a simple or straightforward task [17], [5]. Difficulties encountered have resulted from such issues as understanding requirements, integration and the testing of systems [27]. The operation of these projects are further compounded by cultural and linguistic differences, lack of communication, distance from the customer, different process maturity levels, infrastructure, tools, standards, technical ability and experience. The management of global software development is a difficult and complex task [10]. This has resulted in the necessity for the implementation of a project management strategy which recognises that Global Software Development (GSD) is different to co-site software development and addresses its specific requirements

The authors, through their research undertaken in an Irish based multinational organization who offshored part of their testing operation to the Far East and implemented a virtual team strategy present their findings in this paper. They examine the effective management of global software development projects and specifically, the project management of virtual software teams.

2. The Virtual Software Team

Many organizations are implementing a virtual team strategy as the primary focus of their offshoring and outsourcing policy. In this context it is necessary to define what is meant by the term virtual team. The virtual team is the core building block of the virtual organization [16]. A co-site team is 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. Virtual teams should have the same goals and objectives as co-site teams, but they operate across time, geographical locations and organizational boundaries linked by communication technologies [19]. A virtual team has been 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 organizations.” [22].

The virtual team differs from the traditional co-site team in that it is distributed across geographical sites and usually time zones. Virtual teams normally operate in a multicultural and multilingual environment, which may cross-divisional or organizational boundaries. The focus of this work is the operation of virtual teams in the software development environment.

3. Software Project Management

Software project management has been defined in the following terms. “Software project management today is an art. The skillful integration of software technology, economics and human relations in the specific context of a software project is not an easy task.” [29]. In a globally distributed virtual team environment project management is a more difficult and complex task to undertake than it is in a co-site project.

To implement a successful virtual team strategy, all the factors that impact on the operation of co-site software projects come in to play and need to be addressed by the project manager. There is the need to be an arbitrator between diverse stakeholders. There is the requirement to manage the operation of the team effectively within the constraints of available resources, both financial and technological. This has to be achieved utilizing the available personnel and within their technical capabilities. The responsibility of the software project manager is to determine objectives. Furthermore, it is to define, create, evaluate and select alternatives to achieve those objectives and to control their implementation [7]. This is accomplished through planning, organizing, staffing, leading, controlling and coordinating the project [21].

The attributes that are characteristic of a good project manager are:

- The ability to be a strong motivator of staff

- Having a clear understanding of all aspects involved in the process
- Having an understanding of the relevant technologies
- The capability to be an effective political player in the organizational sphere

These are all essential skills for the effective management of co-site and virtual team projects. In addition to the requirements for the effective organization of co-site teams and projects, there are numerous factors which emanate directly from and impact on the operation of geographically distributed virtual teams and their related projects.

“The complex, usually uncertain, and highly interdependent nature of project tasks, together with geographical, temporal, structural and cultural gaps fundamental to distributed teams, make management of virtual projects a relatively complex undertaking” [24]. In these circumstances it is clear that the virtual team project manager needs to take responsibility for not only the normal co-site project management activities. They also need to take measures to address and leverage all the factors and issues which arise directly from operating in a geographically distributed and virtual team environment.

3.1 Project Management of Virtual Teams

Organizations are increasingly implementing globally distributed software development strategies, significantly impacting the software industry and the world economy as a whole. In doing this, many companies are establishing virtual software development teams. However, this is not a straightforward task. One difficulty is that project management must change from the traditional to the virtual for this strategy to be successfully implemented.

While distance in itself introduces barriers and complexity into the management of a globally distributed software development strategy, for the virtual team, other factors also come into play. Communication between virtual team members is normally electronic with limited opportunities for synchronous contact, depending on temporal difference. Coordination, visibility, communication and cooperation are all negatively impacted by distance. If these are not managed correctly, they can cause further barriers and complexity within a project (see Figure 1).

As with traditional teams, coordination includes realistic project planning and risk evaluation. However, for the virtual team, work must be partitioned between sites. Furthermore, there is a

requirement for the effective utilization of technology between locations. Procedures should be put in place to facilitate and monitor the level of cooperation between remote team members. These should also allow for the identification and addressing of problems when they arise.

To increase visibility within the virtual team, management must ensure that roles and responsibilities are clearly articulated, with each team member knowing what is required for a work product and also when each work product and artifact is due. This requires effective reporting schedules and structures keeping team members informed of progress. There is a requirement for continuous visibility into the team's activities and operation at all locations.

Virtual project management must ensure that communication difficulties do not become a barrier to effective virtual team operation. This requires having a common vocabulary for all aspects of the project and the use of effective communication tools which are understood and utilized by all team members. When teams are distributed culturally, communication protocols – language and temporal differences – between team members need to be clarified and understood. Effective policies and procedures to facilitate communication between sites should be put in place. Training in methods of effective communication should be provided to team members.

Cooperation within virtual teams, as with traditional teams, is important to team success. In the virtual team, there is little opportunity for one-to-one contact giving individuals little chance of getting to know each other at a social level. Project managers need to consider how team relationships can be developed and fostered, particularly where there may be fear of losing jobs to a low-cost location. The impact of cultural diversity on the operation of the project needs to be determined, monitored and addressed, possibly through training. Project managers also need to ensure that team members in all locations know who is the 'expert' that can be approached when difficulties are experienced within a task.

Thus, in the virtual team, the role of a project manager is no longer simply to manage, monitor and coordinate team activities and artifacts as it is in the single site environment. To be effective their management strategy must address the specific needs of the globally distributed nature of virtual team operation, monitoring, addressing and controlling the additional variables caused by the introduction of the virtual team strategy.

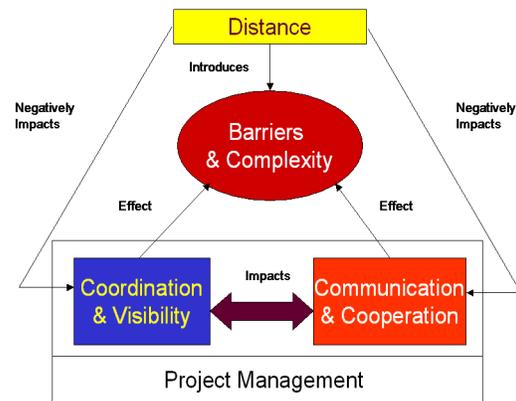


Figure 1. Virtual Software Team Environment

While we recognize and have studied other factors in setting up and operating virtual teams [25], [26] our focus here is to present six of the key issues our research has highlighted that need to be overcome through the implementation of an effective project management strategy which is specifically focused on the needs of the globally distributed virtual team environment.

The inherent difficulty of managing virtual software teams has been recognized. Carmel [5] paraphrased a software manager when he stated, “no one in their right mind would do this”. While that may well be true, the reality is virtual software teams have to be managed. Carmel goes on to identify coordination breakdown as one of his five centrifugal forces which negatively impacts on the effective operation of virtual teams. To address these five forces he has outlined six centripetal forces which can be utilized to counterbalance these issues. These, among others, include managerial techniques and team building. Our research would concur with these findings while also highlighting additional and related factors and issues.

4. Research Project

The research on which this paper is based focuses on the testing environment in an Irish-based US multinational company – this company had distributed their testing to a Malaysian organization, which implemented a virtual software team strategy that incorporated team members in both locations.

4.1 Case Study: Computing U.S.

The company where this research was undertaken is part of a large U.S. multinational, Computing US (a pseudonym). The parent organization has been

operating in Ireland for over twenty years. The Irish software operation has been successful and has expanded over that period. A large percentage of the work undertaken has been in cooperation with the U.S. parent. The success achieved has been attributed to the development of a common corporate culture between both locations and the near shore cultural and linguistic status ascribed to Ireland [12]. In the last two years corporate strategy has changed. The company has established virtual software teams between Ireland and Malaysia. The goal was to leverage the technical ability of the Irish staff with the competitive salary levels of the Malaysian engineers. The Malaysians were part of a CMM Level 5 division and Ireland was CMM Level 3. When the research presented in this paper was undertaken a number of virtual software teams were in operation within the Irish-based Computing US. Some had been established for over a year and a half while others were only operating for a number of months. Given that embarking on a virtual software team strategy with a Malaysian partner was a relatively new endeavour for the company and the complex issues involved had become evident. As a result they were keen to receive any support this research could provide.

5. Research Methodology

It was recognized that this research had to be carried out within specific constraints. Given the nature and impact of these constraints the goal was to ensure that the most effective use was made of the opportunities and resources which were available. In these circumstances it was considered of value to approach this topic with as open a mind and with as much information as possible. The research paradigm was selected based on the direct comparison of the quantitative and qualitative research approaches. As a result a Yin based embedded case study [1] was selected as the most appropriate research methodology to implement for this investigation. It was also determined that it should be combined with a Strauss and Corbin grounded theory based research strategy [2]. When this decision was taken it was realized both approaches had their strengths and weaknesses. The objective of implementing a joint strategy was to capitalize on those strengths, to this end both were studied in detail. Where differences were identified a common sense approach was adopted in selecting the most appropriate elements from each to implement.

The participant observational research approach was selected. Research questions were defined and formulated. On-site research included document review, observation, interviews and questionnaire completion. The on-site aspect of the research allowed

close observation of the teams and organization 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 organization, which was reflected in the candid responses received during interviews.

The data was generated from direct observation, document reviews, interviews and questionnaire analysis. At all times the literature and the previous experience of the researchers was acknowledged and used to sensitize their approach. As the data was generated, it was analyzed and based on the results it provided the direction and focus for further data gathering and analysis. A key aspect of this approach was that the results were grounded in and guided by the data and the objective was to give a clear voice to the respondents.

Using content analysis, data was summarized, displayed and analyzed and conclusions were drawn and verified. This involved the analysis of the data, the writing of memos and the identification of a large number of initial concepts. When the data-gathering saturation point was achieved the data and initial concepts were re-evaluated and broken down further and then where relevant combined. Based on this analysis and an additional review of the original data, fifty-two intermediate categories were identified. These incorporated and expanded on the initial concepts that had been defined. As a result of further analysis, four high level categories emerged from the data which incorporated the intermediate categories and initial concepts. In grounded theory terms this was achieved through microanalysis, open coding, axial coding, process analysis and selective coding.

Once these results began to emerge from the data they were triangulated with the literature and previous research undertaken in the area by the researchers. This all took place within the confines of the case study methodology. As a result of this approach we identified twenty-four key factors which have a specific relevance to virtual software team operation. Six of the most relevant factors are presented in Section 6, each one is illustrated with at least one example from the cases we studied.

6. Virtual Software Teams – Project Management

In Computing US, the export of the unmodified co-site project management process was not suitable for the successful operation of the virtual teams and thus proved less than optimal. The strategy put into practice clearly replicated the co-site approach, due to

the fact that the differences in the nature of virtual team operation and basic outsourcing / offshoring were not appreciated by the management at the Irish site. There is a clear requirement for management to understand and handle the level of complexity involved in outsourcing [11] and this is particularly relevant in a virtual team environment. As a result there were specific issues that needed to be addressed.

There was not only the requirement to plan, monitor and control cost, time, quality, normal risk and productivity on each project. There was also the need to plan, implement and monitor additional communication and coordination related activities within the teams. Effective policies and procedures to facilitate and monitor communication between sites were required. The need for the provision of training at both locations in methods of effective communication and the use of communication tools needed to be addressed.

In the light of the needs of the virtual software team, project management had to be reassessed - *"I would have a good process, which was well defined and followed with clear roles, well coordinated."* - the implication from this respondent was that these key elements were not in place. Policies and procedures needed to be drawn up for the establishment and operation of the virtual software teams that ensured visibility into their activities and operation at both locations, including roles and responsibilities.

The impact of cultural diversity on the operation of the projects needed to be determined monitored and addressed. A coherent team had to be developed from a culturally diverse and geographically dispersed group who were required to work as a single unit to achieve specific testing goals [3]. There was a need for procedures to be put in place to facilitate and monitor the level of cooperation between team members in both locations. Procedures were required to be developed to identify and address these problems when they arose. There was a clear need for the development of trust between team members. There was also the need for measures to address the palpable fear felt by many of the Irish based virtual team staff. This was a serious problem which needed to be acknowledged by senior management and specific measures taken to address it.

There was a requirement for policies and procedures to be drawn up for the establishment and operation of the virtual teams that ensured visibility into the activities and output of the respective team members at both locations. There was the need for the clear and unambiguous articulation of roles and responsibilities for all team members. A clearly defined common vocabulary for key milestones, procedures and processes needed to be produced and put in place which was clearly understood by team members at

both locations [3]. To be effective a successful virtual software team project management strategy should address monitor and control all these additional variables and areas.

6.1. Organizational Virtual Team Strategy

The success of any complex long-term organizational strategy is dependent on the level of sustained support provided by senior management for its implementation and operation [9]. To achieve effective support it is required that the success of such a strategy is directly linked to the attainment of organizational goals and objectives. With regard to the securing of the required support for a geographically distributed virtual team strategy it is important that the implementation of a particular approach will in fact allow the achievement of these organizational goals and objectives. The reason why and how this will be accomplished needs to be realistically defined and clearly articulated to senior management to gain their support.

Cost saving is often cited as a key factor for organizations embarking on such a strategy [28]. As stated by a respondent who had access to such information the real cost of a Malaysian engineer was half that of an Irish engineer. The reality was that this was not an effective figure on which to base a comparison. The Irish based team members had on average four or more years testing experience within the organization. As a result they had technical knowledge and experience of numerous aspects of testing which their Malaysian colleagues did not possess.

In these circumstances the Malaysian engineers may have cost half that of their experienced Irish colleagues, but the Irish engineers technical knowledge and extensive relevant experience which was reflected in their productivity levels needed to be factored into the equation to provide a realistic comparison in the short term. It is equally important to appreciate that the Irish based staff's productivity advantage was time limited. The productivity gap between staff at both locations would decrease as their Malaysian colleagues technical knowledge and experience increased. The implementation of an effective project management strategy would help to address this issue and speed the closure of the gap.

The wage and infrastructure costs are not the only elements involved in the implementation of a virtual team strategy. As this research highlighted there is the effect of factors such as fear and lack of motivation that such a strategy can have on the staff at the outsourcing location and the negative impact this can

have on their level of cooperation and productivity [25]. There is also the possibility of the loss of key personnel at the outsourcing location as a result of implementing this approach. These factors all need to be considered when calculating the true cost of implementing such a strategy.

6.2 Risk Management

While risk should be incorporated into all well planned software projects [8], risk is a key factor which needs to be addressed in the virtual team environment. One of the reasons articulated for the large number of failures of software projects in the nineteen nineties was directly attributed to the fact that managers were not taking measures to correctly assess and manage risks [13]. Globally distributed development projects carry additional high-risk exposure [4]. These include the risk of delay or failure due to linguistic, cultural difference, fear and motivational and temporal distance. These issues need to be recognized and addressed [14].

Our research highlighted the fact that the political risk of offshoring mission critical activities to remote locations was not considered by the management of Computing U.S. For example, the position of risk involved in the operation of a US multinational organization in a predominantly Muslim country (like Malaysia) needs to be recognized. The ethnic and religious make up of the Malaysian population and the possible implications it may have for future political stability [20] also required due consideration.

Another risk which our research highlighted was the risk involved in the strategy of having the Malaysian staff work long hours because they seemed to be prepared to do them. This was directly due to their cultural reluctance to say no when asked to do extra work. A large number of Malaysian staff left the organization as a result of being over worked. The outcome was the loss of a large number of experienced personnel which the organization had invested time, effort and money in training. Depending on the stage of the project when their departure took place this dictated the level of damage which such a strategy incurred. Having realized this the Resource Manager had forbidden such practices within the testing section. In other divisions of the organization in Malaysia, engineers continued to work long hours with similar results. As our research highlighted this can be a risky, costly and inefficient strategy.

The virtual team strategy also had a negative impact on many of the Irish-based staff – thus increasing the risk of losing key personnel with extensive knowledge and technical expertise from the organization. Staff

were demotivated and if the job market in Ireland had been better a number of key people would have left the organization. A point which they articulated to the researchers on numerous occasions.

In these circumstances a co-site risk strategy which addresses the elements of a normal software testing project was not adequate. As a consequence project management and risk management required additional effort and activities to achieve their objectives in a globally distributed environment [18].

6.3 Infrastructure

The availability and investment in key infrastructure to support a virtual team strategy is essential. This issue needs to be considered at an early stage during the selection of an outsourcing location. The availability of a dependable electrical supply and alternative power sources need to be addressed. Of equal importance is the availability of an adequate telecommunications infrastructure. This includes dependable Internet connection, infrastructure and bandwidth. Our research observed problems associated with an inadequate remote telecommunication system which impacted on routine communication and particularly had a negative impact on training and knowledge transfer.

Once basic and effective infrastructure has been put in place common tools for the locations involved should be sourced. This ensures the interoperability of cross-site operations and artifacts. An essential element of an effective virtual team operation is the selection and implementation of a configuration management system. The importance of effective configuration management in a globally distributed environment is appreciated [3], [5], [17]. Within Computing U.S. an effective documented configuration management system was in place for all the relevant documentation and artifacts. However, we observed that while respondents during our research were familiar with the concept of configuration management, they were not familiar with the term!

Provision was also made for the supply and use of the same type of testing tools at both locations. A relevant issue that arose in this area was that while some tools are supported by the manufacturers in North America and Europe they may not be covered when they are located elsewhere. In these circumstances it is important that when tools are being selected for use in the virtual team environment that the situation regarding the geographical areas covered by the warranty is clarified. When necessary, additional cover should be secured if available. Where

this is not possible alternative tools should be selected which have or can provide such cover.

Computing U.S. provided a broad range of communication tools such as telephone, e-mail, instant messenger, NetMeeting, conference calls, team Intranet websites and fax. While we note that the provision of communication tools does not guarantee their use, they are essential and with proper motivation, training and management their effective use can be the lifeblood of a successful virtual team strategy.

We noted that a communication tool which was not available was video conferencing. When asked about its use a respondent replied: *"If we had video conferencing I think that might help... It is quite difficult with a conference call... when you have five people in a room and you are struggling with the accents... it is difficult to recognize who is talking"*

It is relevant that the desire for video conferencing came from the respondents themselves. They clearly appreciated the difficulty of operating in an environment without the normal co-site visual contact with their remote colleagues. Given the advances in video technology over recent years its provision should be given due consideration.

6.4 Virtual Team Process

Once adequate infrastructure is in place the adoption of a common and effective virtual team process must be considered [5], [25]. While in some globally distributed environments this approach might not be appropriate, for example where collaboration is temporary and prompt results are urgently required [3]. That said it is a requirement for the implementation of virtual teams. In Computing U.S., a virtual team process was not implemented and the co-site process was *"exported from here (Ireland)"*. The justification for this approach was that the Irish co-site process was effective and was tied to the tools and artifacts. However, in the virtual team environment, there is a requirement for the process to be reassessed. *"Organizations must reassess existing processes for use in a distributed work environment"* [14]. This includes the need for more formal methods of collaboration and communication given the loss of informal communication methods [15]. This research has highlighted some problems associated with these issues which include:

- Projects not having a formal system or mechanism for identifying remote team member's skills, ability and experience.
- Team members not having a formal procedure or system for identifying subject matter experts.

- Team members not being informed of the status of remote colleagues progress.

There was the need for agreement on how the work was to be carried out [15] and the objective should have been the development of an effective shared and agreed modified process to achieve that goal. This should have been based on the requirements of both locations.

In the virtual team situation there is a clear need for a well defined jointly formulated and documented process to be put in place. In the case study the co-site process had simply been exported to Malaysia. Furthermore it had not been modified in any meaningful way to take the virtual team environment into account.

When asked if the remote staff had any input into the process or if negotiations regarding the process had taken place with them, a project manager answered: *"We exported the (Irish) process out to them and there was no negotiation, or need for negotiation"*. This attitude was reflected in the response from a senior member of the same team to a similar question:

It was clear that exclusive ownership of the process lay with the Irish team members. This approach did nothing to develop an effective cooperative virtual team environment. Sole ownership of a software development process by team members at a single location in a virtual team setting can lead directly to the alienation of team members at the other site [25]. As a direct result this can negatively impact on the whole area of virtual team cohesion and the long-term effectiveness of the virtual team strategy.

Good software practice recognizes that process ownership and development are best placed with those who are closest to the process [6]. This clearly was not the situation in this case. In these circumstances the remote team members could have perceived their input as not being valued or pertinent. As stated previously, the Malaysians were part of a CMM Level 5 division and Ireland was CMM Level 3. Regardless, input was not sought from the experienced Malaysian team members as to how the process could be improved.

To address the issue of process, there was the need for the establishment of common goals, objectives and rewards across both sites. Clearly this had not taken place. A key element in implementing this approach would have been the development of a sense of dual ownership of the process. The input of staff at both locations should have been sought, encouraged and valued. There was a need for the process to be totally reengineered to incorporate these issues to ensure that it would work effectively in the virtual team environment.

6.5 Conflict Management

The specific requirement for conflict management for effective software team operation and particularly in a virtual team setting is recognized [23]. When the respondents were asked about a procedure or method for conflict resolution with regard to their virtual team membership their responses can be summarized by the following reply: *“If you asked the question I would say people would probably say ‘I don’t know’.”*

In the co-site situation an informal procedure was in place where if an individual could not resolve an issue or/and there was serious conflict with another member of staff they contacted their Manager directly. This step was only undertaken in very serious situations. *“You might try sort it yourself... you would go to your manager as a last resort.”*

When discussing the matter with a project manager they outlined the conflict resolution mechanism that had been in place. *“In reality you have to gauge it by the people... In some cases I have had situations where the two people literally work it out themselves by just having a discussion about it. In other cases the right thing to do is just to keep the two people apart.”*

This strategy may have been effective in a co-site situation where staff have the opportunity for regular face-to-face contact and on that basis could work their problems out, but this is not the case with remote members within virtual teams. In this setting “there must be some mechanism for handling conflict resolution and someone who decides that resolution” [17].

It is also important to remember that there are different types of conflict. Some are open and easy to recognize. There is also another type of conflict which is not blatant, but is still there festering. This was particularly relevant to this research given the attitude of many of the Irish based team members toward their Malaysian colleagues. This was compounded by the Malaysians cultural aversion to conflict and their reluctance to express their opinions or even openly disagree with their Irish colleagues. When unreasonable requests or behavior was experienced their approach was to ignore it rather than confront it. This had particular relevance to the effectiveness of the informal procedure which was in place which the project manager went on to outline as follows: *“With reference to the remote sites an informal procedure exists. There is an escalation procedure, which is specific to the project... There is not a formal mechanism.”*

The reality was the procedure was not adequate. This along with the other factors outlined highlighted the requirement for the testing process to be evaluated

as a whole and in the light of the needs of both locations. The co-site process also needed to be modified to address the other specific issues that are relevant to a virtual team environment.

6.6 Team Structure And Organization

Another important aspect in the success of a virtual team project management strategy is the implementation of an effective team and organizational structure [17]. Establishing an organizational structure is the creation of roles, relationships and rules which can facilitate effective coordination and control. In the software industry the overall objective of the implementation of a co-site and virtual team structure is to facilitate the successful management, coordination, and operation of the teams to produce the required software artifacts. It is necessary in the virtual team environment that this structure is cognitive of and addresses the additional variables that need to be considered. The importance of documenting this structure and providing access to this information is an important step. The purpose of this exercise is to allow all staff to understand their and other people’s roles and responsibilities within the project [17].

In Computing U.S. a project manager stated about team size: *“We have a very small (Irish) team, but a big Malaysian team so the balance is actually very right”*. The balance of having a small number of Irish based team members and a larger number of Malaysians was what was considered the ideal objective by the organization. The project manager went on to outline the rationale for implementing such an approach: *“The strategy is to utilize and leverage the local experience and combine that with cheap and more efficient labor costs in Malaysia, that is what we are trying to do”*.

The ‘very right’ size of the teams researched equated to around eight team members based in Ireland and eighteen to twenty in Malaysia. Size is an important element in virtual team operation. Virtual teams are in general larger than co-site teams [5].

Overall team size can impact directly on the effective operation of a virtual team [30]. Equally the number of virtual team members located at one specific geographical location versus another can also negatively impact on team relations. This was highlighted in this research by the fear that was expressed by team members in Ireland at the large number of team members which were employed in Malaysia. This was perceived by some of them as the precursor to the loss of their jobs to the Far East.

An additional issue to emerge from this research was when a large number of inexperienced team

members were located in a remote time zone, this resulted in a limited opportunity for synchronous support from their more experienced colleagues. This was particularly relevant when those colleagues were tasked with providing essential training, knowledge transfer and support. When this is the case the size of the remote team can have a negative impact on the efficiency of the operation of the team as a whole. It also places a large strain on the team members at the outsourcing / offshoring location who are expected to provide support to a large number of inexperienced remote colleagues.

7. Establishing Virtual Software Teams

Our research highlighted issues as directly impacting the management of virtual software teams. In this paper we have discussed six of these issues which should be of concern to those setting up and operating virtual software teams.

The role of a project manager in the virtual software team situation is not simply to manage, monitor and coordinate team activities and artefacts as it is in the single site environment. To be effective a successful project management virtual software team strategy must address the specific needs of this dynamic environment. The process employed must also take account of the globally distributed nature of virtual software teams. In both cases the export of a single site process to the global environment was not successful prior to amendment.

8 Conclusion

As outlined project management in the globally distributed virtual team environment is a difficult endeavor. To be effectively carried out it needs not only to be cognitive of the additional and complex issues which have been highlighted. It is also required that specific measures are taken to address them. The sustained support of senior management is essential. This necessitates a change of emphasis and orientation in the implementation of the project management strategy. As a result it has to be virtual in its focus and methods of operation. To achieve this objective the first step is the recognition of what specific factors need to be addressed. There is the requirement to determine what they are, why they are relevant and where and how they impact.

It is important to stress that the responsibility for successful virtual team software project management is not the sole domain of one or more individual project managers. It is the responsibility of the management team as a whole, which includes senior management,

coordinators as well as the project managers. It requires a concerted effort from all those involved to address and indeed leverage the issues that directly impact on the operation of the virtual team to successfully manage and effectively deliver a virtual team based project.

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