Virtual Teams - Role of ICT in managing globally distributed Projects

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Abstract

Globally distributed teams if managed properly can add a lot of value to organizations. The notion of Information and communication technologies is deeply interwoven with the functioning of virtual teams, so much so that without it the concept of virtual teams collapses. It is observed that there is a direct co-relation between how effectively teams use ICT and how well they perform in the long run. In this report we take a look at some of the challenges faced by remote teams and types of risk inherent in remote IT projects. In the process we will answer the question: how ICT can be used to effectively to conduct and manage remote IT projects and mitigate risks that are inherent in large-scale IT projects?

Keywords

information and communications technologies; teamness; oneness; team cohesion; global project management;

distributed IT project team;Virtual Teams

BACKGROUND

Virtual teams are group of individuals who are geographically dispersed or temporally distributed in different locations, collaborating for the execution of a specific organizational task. Distributed or Virtual Team rely on IT infrastructure for communication, knowledge sharing and operation management. Effective use of ICT technologies can make all the difference between a successful project and failed ones. In this era, organizations face severe pressure to cut down IT budgets and the traditional model of building teams is no longer being followed. Remote teams can allow organizations to quickly gather skilled resources from around the globe and building cross-functional teams in a relatively faster period of time. Remote teams however, cannot function without the availability of quality IT infrastructure. Luckily with the advent of cloud technologies, costs for good quality communication tools and technologies have dropped drastically in the last 5 years of so. ICT technologies based on cloud platform can provide remote teams with cheap and high quality communication infrastructure. However to ensure effective teamwork amongst remote team members, it is necessary to address both people and technological issues.

INTRODUCTION

Outsourcing and globalization has led to an increase in the number of teams that are physically or globally distributed. In literature they are known as distributed or virtual teams where one or more team members might be present at various different physical locations globally. A virtual team is defined as "a group of geographically, organizationally and/or time dispersed workers brought together by information technologies to accomplish one or more organization tasks" (Powell et al. 2004, p. 7). Distributed teams if managed properly can

add a lot of value to the organization. Different time zones enable teams to work around the clock while culture diversity of the team members can bring unique ideas, fresh or alternate perspectives on different problems being solved by the team. Since the team members can be Geographical dispersed, organizations have more flexibility in terms of building teams that constitute of highly skilled members with expertise in or more domains. Overall even though globally distributed teams face a lot of challenges, they have the capability to provide organizations with great opportunities and benefits in terms of adding business value (Akemi et. al,2013).

However for project managers to successfully mange remote teams, they require that a certain level of trust and communication should exist in between the team members. Physical distribution of team can impede communication among team members and might hamper development of trust, which is needed to create a sense of "teamness"(Olga Stawnicza, 2015). Furthermore, IT projects inherently are complicated due to dynamic nature of project requirements. If a sense of "teamness" is absent from a distributed team, there exists a high risk of project failure. Information and communications technologies play a crucial role in communicating and developing trust within global project team(Olga Stawnicza, 2015). Project managers and distributed teams members rely highly on ICT technologies. An essential channel for communication is provided by technology and updating or improving the technology can ameliorate some issues.

Even with the availability of high quality communication tools, it has been observed that distributed teams face challenges in terms of building trust and establishing a solid line of communication channel amongst the team members. ICT technologies usually fail to foster a sense of bond amongst the team members. This is because team members located at different physical locations don't perceive themselves as part of the same team compared to members of a co-located project team(Olga Stawnicza, 2015). There has been very less research conducted on fostering team spirit or building a sense of "teamness".

Organization Reliance on ICT technologies gives rise to a set of questions such as what are the challenges faced by organizations and project managers when employing ICT technologies to manage distributed projects. The role ICT technologies can play in providing effective communication platform for the distributed team should be well under understood by Project Manager. Secondly, Project manager should be able to develop a strategy for mitigating risks inherent in distributed IT projects by leveraging ICT technologies effectively. Lastly, Project Managers should understand the usefulness and difficulties when using ICT technologies to create a sense a bond or a sense of oneness among the geographically dispersed project team members. In this report, we aim to answer the question: how can ICT be used to effectively manage remote IT projects and mitigate risks that are inherent in IT projects? We will talk about the problems faced by remote teams, risk involved in remote projects and how project managers can effectively use the available communication and collaboration technologies to ensure that remote projects get delivered on time and on budget.

RESEARCH OBJECTIVES AND DESIGN:

This report aims at examining the role of ICT technologies from a project manager's perspective. Specifically we look at how ICT technologies can help teams communicate effectively, establish trust amongst the members and create a sense of 'teamness' or 'oneness' amongst physically distributed team members. Existing literature on the topics has addressed issues such as culture and cross-cultural differences, conflict prevention and management of remote teams. But establishing communication, trust, and a sense of unity in dispersed project teams still remains an open problem. Hence the research related to these specific topics is still ongoing. In this report we only focus on ICT technologies and the role that they play in creating a line of communication, trust, and a sense of globally distributed IT projects.

RESEARCH METHODOLOGY

In this research we have addressed the central research question: Role of ICT in effectively managing remote projects. To answer this question, we conducted a thorough and systematic review of the existing literature on topic to identify the key challenges that organizations and managers face and potential solutions that can be employed by the organizations.

In this report, to conduct our review, our team focused on the literature published in prior years that range from 2004 to 2012. The key phrase "project management of virtual team" was used as the relevant primary keyword and "ICT technologies" as the secondary keyword was used in our search strategy. Second, we identified four

major academic databases we used them to search highly cited journal or conference articles relevant to our research question. The databases we focused on are SCOPUS, IEEE, Springer, and AIS. Through hit and trail searches, the team was able to formulate one strategy that worked the best. The following Search string containing relevant keywords was used in the search bar.

Project AND
(global* or distribut* or dispers* or virtual*) AND
(IT project OR software project) AND
(teamness OR oneness OR team cohesion OR teamwork OR performance OR commitment) AND
(ICT or Commination Technology).

Furthermore, citation count was used by team members to evaluate the popularity and usefulness of a certain publication. Overall, the following inclusion/exclusion criteria was used by the team to ensue that the papers selected are of the highest quality possible:

1) Paper has been published after 2005
2) Is a proper research papers published in a renowned scientific journal or conference proceedings
3) Contains theoretical (applying systematic literature review methods) or empirical studies
4) Were related to globally distributed project teams?
5) Were the studies conducted in an academic setting?
6) Was the study related to IT projects?

Using this search strategy criteria, we selected 60 journal articles and conference papers across the four major academic databases. Figure 1 shows a bar graph that depicts the overall trend in academic databases in publications related to virtual teams and ICT from 2005 to 2012. The bar graph shows the frequency distribution of these published VT studies for the four databases. Of the four databases we went through, Springer leads the number of publications, which is followed by SCOPUS (14), IEEE (17) and AIS (5). Overall it was found that interest in this topic has revived recently due to emergence of cloud computing technologies that can provide better communication and collaboration tools at lower costs.
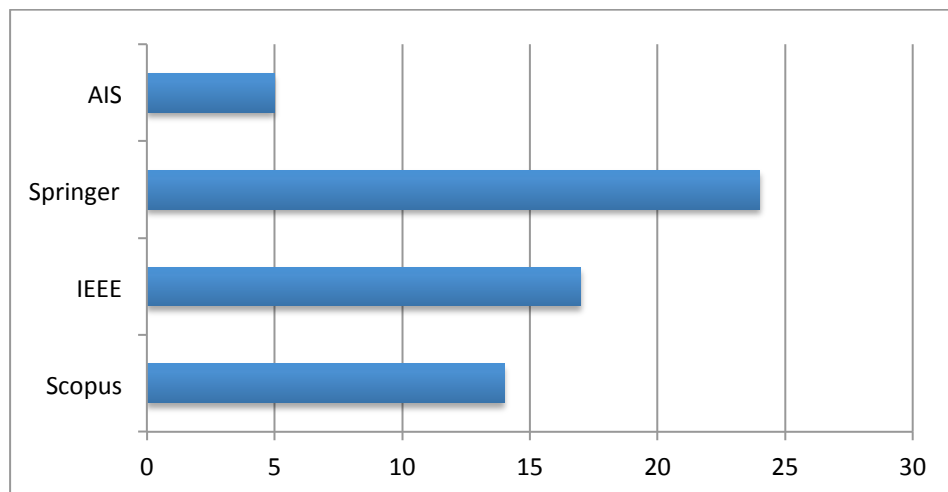

Figure 1: Trend of Studies published across major academic databases 200-2015

LITERATURE REVIEW:

In Table 1 represents the complete list of reviewed articles related to virtual teams. In the key Insights column we aim to provide review and provide insights related to our research question. i.e how ICT can be used to effectively to manage remote IT projects and mitigate risks that are inherent in IT project?

Table 1. Articles on the use of ICT in effectively managing remote projects

No.	Title	Authors	KEYWORDS	Review and Key Insights related to research question
1	Creating Value through Virtual Teams: A Current Literature Review	(Akemi et al, 2013)	Virtual teams, business value creation, organizational challenges, resource-based implications, literature review	- IT is valuable in creating business value in the organization but the extent and dimensions of IT roles are contingent on internal and external resources - People need special skills in leadership and technical tools usage to maximize the utilization of communication channels. - Business value creation through IT is still a myth for both traditional and VT
2	Distributed team cohesion – not an oxymoron. The impact of information and communications technologies on teamness in globally distributed IT projects	(Olga Stawnicza, 2015)		- Communication, trust, and teamness are identified as salient factors influencing team performance in globally distributed projects - The better team members communicate, the stronger the bonds between them are and the higher the trust level in the project team is. - After communication the next challenge teams face are fostering the feeling of oneness - Roles and responsibilities and experience level of distributed team members is often not clear - Organizations should encourage communication through social channels where they can share personal stuff. This will help build social bonds amongst team members. - Age group of team members can effect and decide how well certain members make use of available tools and technologies
3	Does virtual team composition matter? Trait and problem-solving configuration effects on team performance	(Turel, O, & Zhang, Y 2010)	virtual teams; online collaboration; team configuration; person-team fit; problem solving	- The setup of virtual groups, and the properties of people who are assigned to the group, are issues that project managers ought to consider before doling out people to self-guided virtual groups. - Combination of extrovert and introvert team members with in a virtual team may lead to conflict and coordination issues arise. - Not only team size but characteristics of team members are also important in diversified team and assessing the characteristics of team members is necessary before forming

				a virtual team
4	Enhancing Team Performance Through Tool Use: How Critical Technology-Related Issues Influence the Performance of Virtual Project Teams	(Weimann, P, Pollock, M, Scott, E, & Brown, I 2013)	Collaboration, Communication, Team Performance evaluation, project management, Virtual environments	- The start of a project is a crucial phase and selecting the right tools at this phase holds the key to avoid discontinuities in project work. - The degree of alignment between team's choice of tools and team members' individual needs and preferences affects team member satisfaction and team performance. - Trust plays an essential role in virtual teams, and tools like sharing knowledge and information and task awareness facilitated by tools help to develop trust. - The conditions which exert influence on selection and use of tools relate to Internet access and Availability, Tool Training, Usability Tool Integration, and Task Management.
5	Cross Cultural Management: geographically Distributed IT Projects.	(van Marrewijk, Alfons 2011)	INFORMATION technology, ETHNOCENTRISM INFORMATION technology projects	- Lack of cross-cultural collaboration of employees in globally distributed project teams is an important factor for failure of projects involving global sourcing. - Power issues, situational behaviour and hybridization for solving collaborative tensions led to emergence of new cultural practices adding more complexity to the IT projects -Collaborative cross-cultural learning needs to be better understood in its power context. -Managers need to be trained to acquire the desired knowledge on these social processes and cultural

				arrangements to successfully manage these global IT projects.
6	Information and Software Technology	(Suprika V. Shrivastava , Urvashi Rathod 2014)	Distributed Agile Development (DAD), Agile software development (ASD), Distributed Software Development (DSD), Risk factor classification, Leavitt's' model, Risk management ,agile development	- This research aims to create a set of identifiable and relatable set of risks effecting the performance of distributed agile development (DAD) projects and identify management methods for the same - In-depth interviews of thirteen practitioners and work documents of twenty-eight projects from thirteen different information technology (IT) organizations were analyzed using constant comparison method. - The result is identification of 45 risk factors associated with DAD. - These 45 risks are categorized into 5 core groups namely Spatial Distance, Temporal Distance, Language Barrier, Development/Work Culture, Large Project Scope. - Authors acknowledge that traditional methods of management does not cater to the complexity involved in DAD projects, thus requires a lot of further research to effectively develop effective tools to counter the risks.

7	Challenges and Improve ments in Distributed Soft ware Development: A Systematic Review	Jimenez Miguel, Piattini Marioand Vizcaino Aurora	Communities Practice, Agile development, Information Technology	- The main issue addressed by the authors in this paper is the coordination and communication in distributed software development (DSD), as it becomes increasingly difficult for sourcing the code from different places and different people.
				- authors have done a systematic review of the available literature to identify solutions and improvements for the issue
				- The existing literature is extracted with carefully formulated search strings, the identified literature is then categorized and carefully mapped for trends.
				- several success factors for DSD mentioned by authors are identified as follows
				  • *"Intervention of human resources by participating in surveys*
				  • *Carrying out improvements based on the needs of the company, taking into account the technologies and methodologies used. The tools employed at the present*

				must be adapted and integrated. • *Training of human resources in the tools and processes introduced.* • *Registration of activities with information on pending issues, errors and people in charge, and the provision of awareness of software development activities."* - This paper established as a stepping stone and a starting point from which further research can be pursued.
9	Team Knowledge and Coordination in Geographically Distributed Software Development	(Espinosa, j. alberto slaughter, sandra a. kraut, robert e. herbsleb, james d. 2007)	software development, international business, enterprises, business enterprises, globalization, information technology, management information & communication technologies, technological innovations, knowledge management	• Prior research establishes that team members coordinate through team knowledge. But, this has only been studied in real-time collocated tasks. • What kind of team knowledge best helps coordination is hardly known in geographically distributed teams • The investigation in this paper addresses the coordination needs of software teams, how team knowledge affects coordination and how this effect is influenced by geographic dispersion. • technical, temporal, and process needs are identified as the three types of coordination needs required by software development teams • Geographic distance while having a negative effect on coordination can be mitigated by shared knowledge of the team and presence awareness. • Shared task knowledge is more important for coordination among collocated members. Coordination in software teams of a large telecommunications firm are studied through individual and semi structural face to face interviews to identify these traits.
10.	Knowledge Transfer in Virtual Systems Development Teams: An Exploratory Study of Four Key Enablers	(Saonee Sarker; Suprateek Sarker; Darren B. Nicholson; Kshiti D. Joshi 2005)	Cross-cultural group work, knowledge management, knowledge transfer, systems development, virtual teams.	• Knowledge transfer is identified as the key enabler for successful coordination among geographically dispersed teams • The paper identifies four factors communication, capability, credibility and culture involved in successful transfer of knowledge based on existing literature. • It also tests these identified factors among a geographically dispersed team members to quantify the transfer.

				• Post testing the authors identify communication as the key factor that contributes more towards successful transfer of knowledge. A recommendation is made to encourage team members to communicate more to enable an effective knowledge transfer.
11.	Virtual team collaboration: building shared meaning, resolving breakdowns and creating translucence	Bjorn, Pernille1,2 pbjornra@sfu. capbr@ruc.dk Ngwenyama, Ojelanki 2009	multinational work teams teams in the workplace business communication industrial organization virtual reality shared virtual environments communication -- methodology organizational behaviour work environment.	• The paper aims to establish theoretical concepts and patterns based on empirical data to explain the social phenomenon of virtual team collaboration. • Multiple levels of communication breakdowns are identified along with the technological issues behind them and resolving mechanisms are proposed. • These multiple levels are categorized into lifeworld (language barriers, cultural differences), organization (regional policy differences, missing out on team activities due to geographical separation), work process (work practices, norms) and technology mediation (lack of collaborative applications, lack of shared workspace). Reassessment of mental models and work routines, reassessment of policy, procedures, technology and norms, reassessment and redesign of teamwork practices are some of the recommendations made to resolve the communication breakdowns.
12.	Enhancing Team Performance Through Tool Use: How Critical Technology-Related Issues Influence the Performance of Virtual Project Teams	Peter weimann, michael pollock, elsje scott, and irwin brown (2013)	Communication, internet, performance, project management, teams, tools, virtual teams.	-It is important to have a technical infrastructure available, which performs well in monitoring the team progress using technology. -Technology can help manage the tasks and to promote transparency in the work progress of the project; this enhances the visibility of virtual members of the team. -Establishment and maintenance of trust in virtual team with the use of essential communication technology.
13.	An Examination of Deception in Virtual Teams: Effects of Deception on Task Performance, Mutuality, and Trust	christie m. fuller, kent marett, and douglas p. twitchell (2012)	Collaborative work, deception, distributed decision making, virtual teams.	- Deceptive team member can have a direct impact on the team performance. -Perceptions of deception can be more accurate when receiver has baseline knowledge or a prior relationship with deceiver, which can be accessible in the virtual team environment.
14.	The Impact of Enterprise	Ayoung Suh,	Enterprise social	-Enterprise social media (ESM) can

	Social Media on Task Performance in Dispersed Teams	Gee-Woo Bock (2015)	media, Framework of Social Network, Team dispersion, Task performance	influence the individual's task performance in virtual teams. -Use of ESM significantly influences the content and structure of individual's social networks resulting in improved task performance. -Electronic connectivity allows the team members of the virtual team to overcome physical constraints (physical proximity).
15.	Building effective virtual teams: How to overcome the problems of trust and identity in virtual teams	Kimble, Chris (2011)	Virtual work teams, Management, Problem solving, Associations etc.	-Time and effort required to manage the communication in virtual team can be a challenge, even when members in the team are prepared to share knowledge and information with each other. -To ensure that virtual teams work effectively, both people issues and technology should be considered. By improving or updating technology some problems can be mitigated.
16.	Project duration and risk factors on virtual projects	april h. reed, linda v. knight (2013)	risk, virtual project, virtual teams, project duration, project risk, risk exposure, risk effect, project length, large projects,duration effect	-Three risks such as cost, scope and schedule risk along with integration of complex components, poor decision making and lack of skilled resources will affect the duration of virtual projects in the long run. -Project risk is a known challenge for information systems development projects which can create delays, failures and even project disasters.
17.	Evaluating risk factors in the operation of virtual teams in ICT projects	N. Rassias, K. Kirytopoulos (2014)	Risk, IT, ICT, virtual team, project	-Scope management is always an important aspect of ICT project management -In many cases Information and Communication Technology (ICT) projects are similar to other technical projects with the use of same tools and procedures -Thematic areas such as teamwork, cohesion, trust, communication, internal process and so on are mostly related to risk factors affecting the virtual team operation on ICT projects.
18.	the impact of knowledge coordination on virtual team performance over time	Prasert Kanawattanac hai, Youngjin Yoo (2007)	Virtual team, transactive memory, trust, repeated measures, temporality	-Task-oriented communications will positively influence cognition-based trust and expertise location in virtual teams. - Task-knowledge coordination positively influences team performance, mediating the impact of

			cognition-based trust and expertise location.
19.	IT Service and Support: What To Do With Geographically Distributed Teams?	Albert S. M. Tay (2010)	Geographically distributed teams, Intervention	Complexity in the structure of geographically dispersed team results in the heavy use of ICTs for communication and coordinating activities. The complex structure of the distributed organization require complex planning prior to team formation and organizational effort to maintain and ensure continual services of IT.
20.	Virtual teams: opportunities and challenges for e-leaders	Snellman Carita Lilian (2013)	Global teams, leadership, IT, virtual teams, e-leadership.	The rise and continuous development of information and communication technologies have created new mechanisms for coordinating work and also new collaborative organizational forms. Technologies provide virtual work arrangements such as teleworking, teleconferencing and video-conferencing which enable effective communication and information diffusion. However each of them can bring different level of communication richness.
21.	Spontaneous virtual teams: Improving Organizational performance through information and communication technology	Yu Tong, Xue Yang, Hock Hai Teo (2013)	Spontaneous virtual Team, Work performance, Team lifecycle, Team structure, Challenges and Solutions.	- IT related training, for example utilizing technology platforms is important to enhance employees effectiveness when it comes to using available technologies. - With the prevalence of information and communication technologies in work settings, team members must be trained to familiarize themselves with communicating to each other through virtual means
22.	Virtual teams: understanding the impact of fear', Software Process: Improvement & Practice	Casey, V, & Richardson (2008)	Fear, motivation trust, team, communication and knowledge transfer	- Sophisticated communication technologies can go in vain if the team is reluctant to share knowledge in a virtual team environment. - Fear of trusting a team member who was never met face to face has huge impact on success of virtual team. - Fear is inversely proportionate to motivation which has catastrophic effect on trust, cooperation, oneness and knowledge sharing. - To overcome fear, team members should interact on a regular basis.
23.	'Collaborative Process Management and Virtual Teams'	Donker, H, & Blumberg, M 2008	virtual team, Team connection, Oneness	- Companies that employ the distributed team model face enormous stress in organisational and management issues.

			- Communication gaps in virtual work can lead to difficulties such as the ability to accumulate data about the continuous work of all members - Creating a symbiotic relationship between project Management tools (like MPP) and collaborative software (like chats, mail) can help in virtual teams to communicate better.
24.	Perceived Risk and ICT used in Globally Distributed Software Development Teams	(Mary Beth Watson, 2011)	Distributed Teams ,ICT, Perceived Risk Software Development.	• Perceived communication problems encountered by globally distributed software development team (GDSDT) are examined with respect to the ICTs they use during different phases of a lifecycle of the software. • Two global teams were studied that are at different phase in a lifecycle. • The examined perceived risks are risk in reception, understanding and action. • The results of the examination establishes that the perceived risks in reception and action significantly differ between the two teams Also the effects of these perceived risks on ICTs are different between the two teams.
25.	Case study on risk management practice in large offshore-outsourced Agile software projects.	(Sundararajan, Srikrishnan, Bhasi, Marath2 Vijayaraghavan, Pramod K. 2014)	Risk management, information systems, agile software development, project management, performance evaluation, software engineering, information technology,	- Industry practices in risk management in a large offshore-outsourced Agile Scrum software development project are explored by author. - Agile Scrum software development project are projects with small and collocated teams from two distributed IT vendors with team members having a high level of knowledge and commitment. - It's also studied, how best to address these identified risks. • The research is based on a single case study in which there were 4 teams. Customer team, 2 teams belonging to one vendor and one more to a different vendor • A large, Agile scrum, offshored-outsourced software project was selected for the study • The risks were assessed and analysed through thorough interviews with the participating team members and managers • Multiple recommendations were made at the end of the analysis of the case study like having a

				detailed first phase in which a high level design must be prepared including requirement identification, overall system architecture, database design and system interfacing needs. Also it's recommended to undertake a proof of concept program to test the design.
26.	Team Dispersion, Information Technology, and Project Performance.	(Bardhan, Indranil1 Krishnan, Vish V.2 Lin, Shu 2013)	information technology moderation project management project performance team dispersion	- The role of Information Technologies (IT) as a mediator between team dispersion and project performance is the primary focus is empirically studied. - The findings of the empirical study are as follows: • Project performance is directly proportional to the Usage of IT and is inversely proportional to the team dispersion. • The negative influence of team dispersion on project performance can be moderated by IT usage. - The moderation effect is greater in high information volume projects compared with low information volume projects.
27.	Information and Communication Technologies – Creating Oneness in Globally Distributed IT Project Teams	(Stawnicza.20 14	Information and communication technologies; oneness; tameness; global project management; distributed project team	- Research done by authors aims to fill the gap in literature on the impact of Information and communication technologies (ICT) on the performance of globally distributed project teams and their unity. - It tries to increase the awareness of the practitioners' of the need for striving for being one despite the geographical separation. - The investigation is done by analysing the interviews recorded of project managers of Indian origin. - The paper concludes with a proposed further research involving diverse range of respondents for interviews mainly from Germany and Poland in addition to India to emphasize further on ICT impact of being one team despite the separation.
28.	Emerging Markets Managing Global IT Teams: Considering Cultural Dynamics	(Niederman & Tan, 2011).	teams in the workplace, globalization, communication information science	- Globally IT team dynamics varies according to the degree to which group membership is voluntary. - Groups will vary in using their preferred mode of communication as

			information technology , cross-cultural, cultural awareness	well as their understanding of messages within and across groups as well as cultures. -Global IT projects team manager needs to acquire and learn general distributed team management skills supplemented with cultural sensitivity.
29	The Impact of Emergent Web 2.0 on Virtual Teams	(O'Keefe, M, & Chen, ET. 2011)	Project Management, Social Networking, virtual team, Web 2.0	- Risks and trust can play a vital role on team performance - Team Performance is also impacted by employee satisfaction and their need for networking. - It is also impacted by how the members maintain and develop bonds within their network.
30.	Effect of a virtual project team environment on communication-related project risk	(Reed,A. H. & Knight,L,V. 2009)	Virtual teams, virtual projects, risk management, project management, communications, co-located teams, knowledge transfer, Implicit knowledge	- Insufficient communication has a significantly higher risk for projects involving virtual teams as compared to traditional co-located teams. - Technical communication issues hinder communications and have a greater risk in project involving virtual teams due to their increased dependency on electronic communication. - Insufficient knowledge transfer does pose a higher risk for projects involving virtual teams.
31.	Making knowledge work in virtual teams	(Thomas, DM, Bostrom, RP, & Gouge, M 2007)	ICT technologies virtual teams knowledge sharing	- Various communication technologies like email, fax exist in organisation for virtual team communication ICT can improve collaboration performance, but persuading colleagues to utilize them adequately remains a challenge. -On top of work and colleague instability and time constraint, the quality, quantity, various, and interoperability issues of ICTs being utilized particularly communication challenges for these virtual groups.
32.	Vital signs for virtual teams: an empirically developed trigger model for technology adaptation interventions	(Thomas, D, & Bostrom, R 2010)	Information and communication technology (ICT) inadequacy, ICT, trust and relationship.	- The five trigger model helps to better understand the relationship between the technologies structure strengths in adaptive structures as well the necessity for technology adaptation intervention. - The five trigger model provides a diagnostic tool for examining real, multi-trigger team technology adaptation contexts which facilitates not only better training and evaluation

				of leaders but also better research on team technology adaptation and interventions.
33	Virtual Teams: A Review of Current Literature and Directions for Future Research	(Anne Powell, Gabriele Piccoli & Blake Ives, 2004)	Virtual teams, IS teams, Distributed Collaborative Work, Computer Mediated Communication	- Paper reviews previously published research pertaining to the issues involved in virtual teams. - The review is focused around the input – process - output model. And is structured around the life cycle model, with the general categories being input, socio-emotional processes, task processes and output. - Multiple issues like design, culture, cohesion, trust, communication, coordination, performance and satisfaction across these four general categories are discussed.

The above table shows that information and communication technologies role is deeply interwoven with the functioning of virtual teams so much so that without it the concept of virtual teams collapses. As for the measure of its importance, it's found that how a well a team performs is directly proportional to the how effectively they leverage ICT technologies and is inversely proportional to the team dispersion. Furthermore, it was noted that the negative influence of geographic separation on project performance can be moderated by effective ICT usage. While the moderation effect is greater in high information volume projects compared with low information volume projects, ICT is an established critical factor in project success and for the existence of distributed teams. Frequent communication through ICT technologies should be encouraged. One of the way project manager can do that is by making a comprehensive ICT usage strategy prior to starting the project and accustoming team members to the communication process. By frequent communication, the feeling of unity is strengthened. Certain ICT tools like email can provide less communication richness and thus establishing social relationships become difficult. It was observed that establishing social relationships can become easier if there internal social software tools are available to the team members and can help team members establish a line of informal communication. The technologies selected for team communication should empower the team members to rapidly exchange key information. Project Managers must strive to encourage team members to use the available channels and should establish a communication protocol to ensure important information doesn't get lost. In the following sections we'll discuss these insights in more detail.

REMOTE TEAMS – PROBLEMS FACED:

From our literature review, it was observed that a lot of research has been done to identify and provide remedies to the issues in distributed teams, these issues range from communication to socio-economic issues. This report specifically focuses on identifying these issues from prior art and the respective remedies if any that are provided. It also focuses on the effective role of ICTs if any to resolve the same.

(Anne *et. al,* 2004*)* proposed a comprehensive model of issues that might arise in a distributed team setting, known as the input-process-output model. It identifies several issues and categorizes them into inputs, socio-emotional processes, task processes, and outputs. In the following sections we describe the model in detail and couple it with other research found during our literature review process.

The issues categorized in 'Inputs' are those that are required to begin the work by a distributed team, like the design and composition characteristics, resources, skills and abilities. The issues identified and categorized into Inputs are as follow.

     i.**Design**: the design of the virtual team is of paramount importance and impacts the overall performance of the team to a great extent. The design factors include planning various levels of face to face

interactions enabled through teleconferencing or in person to establish common language and knowledge transfer. Also, planning of activities and the use of communication media, and the articulation of goals, structures, norms and values. Designing of team interactions require setting of goals and strategies to enable a shared mental mode, this in turn helps in formulating media strategy, i.e., planning the communication setup for an effective knowledge transfer so that every team member is on the same page.

ii. **Cultural differences**: Differences in culture can affect the team member's behaviour and work practices giving rise to complications in communication and execution of work. However it has been observed that diversity challenges can be converted into opportunities to improve the team success and create organizational value (Lilian 2013, p. 1259). So even though Cultural differences makes coordination difficult, the negative effects due to these differences can be mitigated by trying to understand and accept the team members culture and its associated values.

iii. **Technical Expertise**: Lack of technical expertise in a team can lead to a project failure. Research indicates that virtual team members are affected more by the newness of the technology being used than by the newness of the team structure itself. The ability of the team members to adapt to new technologies greatly increases the trust between them resulting in better communication capability and performance in the long run.

iv. **Training**: Proper and continuous training of all the team members results in an increase in performance. While teams with diverse set of skills required to complete a project might experience conflicts in agreeing to the skill set to be used to complete the task resulting in commitment, satisfaction issues. Thus a uniform and consistent training among team members is essential for team member to be on the same page.

Relationship, trust and cohesion are identified as the fundamental processes that enable the successful functioning of a team. These are described as follows

i. **Relationship building:** Virtual teams are more task oriented and can lag behind in building personal relationships compared to the collocated teams, good relationships between the team members is considered to be one of the driving factors that motivates each team member to collectively work towards a goal more effectively (Anne *et. al 2004)*. The lack of relationships in a virtual team can adversely affect the performance due to the lack of motivation and mutual respect for each team member. To minimize the issues arising due to the lack of relationships team members should be encouraged to socially communicate and have face to face (F2F) interactions whenever possible. Prior research also suggests that the team members who exchange more social information tends to build more trust and better social and emotional relationships. Also, social interactions involving cultural commonalities between team members tends to improve relationship bonds. Research also suggests that effective leaders are those who stimulate relationship building by facilitating socialization among virtual team members by scheduling regular chat sessions or informal meetings with all team members(Rassias & Kirytopoulos 2014).

ii. **Trust**: Plays an important role in the virtual environment because of uncertainty and incomplete knowledge about the team members. Virtual team works on the time-limited task and it is necessary to develop high levels of cohesion building trust within the group. Globally distributed virtual teams are facilitated by electronic communication technology and it is expected that team members will work hard with good intentions and mutual trust. Activities like sharing knowledge and information in virtual environment helps to build trust within team members using support tools. Virtual teams that exhibit high trusting behaviours experience significant social communication resulting in better relationship building, predictable communication patterns, substantial feedback, positive leadership, enthusiasm, and the ability to cope with technical uncertainty resolving the technical expertise issue as well(Kimble 2011, p. 10).

iii. **Cohesion**: Majority of the research done in this area is comparative, thus the information available is just the results of comparisons between virtual teams. It shows that collocated teams enjoy an increased level of cohesion compared to the virtual teams, research also suggest that the virtual teams begin with a low level of cohesion and overtime with the increased exchange of social information develops high level of cohesion.

Task processes are those that enable the collaborative work environment, the major issues identified in Task processes are as follows.

i. **Communication:** is typically based on computer-mediated information and knowledge diffusion which allows team members for multiple themes of conversation. Communication breakdown causes project havoc where the team members of the virtual team struggle to communicate and work with one another (Rassias & Kirytopoulos 2014, p. 1194). Failure in communications also results in failure in knowledge transfer and results in reduced performance. The main causes of an abruption in communication is not only due to the failure in communication technologies but also due to the lack of mutual knowledge and lack of shared language. Problems related to misunderstandings, information diffusion and knowledge management are generated in virtual environment with the use technology mediated communication for coordination (Lilian 2013, p. 1258). Issues related to trust, team cohesion and conflict management are rooted in the communication behaviour and process of the virtual team (Weimann 2013, p. 336). More effort and time is required to manage the communication in distributed team even when team members are ready to exchange information and knowledge with each other (Kimble 2011, p. 10). Members of the virtual team are completely dependent on technology for communication and sharing of information as they lack in physical contact. Physical proximity is not an important element because electronic connectivity allows the team members to connect together in a network and to overcome the physical constraints (Suh & Bock 2015, p. 1911). Distributed group members are inspired and motivated through socializing activities for mutual, active and continuous communication. This enhances mutuality, togetherness and team cohesion leading to success and value creation for an organization (Lilian 2013, p. 1258). Within a single generation we have moved from one-to-one communication (telephone, telex) to different multiple modes of communication and this change is due to rapid expansion of digital networks (Kimble 2011, p. 14).

ii. **Coordination:** this represents efforts for unity between multiple organizational factors that enable its members to work in logically consistent manner and have coherent work activities. Research indicates that the significant difficulties that virtual teams face to coordinate are time zones, cultural divides and divergent mental models, latest research indicates that frequent F2F interactions improves the virtual teams coordination, in case of the unavailability of F2F interactions a well-planned coordination protocols and induced organizational training interventions proved to be effective. Majority of the research in this area is focused around replicating the coordination enjoyed by collocated teams through better interactions, while some of the research puts forward a radical idea to approach the coordination problem by reducing the amount of co-ordination needed in a virtual team during the design phase itself, this approach requires extensive planning and design that compartmentalizes the team during its inception with strict and well established communication protocols(Weimann 2013). This drastically reduces the need for coordination eliminating all the issues that comes with failure to coordinate between team members. But this radical approach is sought after by a minority of organizations while the majority of the research is done in the traditional way to increase the level of co-ordination. Prior research also establishes that coordination is done through team knowledge, but what kind of team knowledge is still to be established. Geographic distance while having a negative effect on coordination can be mitigated by shared knowledge of the team and presence awareness.

iii. **Task-Technology-Structure Fit:** as observed a significant of the issues are resolved with the increase in F2F interaction, it's important for virtual teams to evaluate the technology requirements that enable a successful functioning of the virtual team. While evaluating technology requirements research indicates that selective the best fit technology between various technologies available specific to the tasks they are called upon to execute. F2F meetings or phone calls are effective for ambiguous tasks, managing conflicts, managing external resources, brainstorming, and for setting strategic direction. While electronic communication like email is best suited for structured tasks like monitoring the project status, comparisons etc. Several web-based tools are available to support the processes of virtual teams that are communicating over the internet (Weimann 2013, p. 337). Members of the virtual team can post messages on online message board using web-based forum. Web-based document storage and sharing allows the team members to download and upload their project documents. The task list of the project can be maintained and managed by the virtual team with the use of web-based task tracking system. Similarly there are web-based project planning tools to allocate the resources and to support task, and web-based calendar to schedule the events and remind the group members about the tasks. Team members in the virtual team are linked by variety of information and communication technologies and the challenge of sharing important information lies at the core (Weimann 2013, p. 338). Technology helps manage the tasks and also to promote transparency in the work progress of the virtual team; this enhances the visibility of virtual members (Weimann 2013, p. 348). The complex structure of the distributed team results in the heavy use of information and communication technologies (ICTs) for

communication and coordinate activities and also complex group effort is required to maintain and continual of IT services (Tay 2010, p. 152).

Output category of issues specifically focuses on the performance of the virtual team, extensive research had already been done in this category with primary focus on design quality, number of ideas developed and the time taken for developing these ideas thus calculating the effectiveness. Performance and satisfaction are the two categories that focuses on the outcomes thus fall into this category.

i. **Performance**: it is the primary measure of the how well a team is doing in terms of achieving tasks and completing milestones. Majority of the issues discussed above either directly or indirectly effect the performance at the same time all the factors that mitigate the negative effects of all the mentioned issues also improves the performance.

ii. **Satisfaction**: satisfaction though seems like an individual trait, effects the team performance. majority of the research in this area compares collocated teams and virtual teams, majority of the research indicates that the satisfaction levels in a collocated team is high at the beginning, virtual team members satisfaction level rise over time and surpass the levels of a collocated team, surprisingly one research identified that women in a virtual team are more satisfied than men in a traditional team. The key factors that result in raised satisfaction levels in team members is identified as increased training and effective communication.

Establishing a Communication Framework

IT projects, including software development projects are usually more challenging when compared to other projects. The main reasons are higher level of uncertainty with the use of latest technology, low product visibility, constantly changing requirements and also higher risk involvement. Heavy use of technology and strong dependency of project team on technology can also lead to communication problems in distributed projects. It is recommended that companies should establish a communication framework for teams which includes the protocol and policies for communication amongst team members. This can help in on time knowledge transfer and largely mitigate risks associated with lack of communication. In the following sections we discuss some important aspects that should be considered which developing this framework.

Information overload

Project teams rely on various communication media such as telephone conferences, forums, phone calls, video calls, instant messenger and e-mail. E-mail is the official way of communication and historically has been the most extensively used media for communication between team members. Information overload results in information loss, for instance when a team member get hundreds of mails in a day, important information might get lost or might slip away. Furthermore, conversations in email might become chains which can go on and on it will be too big and also sometimes meaningless. Phone calls help to clear the issues when e-mails are creating the problems because of information overload and loss in information. Some companies follow no e-mail culture within their organization unless it is necessarily required for communication (Olga Stawnicza, 2015).

Information overload also has impact on decision making where the team members might not get the immediate response to be able to make timely decision. E-mails, discussion forums, shared documents, web logs etc. are asynchronous tools and it is a difficult task to solve the urgent issues or problems. Delayed response is an obstacle to development and is crucial in particular situations leading to project failure.
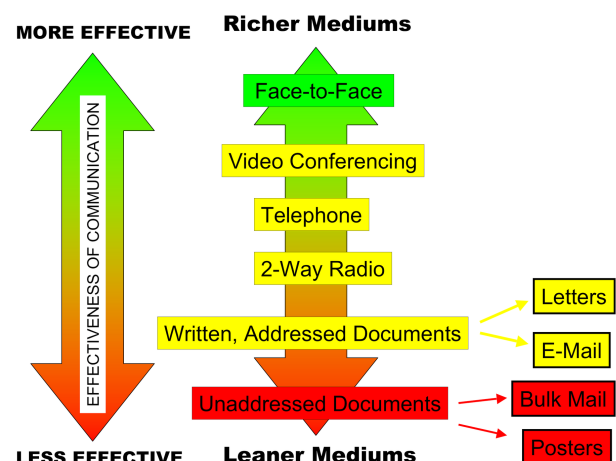
Figure 2: Media Richness Theory (Daft, R.L. & Lengel, R.H. ,1986)

Ranking communication tools

Choosing the right communication tool for task oriented communication is one the main challenges in distributed projects. Information loss is one of the major communication problems and also leads to

collaboration challenge. Communication media can be differentiated with the level of information richness they provide. The Media Richness Theory (MRT) was proposed by Draft and Lengel to define the ability of different media for communication and information exchange(Figure 2). According to this theory face to face communication has highest level of information richness followed by video conferencing, telephone and online chat while email provides the lowest richness.

Social Media

Social media enables quick communication between stakeholders and the teams working on the project. Social media positively influences to create the feeling of oneness in distributed projects and it has low limitation with respect to distance and time. Social media removes the cognitive distance between the team members and increases the knowledge sharing level(Olga Stawnicza, 2015). . It also allows informal communication between the team members and they can share their good memories(using photos etc) with other team members. This certainly increases the sense of creating oneness within the project team. Modern companies adapt ICT technologies according to the employee's preferences and communication habits. Social relationships can be created with the increase in frequency of communication and team members should be flexible and easy to reach.

RISK MANAGEMENT OF REMOTE PROJECTS:

In this section we discuss some of the Major risks involved in distributed projects and how these challenges can lead to a project failure. In the following sections we analyse major risks and will discuss the role that ICT technologies can play to mitigate these risks.

1. Lack of Communication – Associated Risks

Lack of communications in virtual team creates a risk of chaotic and redundant work (Donker & Blumberg, 2008). Right from the beginning of the project, virtual team members should communicate frequently to ensure the project gets completed on time and within budget. Lack of co-ordination brings the risk of not knowing the bigger picture of the project and may lead to inconsistencies and redundant work done by multiple people in the same team. Insufficient communication carries higher risk of failure for projects involving virtual teams as compared to traditional co-located teams. Technical communication issues hinder communications and have a greater risk in projects involving virtual teams due to their increased dependency on electronic communication. Insufficient knowledge transfer also poses a higher risk for projects involving virtual teams (Reed & Knight, 2009).

Project Management using ICT technologies

There are abundant technologies available for project management and collaboration (chats and mails) but creating a symbiotic relationship that can lead to a sense of trust and onneness amongst the team member is necessary in a virtual team environment (Donker & Blumberg, 2008). Virtual team leaders must be proactive to overcome the communication gaps or cultural issues with in virtual team (Thomas, Bostrom & Gouge, 2007). Effective communication helps virtual team members to create and build trust among them. The benefits of virtual team cannot be bagged until the fear and communication issues are resolved.
Integration of Project Management software and collaborative tools can enable the team members to know the status of work that team members are working on and can help reduce confusion or redundancy in normal workings of the team. The project plan ought to be stretched out by developmental and summative results of continuous work originating from the utilized virtual team. ICT technologies ought to give elements for arranging and building components needed for a virtual team to function(Donker & Blumberg, 2008). Motivation to work in virtual team and using communication tools is the underlying success factor in virtual environment (Casey & Richardson, 2008). Project manager should trust the new technologies and should help facilitate transfer of knowledge as they form the cyst for the success of the project. They should encourage virtual meetings for better coordination. In order to face the cultural barriers they need to be trained online to maintain and perform diversity management. Project managers must also vet members and ensure that they have the necessary technical expertise which will enable them to complete the concerned project. Project managers can address the quitting or pulling out of team members by cross-functioning within the virtual team. More importantly the project managers should focus on team building to increase trust between members and social capital. This is important in virtual teams as building trust will improve team performance and dynamics (O'Keefe & Chen, 2011).

2. Heterogeneous culture - Associated Risks and Mitigation Strategy:

 Traditional functionalist and instrument project management approaches including traditional multi value models failed to address the situational construction of cultural differences in global IT projects. Power issues, situational behaviour and hybridization for solving collaborative tensions led to emergence of new cultural practices adding more complexity to the IT projects (Marrewijk , 2011). Teams can vary in terms of their preferred mode of communication as well as how they comprehend messages within and across groups as well as cultures (Niederman & Tan, 2011). Lack of cross-cultural collaboration of employees in globally distributed project teams is an important factor for failure of projects involving global sourcing (Marrewijk , 2011). Globally IT team dynamics varies according to the degree to which group membership is voluntary (Niederman & Tan, 2011). Business anthropologists with a view to support such projects tend to improve business with cultural training, management, business communication and expatriate management. Collaborative cross-cultural learning needs to be better understood in its power context. Managers need to be trained to acquire the desired knowledge on these social processes and cultural arrangements to successfully manage these global IT projects. Manager and employees need to not only learn about the other's culture but also about themselves at the foremost to become more culturally and politically sensitive. In addition they need to learn how their own behaviour is interpreted by the others symmetric power distance relations. Thus they can better handle the difficulties more efficiently and promises of cooperation in IT projects (Marrewijk, 2011). Global IT project team manager needs to acquire and teach general distributed team management skills supplemented with cultural sensitivity. The manager needs to not only learn but also how to apply these approaches in different circumstances as per the need of the situation (Niederman & Tan, 2011).

3. Collaboration Tools - Associated Risks and Mitigation Strategy:

IT collaboration tools plays a major role in determining the success of a project involving virtual teams (Weimann et.al, 2013). Tool selection and improper usage of appropriate tools affects the performance of the teams and transparency of the work progress. Time taken for facilitation of knowledge transfer by project manager even while using Web 2.0 tools decides the success of virtual teams. Limited Internet availability and bandwidth can contribute to reduced effectiveness of members and a lower performance level amongst virtual teams. Secondly some tools have a low usage frequency because the teams feel that they need more 'Tool Training' to use them effectively(O'Keefe & Chen, 2011). This is because the tools selected for the project are too complicated or difficult to use without proper and detailed training. Lastly tool usage is related to the integration of functionality within the tool and lack of it leads to decrease in teams' effectiveness (Weimann et.al, 2013). Although use of web 2.0 technologies by virtual team improves collaboration, communication and contribution they take more time due to limitations of face-to-face interaction which might result in lack of trust and thus these teams take more time to progress through the initial stages of a team formation and project. Other risks that may originate might be lack of team cohesion, and lack of technical expertise needed for the selected project, constant shuffling of members where team members quitting or being pulled for other projects (O'Keefe & Chen, 2011).

Theories, such as the TTF(task-technology-fit) model , the Media Synchronicity model, as well as five Trigger model (External constraint, Internal constraint, ICT inadequacy, trust and relationship inadequacy and ICT knowledge skills and abilities(KSA) inadequacy) describe single aspects of the role of technology to support virtual teams (Weimann et.al, 2013). Web conferences, instant messaging, email, document sharing sites, texting, wikis, blogs, social networks etc. can be used to improve communication on projects. To address the issue of technical connectivity issues hindering communication we need to modify and improve upon the capabilities of the communication related tools as well as formulate strategies and develop expertise to correct the technical disruptions. In order to address the issue of knowledge transfer, manager needs to convert the information into explicit knowledge and document them which then can be transferred electronically (Reed & Knight, 2009). The five trigger model provides a diagnostic tool for examining real, multi-trigger team technology adaptation contexts which facilitates not only better training and evaluation of leaders but also better research on team technology adaptation and interventions. The five trigger model helps to better understand the relationship between the technologies structure strengths in adaptive structures as well the necessity for technology adaptation intervention (Thomas & Bostrom, 2010). Also Task-oriented communications will influence expertise location and cognition-based trust in virtual teams (Kanawattanachai & Yoo 2007, p. 787). E-mail messages will be automatically archived and included for the content analysis; this contains entire set of messages exchanged between the participants. Interaction protocol analysis is one of the frequently used methods to examine the interactions among team members (Kanawattanachai & Yoo 2007, p. 791).

4. Team Collaboration - Associated Risks and Mitigation Strategy:

Collaboration plays pivotal role in virtual projects. Collaboration is affected by the formation of team. The characteristics of team members and the size of team affect the degree to which collaboration required in a virtual team environment. Heterogeneity and homogeneity of various team members will have impact on the project (Turel & Zhang, 2010). Reduced efficiency of virtual teams is due to inadequate interfaces between project management and collaborative tools. Furthermore it is observed that real ongoing task results are not integrated into the project plan. Few tools that are integrated focus only on supporting conventional work processes. Perspective of trait configuration of virtual teams has impact on outcome of the project. Combination or configuration of, between introvert and extrovert team members may cause failures in collaboration. Failure in collaboration may have negative effect on the success of the project (Turel & Zhang, 2010). The outcomes of the creative collaborative processes needs to be rightly integrated in the process of project management which otherwise will lead to inefficient management of human resources and people skills which will eventually lead to failure or less success of teams and projects (Turel & Zhang, 2010).

Compatibility of person and team fit need to be considered at the beginning of the virtual team formation. Assessing the team members for behavioural characteristics can address this issue with collaboration and leads effective configuration (Turel & Zhang, 2010). Project plans should utilize collaborative tools supporting features for planning and building collaborative work processes. The tool should have interface to an intra-organizational collaborative network which gives out information on existing connections between teams, tea members and related outcomes. The tool should also provide recommendations for virtual team formation processes considering the relationships between people (Turel & Zhang, 2010)

5. Establishing Accountability:

Establishing accountability is one of the key responsibility of remote team project managers. In remote teams it often becomes the case that task responsibilities are not clear. This can lead to project delays or redundant work being done by project managers. Remote team members that join the team at a later stage are often ambiguous of roles and responsibilities of other team members. Project Managers need to assign roles and make them clear to other team members right at the beginning of the project. Team Members should then make a continuous effort to improve the team process that leads to achievement of project goals. This involves identifying gaps in task ownership, assignment of new roles during the course of project etc. lastly, to receive new and creative ideas from members, certain amount of freedom must exist in the team roles. Team Members should debate and hear each others opinion before making key decisions during the course of project. Overall Project Manager should ensure that team members have at all times the right resources, knowledge and assistance needed for project completion.

CONCLUSION

In this report we critically examined, literature on virtual teams and discussed various problems and challenges faced by such teams. We discussed the role that ICT can play in managing risk inherent in remote IT projects. We can conclude that sophisticated communication technologies can go in vain if there is lack of oneness and trust amongst the team members. Remote Projects can take a path of failure if the team members are not willing share important knowledge. Certain ICT tools can provide more information richness and can reduce the communication gaps better than others. Furthermore, internal social communication tools that allow informal commination can go a long way in establishing bonds or oneness amongst team members

It is also recommended that companies should establish a communication framework for teams which includes the protocol and guidelines for communication amongst team members. This can help in on time decision making, can enable quick knowledge transfer and can effectively mitigate risks associated with lack of communication in remote teams. It is worth mentioning that even though globally distributed teams face a lot of challenges, they have the capability to provide organizations with great opportunities and benefits in terms of adding business value (Akemi et. al,2013).

Lastly, It was observed that a lot of research has been done to study the problems faced by remote teams but few researchers have focused their attention on studying directly the co-relation between ICT usage and remote team performance. We believe effective ICT usage is an important aspect for project managers to consider while building remote teams. Further research in this area has the potential to bring valuable insights to organizations and can help project managers to become more effective.

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