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Knowledge Regarding the Control and Coordination of Global Software Development (GSD) Projects

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Abstract:
Knowledge management is one of the aspects challenged by workdistribution, seen in its concrete manifestations.Knowledge in global software development projectsabsolutely essential in order to cope with the control, coordination and integration ofmultiple knowledge sources under time pressure and budgetary constraints. In order to have better knowledge, team members should have domain expertise and deep understanding of the client's pain areas and corporate culture limited the ability of an offshore vendor from delivering an effective solution. This study mainly identifies the level of knowledge required regarding the control and coordination of GSD projects in the selected software companies in Karnataka. Also we have briefed the factors which influences and required for better knowledge to attain the project goals and objectives.

1. Introduction

To attain the project goals successfully, knowledge regarding the control and coordination of global software development is very muchrequired. Every project has its own set of complexity levels, correspondingly the knowledge required to execute the project also differs from one level to another. Knowledge of better control and coordination of software projects helps team members to understand the project goals and result expectation in the initial stage of the project, so they can plan and schedule the time for project execution accordingly. Frequent interaction among team members plays a major role because their communication is more efficient due to shared vocabularies and more common ground.Some of the important things in which team members develops organized shared knowledge about manythings are project goals, project execution strategies, processes, team interaction, etc. but that knowledge matters the most for task performance relates to the activities necessary to carry out by team. Havingshared knowledge about technical concepts, products, and processes can helpsoftware team members develop accurate expectations about future states of thetask and improve common grounding in their communication, which helps for better coordination.

2. Scope

The study is limited to the selected software companies in Karnataka. The software companies in Karnataka were selected taking into consideration various parameters like the number of employees, organisation's age, investment outlay, global exposure and market share in the respective area of specialisation.

3. Research Methodology

This study has been undertaken to assess the Management of GSD projects in selected software companies in Karnataka. We have explained here the purpose, design of the study, participants, instruments, procedure and statistical techniques used. Research on knowledge regarding the control and coordination of GSD projects is of great relevance to modern industry as it provides a new dimension to the understanding of how to deal with organizational problems in software industries. Since the problems to be investigated is relatively new, we have chosen an explorative approach.

The empirical study was accomplished through data collection from Project Managers, Team Leaders and Software Developers experienced in working with software development projects in software industries. To obtain the data a well-designed and structured questionnaire has been used and the data for the present study is culled out from both primary and secondary sources. The secondary data is collected by referring the books and searching the websites to present the conceptual foundation of the knowledge regarding the control and coordination of GSD projects.

The primary data relates to the perceptions of the software development professional groups are Developers, Team Leaders and Project Managers. There are more than 2,500 well-establishedsoftware development companies in Karnataka. For the purpose of the study the major companies have been selected on random basis. From each selected software company 20 respondents were chosen for eliciting responses. When the structured questionnaires were served to all the respondents of the selected 35 companies, respondents from 3 companies did not respond to the request. Out of the responses received from 640 respondents, 140 respondents have failed to respond to the request in an orderly manner. Hence only 500 completed questionnaires in all respects were received and considered for the detailed study. The response towards the management of GSD project was collected by serving a structured questionnaire on five-point Likert scale. For analysis and interpretation of data, weighted mean value, standard deviation, t-test was used.

The data processing was done through SPSS for windows (version 16.0).

4. Pre-Tested Questionnaire

The pilot instrument comes in the form of an advanced draft of a documentwhich adequately represents the progression of the research from abstractconcepts, through the development of valid constructs, to the identification ofreliable individual questions. With this in view, a pilot study of the questionnairehas been carried out with an aim to provide a broad picture of evaluation ofManagement of GSD projects and the evidence of accepting or rejecting initialproposed measurement variables or items from the literature. That is to say, a setof questionnaires has been designed for the purpose of collecting primary data bytargeting Developers, Team Leaders and Project Managers related to Managementof GSD projects in selected software companies in Karnataka.

Data from the literature and the pilot study was used to build the preliminary research framework suitable for software business environment of evaluation of knowledge regarding the control and coordination of GSD projects. The pilot study was conducted prior to the formal data collection process in accord with the recommendation that conducting a pilot study is the final preparation for data collection. The pilot study helped in determining the usefulness and assessing the reliability and validity of the instrument so that we could refine the data collection plans with respect to both the content of the data and the procedures to be followed before final drafting of questionnaire is distributed.

5. Reliability of the Tool

Once the data was collected, it was entered into computer software for analysis. The obtained Cronbach coefficient is .7116, where we can say that the tool obtained to measure the knowledge regarding the control and coordination of GSD project is reliable.

6. Validation of the Tool

The validation of the tool was established through face validity and content validity.

7. Review of Literature

The purpose of knowledge management is to absorb the organizationalintellectual capital to use in the future (Lindvall and Rus 2002, pp. 26–38). But themain problem is that the intellectual capital is intrinsic to the human being. Insoftware development organizations, this concept has been applied with thepurpose of investing in learning from experience, i.e., an individual can learn onthe basis of the experiences lived by other individuals, since all experiences aredocumented in a systematic way. Knowledge management can help in the decisionprocess, increasing the quality and decreasing costs and project time (reuse),stimulating the development of a consistent information repository to be used inthe future. Knowledge management also relates to information collection fromprojects. Projects generate many types of information that, if shared, can bringbenefits for the teams and for the organization. One of the consequences for distributed projects is the stimulation oflearning from experiences shared between distributed teams. The interviewsconducted indicated that such investment in knowledge management (tools oractivities that stimulate information sharing) minimized many obstacles to GSD.The existence of historical data from all projects in the organization, there is not aculture of using this information in an efficient way, because people are not able touse, don't want to use or simply are not trained to use the benefits of aninformation repository'.

De Souza's study is based on knowledge management practices observedin more than 50 software organizations, and after taking into account three factors(the focus of the organization, the degree of structure and the knowledgerepositories in place), the authors described three models for distributedknowledge management architectures: client-server (corresponding tocodification), peer-to-peer (corresponding to personalization), and a hybrid model,which is a combination of both. While we agree that, taking into account the large79variety of settings for GSD, choosing suitable approaches for each organization isimportant.Abetter understanding of knowledge work practices can provide useful insights inthe role of the organizational culture and of a stimulating work environment asvital for the successful organization of distributed work.Speaking aboutknowledge in the context of software organizations, Davenport described it as afluid mix of framed experience, values, contextual information, and expert insightsand grounded intuitions that provides a framework for evaluating andincorporating new experiences and information.It originates and is applied in theminds of the knower. In software organizations, it often becomes embedded notonly in documents or repositories, but also in organizational routines, processes,practices, and norms. (Davenport 1998, p. 5).

Most of the theory building and empirical research on team cognition hasconcentrated on real-time and collocated contexts. However, some of the theoriesand findings in this area may not necessarily extend to geographically distributedcontexts (Chen and Gaines 1997). Geographic dispersion affects the nature of interaction within the team and provides fewer opportunities for spontaneousinteraction and acquisition of team knowledge. Because of this, it often takeslonger for members to get an acknowledgment, obtain an answer, or correctmiscommunication. Furthermore, studies have shown that a substantial amount ofcoordination in software development takes place through informal encounters andmeetings in public places such as the water cooler or coffee room (Majchrzak etal., 2000, pp. 569-600), which does not happen when members are separated bydistance. Indeed, a recent empirical study examined the radical collocation ofsoftware development teams and found significant benefits of collocation in termsof facilitating coordination, learning, and performance.

Consequently, authors have anticipated that geographic dispersion hinderscoordination in software development (Espinosa 2000 et al., pp. 392-399). Whilethis may not seem like a novel prediction, it is important to point out that the80effects of geographic distance on coordination have not been conclusivelydetermined, mainly because geographic distance often correlates with otherboundaries that affect coordination in global teams such as time zones, culturaldifferences, and technology mediation. In an

article summarizing their severalyears of research on the effects of distance in teams, Olson and Olson concludedthat many of the observed effects of distance are due to factors other than distance.Similarly, more recent studies have shown that factors such as cultural differencesand time zones affect coordination more strongly than geographic distance alone.In contrast, recent studies of global teams suggested that distance is still asubstantial barrier in collaborative work (Kraut and Streeter 1995, pp. 69-81).

Kakumanu and Portanova (2006, p. 4) have mentioned that for effectiveoutsourcing a company needs good process discipline. Most companies enter intooutsourcing agreements without that. This can lead to escalating costs, poorresults, and difficulties managing the relationship. The elimination of easy, clearcommunications channels can further complicate the development process.Process discipline can be lax within companies because employees have theknowledge and communications channels ("over the cubicle") to overcome theselapses. Once a process is outsourced, this knowledge and communication can belost, causing poor results.

As Alavi and Leidner (2001, pp. 107-136)concluded in their literature review of knowledge management research, sharedknowledge is important because knowledge is processed in people's minds andtherefore individuals need to have a certain level of overlap in their individualknowledge bases to coordinate their collective action.

Gutwin and Greenberg (1996, pp. 177–201) concluded from their severalstudies on the subject that team awareness is important for coordination incollaborative tasks that contain interdependent activities, because it helps members shift from individual to shared activities seamlessly and easily, and becausemembers have a better understanding of the sequence and timing of things and thetemporal boundaries of their actions. There are several types of team awareness,including work space awareness, activity awareness, environmental awareness,and task awareness and presence awareness, which are particularly popular amongcollaboration tool design researchers. There aretwo types of team awareness that are important for coordination task awareness and presence awareness.These two types of awareness are mostimportant in virtual collaboration and because they provide situational knowledgeabout task work and teamwork. Consistent with the definitions of team awarenessdiscussed above, task awareness as a member's up-to-the-minute knowledge ofwhat is going on in the task in areas that affect that member's work. Thisdefinition is similar in concept to Chen and Gaines's concept of chronologicalawareness, which is knowledge of recent task activities (e.g., knowing who didwhat recently, who is behind schedule, what tasks are pending).

Gokakkar, Raghavendra. (2007, pp. 281-296), stated that the distributedwork environment suffers issues such as lack of mutual knowledge, ineffectiveknowledge sharing, lack of trust and coordination and interpersonal conflicts. Theauthor conducted an empirical investigation in two projects each employing ahybrid offshore software development model to gain a deeper understanding of theunderlying issues. The case study approach allowed for the study of phenomenon in a real-work context. For their study, open-ended semi-structured interviewswere conducted as a primary means of data collection. An interpretive analysisusing a framework of social identity theory revealed that the in-group/out-groupeffect generated by a geographical fault line was further severed or diluted by twofactors: individual mobility a realistic opportunity to become a member of othergroup and the common expertise between two sub-teams. The study concludedwith an observation that the absence of these factors resulted in strong groupstereotypes, which in turn caused stronger inter-group behaviour.

Martinsson, Irene (2009) analyzed the empirical material considered comesfrom 11 recurring projects from two sectors: the construction sector and the ITsector. Existing research is extended by developing a conceptual framework thatexpresses how standardized knowledge transfer and where difficulties arise. Results show the knowledge is difficult to capture and control. Standardization isviewed as the core over which the team member, the recurring project, thepermanent organization and the product claim joint ownership. Frameworkdescribes how standardization tasks are fulfilled as knowledge proceeds throughthe transfer process. They showed that standardized knowledge tends to take theshortest path in a transfer, i.e., to move the individual who has acquired theknowledge. However, choosing the quickest transfer path de-standardizes theknowledge. Engaging the permanent organization offers opportunities tostandardize but requires a longer transfer process. This process is often too lengthyto achieve. It is difficult for the permanent organizations to transfer even existingroutines. Project members often fail to use standardized knowledge. Theirframework is also designed to take into account the new knowledge that developsin projects. They showed that knowledge from projects fails to complete thelengthy transfer process and remains personalized. The studied corporationsresisted transfer. To provide an explanation they highlighted roles in the transfer.

Minghui Yuan; Xi Zhang; Zhenjiao Chen; Vogel, Douglas R.; Xuelin Chu.(2009, pp. 494-507), among the numerous reasons for software project failure,coordination problems are especially salient. Prior studies on coordination insoftware development are confined to team internal coordination and do notexplicitly differentiate team internal and external coordination processes. Thisstudy presents a research model to explain the antecedents of coordinationeffectiveness of software developer dyads from interacting teams. In this studyrefer to software developer pairs where each member comes from a different team.They explore the antecedents by integrating interpersonal and technology basedcoordination. They test this model using data collected from 59 software developerdyads from interacting teams as well as from software developer leaders. Theresults reveal that the implicit knowledge sharing has a significant positive impacton coordination effectiveness. The use of explicit knowledge sharing andcoordination technology has no statistically significant impact on coordinationeffectiveness although the teams studied were working predominantly in acollocated mode. Mutual trust and project commitment have a significant impacton knowledge sharing with mutual trust directly affecting both implicit andexplicit knowledge sharing. Project commitment also has a direct impact onexplicit knowledge sharing and mutual trust, but it does not directly affect implicitknowledge sharing.

Adenfelt, Mari (2010, pp. 529-538) discussed on transnational projectperformance is linked to knowledge sharing. The aim is to enhance the knowledgeof how knowledge sharing affects transnational project performance. Using casestudy data, derived from a transnational project assigned with the task of developing a transnational product, show that transnational project performancewas hampered by communication and coordination difficulties. The findings haveshown how (1) the meaning of knowledge sharing

and (2) the organizationalcontext as setting the boundaries for project management in practice are related totransnational project performance.

Fægri, Tor Erlend; Dybå, Tore; Dingsøyr, Torgeir (2010, pp. 1118-1132)discussed the job rotation is a widely known approach to increase knowledgeredundancy but empirical evidence regarding introduction and adoption insoftware development is scant. A lack of knowledge redundancy is a limitingfactor for collaboration, flexibility, and coordination within teams and within theorganization. The scientific objective of this investigation was to explore benefitsand challenges with improving knowledge redundancy among developersparticipating in job rotation. There were two practical objectives; (a) to establishcustomer support as a legitimate organizational function that would shielddevelopers from support enquiries, and (b) to contribute to improved flexibility inproject staffing by enabling overlapping product experience among developers.The method used they used action research to integrate organizational change withscientific inquiry. During a period of eighteen weeks, nine developers rotated tocustomer support.

8. Analysis and Interpretation

Mean Obtained and expected score on "Knowledge regarding the Control and Coordination of GSD Projects" and results of one sample 't' test

Mean	S.D	Mean expected (min)	Difference	't' value	P value
3.68	.183	4.00	.31	38.48	.0

Table 1
Source: Primary Data

The mean score for the entire sample was 3.68 out of the maximum score of 5. A minimum test value of 4.00 was fixed to see the agreement by respondents on the component 'knowledge regarding control and coordination of GSD projects, the sample had the mean value of 3.68. One sample 't' test revealed a significant difference having deficit from the test value of 4.00 (t=38.48; P=0). On an average the sample did not reach the mean agreement on the statement.

To attain project goals successfully, knowledge on standard practices arerequired, all the respondents have shown their perception on higher level ofknowledge is required to attain the project goals. Every project has its own set ofcomplexity levels, correspondingly the knowledge required to execute the projectalso be at different level. Senior members will be having much more hold todetermine the project goal. In order to carry out different activities in theorganization, communication plays a major role. Every organization will havetheir own set of channels and levels for communication. So there are certainchanges which are required for effective and efficient communication. Majorityof the respondents agreed for the changes in interaction and communicationamong employees in the organization.

Sharing the right knowledge among the employees is an important activityand it mainly could be carried through different channels and activities. All therespondents have different level of perception on each tool. Training is one of theeffective and efficient tool, because it carries out through its own set of differentactivities and processes. Having a group discussion frequently, help the people to beupgraded knowledge on right information. Also regular interaction will helps infrequent updation on the changes. In order to attain theeffectiveness and efficient of given task, motivation plays a major role. It mainlyurges and attracts people for better performance. There are many ways ofmotivation through various activities and processes and which would line directlyor indirectly to their personal life or professional carrier growth. All therespondents have different level of perception on each motivation factor.

The human actors are the only ones who can process, share and create newknowledge by interacting with each other and with the technologies. Regardingknowing as something people do (rather than looking at knowledge as somethingthat people have) draws attention to the need to research, ways in which thesystems that mediate knowledge and action are changing and might be managed.

In-order to find and resolve the issues, seniors preferred to interact with theconcerned person in the organisation. For the authority of controlling particular group managementhas to change their team structure. Interaction among team is veryimportant, because they directly interact with customer. For communication, seniors always prefer good communicator to interact taking intoconsideration of effectiveness of communication. Management adopts thepolicies and frameworks to carry out the smooth operation. Every organizationwill not change the Vision and Mission statements for long run, there statements ismainly to alert the members of the organization to step into the organizationalgrowth. Changes ininteraction and communication relate to control and coordination of GSD projects,all the respondents have different level of perception on related information. In anorganization every activity will be having their own set of importance to performwith respect to particular department.

Right information sharing is a major role, usually people will notdisclose the confidential information. Some of the generic information could beshared to inform or help some other employees in the organization. In this case allthe respondents have different level of perception on the shared information.Sharing of the knowledge on product and market is very essential which helps ingeneral awareness in order to understand the operations and activities associatedwith organization mission and vision.

9. Findings

We find that knowledge regarding control andcoordination of GSD projects is low in selected software companies. Because theobtained total mean value 3.68 has not reached the expected mean value 4.00 out of 5.00. To obtain this result, some of the major factors have been considered andthose factors with the results are as follows.

For the knowledge regarding GSD projects, all the respondents agreed that,there must be more than 80 percent of the knowledge of the standard procedure isrequired for attaining the project goals. For changes in interaction andcommunication (with peers, superiors, subordinates, users etc.,) as a result ofgeographic dispersion, about 92 percent of the respondents agreed on some of thefactors are changes in management team structure, technical team structure,organizational structure and departments, 58 percent of the respondents agreed onthe information on advanced technology and about 60 percent of the respondentsagreed on personality skills information. 56 percent of the respondents agreed thatknowledge sharing management among the employees at GSD projects throughsome of the tools are training, group discussion and regular interaction andassignments.

The knowledge regarding control and coordination of GSD projects is low inselected software companies, and there should 80 percent of the knowledgerequired as per the standard/ written procedures etc is required to attain theproject goals. In order to enhance the knowledge level of an employee, theyshould be aware of some of the key areas are software products, market,organization, technology etc for better project execution and understanding.

10. Conclusion

In GSD projects, knowledge management among the team members playsa critical role. As per the standard practices and written procedures, morethan 80 percent of knowledge is required to attain the project goals. Thechanges in interaction and communication (with peers, superiors and subordinates,users etc.,) as a result of geographic dispersion is mainly due to some of thefactors are changes in management team structure, changes in technical teamstructure, changes in policies and frameworks, changes in organizational structureand changes in mission and vision statement. Apart from the mentionedinformation, still there are some other information that have been shared, they aregeneral information about products/ industries, information on advancedtechnology and information on personality skills. Some of the important tools usefor knowledge sharing management are through training, by group discussion,through regular interaction and follow up's.

Usually there will not be much direct focus on vision and missionstatements towards the control and coordination of GSD projects. Importance ofvision and mission statements relates to knowledge on control and coordinatingthe various activities, some of the importance are customer satisfaction oriented,company growth oriented, technology oriented, employee oriented and product/market oriented. Authorized entities, steering committees and project managershelp on control and coordination towards some focuses are customer orientedservices, company growth oriented, employee oriented policies and proceduresand product/ market oriented.

11. Suggestion

In order to avoid the major difficulties in control and coordination at GSDprojects, team members should aware on some of the key aspects liketechnology variation, cultural differences and knowledge among teammembers. For the problems on controland coordination of GSD projects, developers/ team leaders and projectmanagers should alert on the initial, execution and final stages ofthe project.

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