

# Most Effective Communication Management Techniques for Geographically Distributed Project Team Members

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## Abstract

The effective project management for high quality software projects is only possible by effective communication and coordination among project team members and is a complex task when team members are geographically distributed. This research paper describes the techniques of the communication management of the data mining based and knowledge based tools and advance analytic techniques for extracting data and knowledge of social structures using email, chat and mobile and predicting the communication relationship analysis on the basis of this knowledge.

**Keywords:** *Software Project Management, Social Structure Networking, Software Communication Management, Communication Network Analysis.*

## 1. Introduction

At the end of the 20th century, as IT industry established, knowledge economy entered in the new era. At this time, IT industry began to develop rapidly. More and more people are fascinated by its features combined with both risks and benefits. And people gradually participated in the software development industry. However, after several years of development, many problems in the software industry are gradually revealed. The main problem is ultimate failure chance in software development projects which is increasingly very high. According to statistical ratio, only 10% -20% of software development projects can be completed and delivered on time, and 25% of large software development projects with high demand cannot be completed on time. Survey carried out on failure reasons showed that 70% of projects fail because of improper effective project management [1]. Organization network analysis for a mission critical project done at Fortune 200 company in IT solution industry showed that time and scope slippage was due to the problems in communication and integration management of four project teams residing in different locations of U.S. and Russia[10].

Projects involving diverse tasks and skills do not meet their specialized functionality within the given scope, time, cost and resources. For the successful completion of projects, the subject of project management has evolved to meet the project to its functionality within the given scope, time and resources. Project management relies heavily on the team work and knowledge so it is important to know for a project manager about the coordination,

communication and resources [2] [3] [4] [5]. Communication network analysis acts as a powerful tool for analyzing the team working in an organization from different management perspectives. Communication network analysis (CNA) is ability of visualizing communicating network nodes and to predict these visualizations in real time. Nodes represent individuals or teams while linkages represent communication relationship as shown in figure-1.

In project management context communication network analysis acts as predictive gap analysis tool for communication networks in organizations [6]. Analyzing communication networks we can improve the projects resources and teamwork and also project risks can be mitigated which is very helpful for project management [7] [8]. In this research paper we describe social structures that are helpful in building associations and relations among people communicating through email, chat and mobile to maintain type wise log and to provide timely information to critical infrastructure and predicting the relationships.

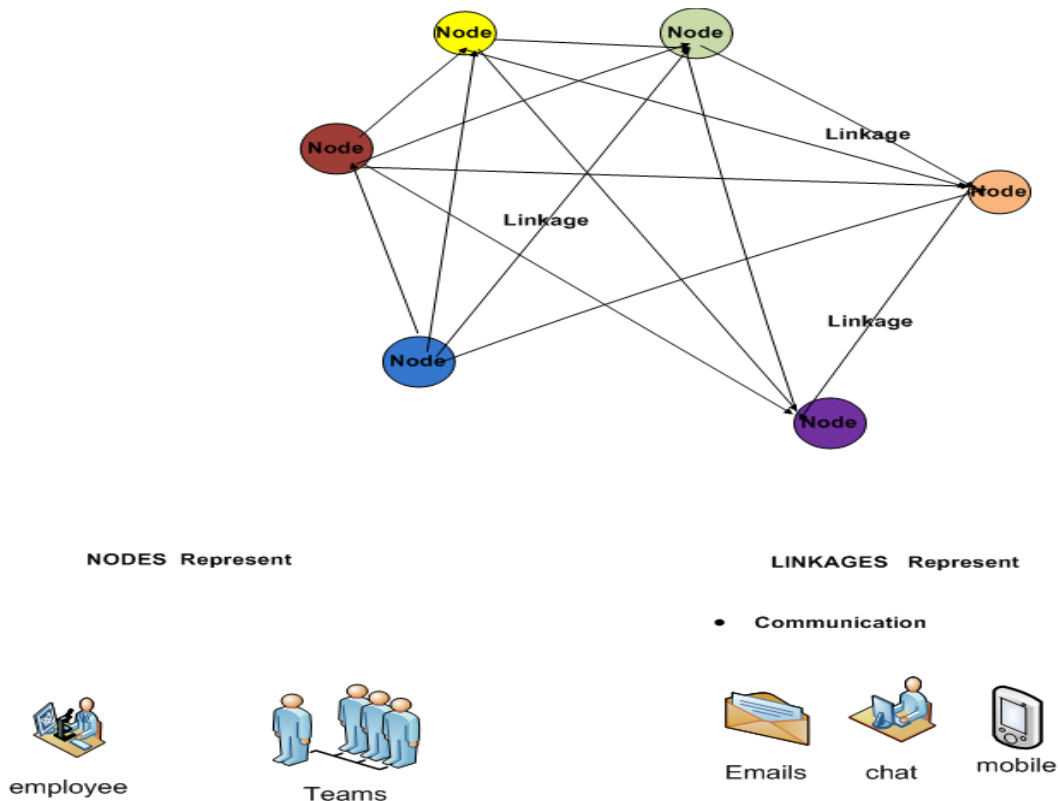


Fig 1: Communication Network Analysis

## 2. Scope of Research

In software project management the communication management is most challenging when coordination and communication has to be made among the team members of distributed teams located in different geographical areas [9].

In this research paper we find the social structures that are helpful in building the associations among people communicating through email chat and mobile. We maintain type wise log and provide timely information to critical infrastructure and describe the communication relationship.

### 3. Proposed Approach

We select email, chat and mobile features for analysis of social structures. The email parameters are sender and receiver email addresses with which they are connected to the internet and for mobile are the mobile number and also time when they connected. Then this information is used to populate the database. We use the database information to find and build the hidden structures, and building correlation between internet users, geographical location, telephone numbers, and emails. Relationships and associations are developed from these network structures and network metrics are calculated by analyzing the connections that help in the detection and analysis of social structures. By viewing the graph it can be easily found that on which nodes communication links are established. Figure-2 shows our approach about the system model.

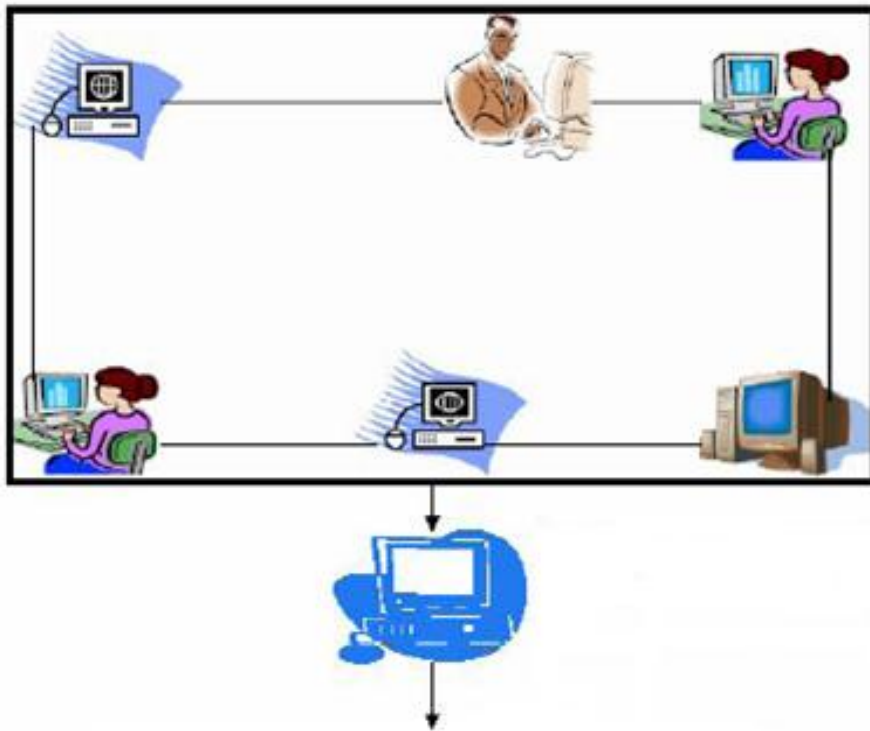


Fig 2a: System Overview

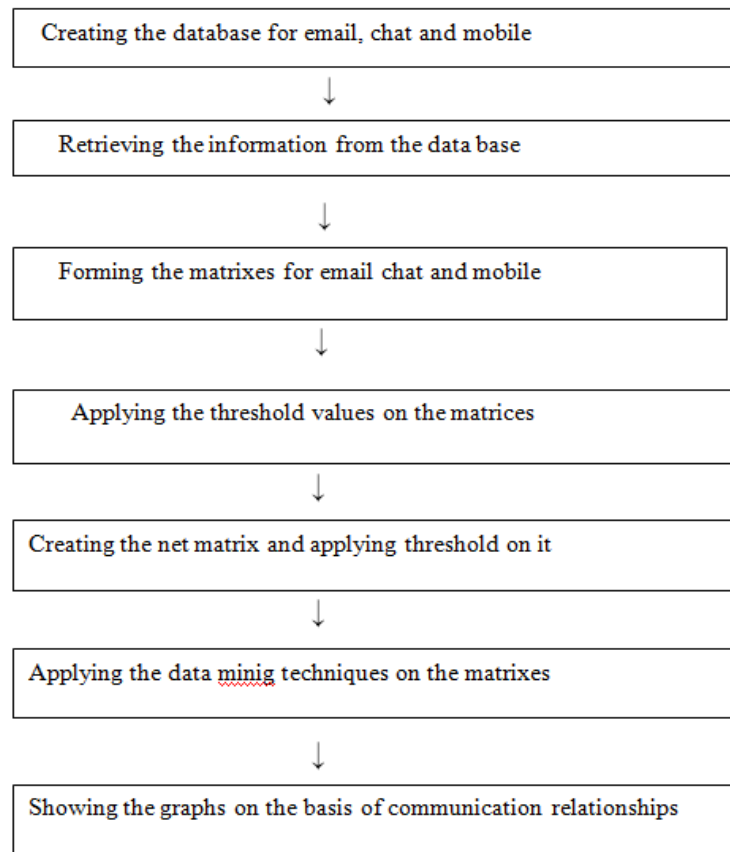


Fig 2b: System Overview

### Creating the Database

First the database is created and the information about the email ids, duration, and call logs mobile numbers and log details is created.

### Retrieving the data base

The information from the database is retrieved where is type id ' 1 ' is for email ' 2 ' for chat and ' 3 ' for mobile .

### Matrices and Applying Thresholds

We form the matrices and apply threshold on them which shows the association among the people on the basis of the sending and receiving information via email, chat and mobile phone information. For facilitating ourselves we apply a threshold value of 5, which means if the person has exchanged at least 5 emails with its neighbor, it is included in the email exchange network of the sender .

## Extracting Information and Applying Data mining Techniques

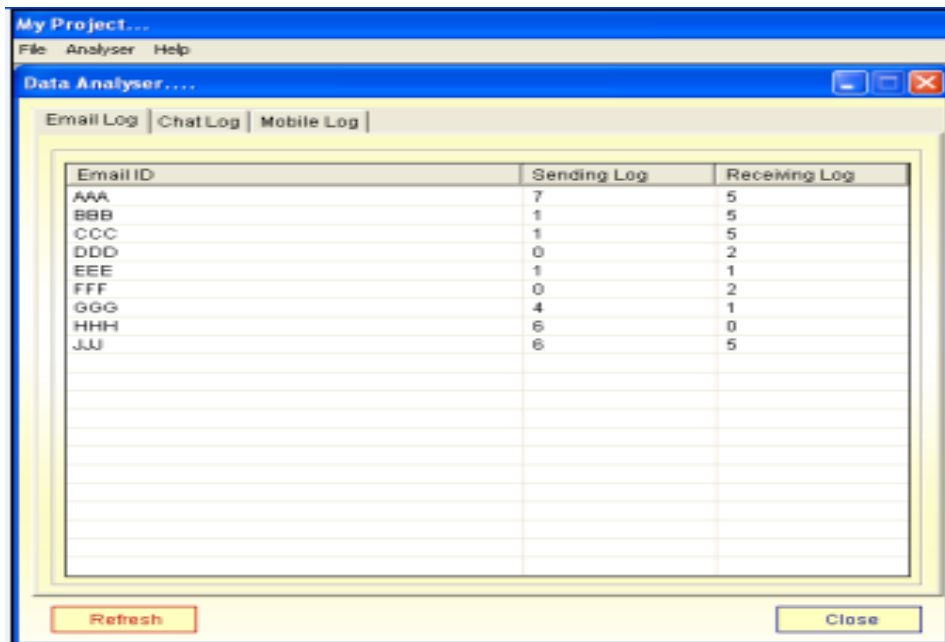
The information is extracted and data mining techniques are applied extracted from the email messages and mobile numbers.

## Graph Representation of Communicating Relationships

We show graph results in the form of communication graphs. Nodes and ties depict the communication relation among people. We then make inferences and analysis for the communication management of software projects.

## 4. Evaluations and Results

In figure-2 there is the email log matrix which shows the email addresses and sending and the receiving when the email is either sent or received. The above figure matrix depicts that person having email id AAA has sent seven emails so its sending log is ' 7 ' and has received ' 5 ' emails so its receiving log is ' 5 '.



Email ID	Sending Log	Receiving Log
AAA	7	5
BBB	1	5
CCC	1	5
DDD	0	2
EEE	1	1
FFF	0	2
GGG	4	1
HHH	6	0
JJJ	6	5

Fig 3: Email Log Matrix

The next matrix Email Log Details in figure-4 represents the details of this sending and receiving of this matrix.

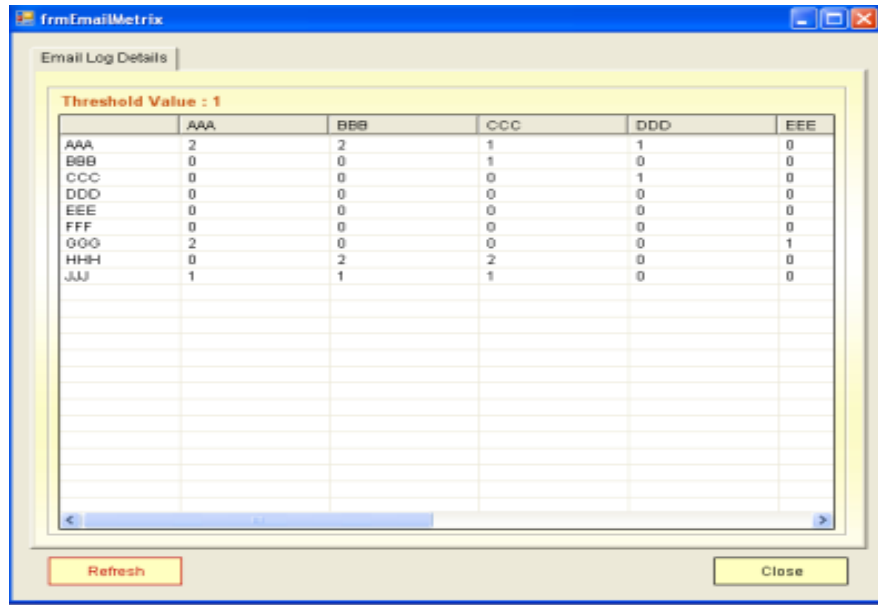


Fig 4: Email Log Details Matrix

This email log details matrix shows that if AAA has received seven mails then who has sent these mails. This matrix shows that, two mails are sent to the AAA by itself and two are sent to it by BBB one is sent to it by CCC and one by DDD. A threshold value is applied which ignores the value if the sending or receiving value is below or equal to this value. Similarly mobile log matrix shows the sending and receiving calls and mobile log details matrix shows the details of sending and receiving calling details in figure-5 and also chat log matrix shows the sending and receiving chat sessions and chat log details matrixes shows the details of chat in figure-6 as in figure-3 and figure-4 matrixes.

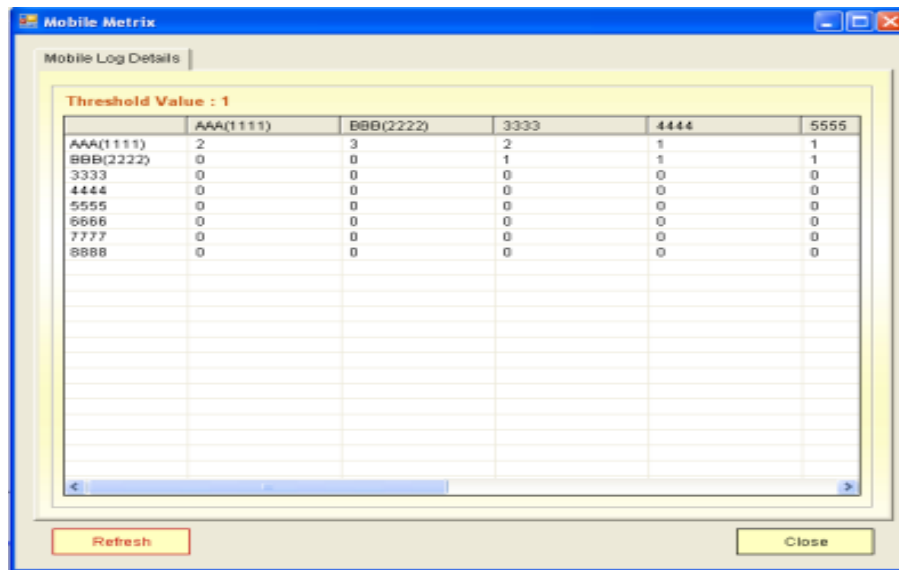


Fig 5: Mobile Log Details Matrix

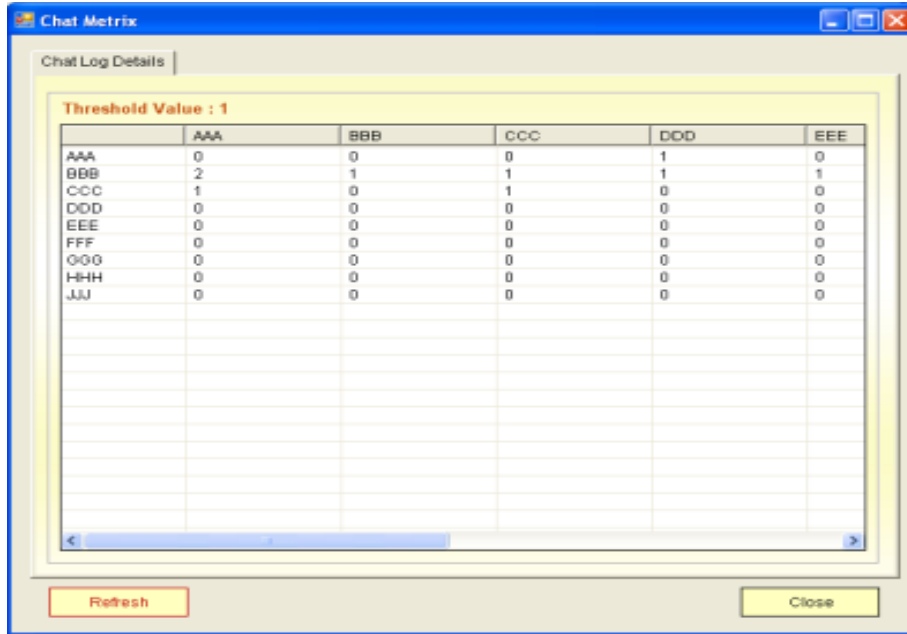


Fig 6: Chat Log Details Matrix

The net communication matrix in figure-6 shows the parent or child relationship and the cofactors. The net communication matrix is the combined matrix of the three matrixes and it shows the cluster analysis. The communication relationship graph is as shown in the figure-8.

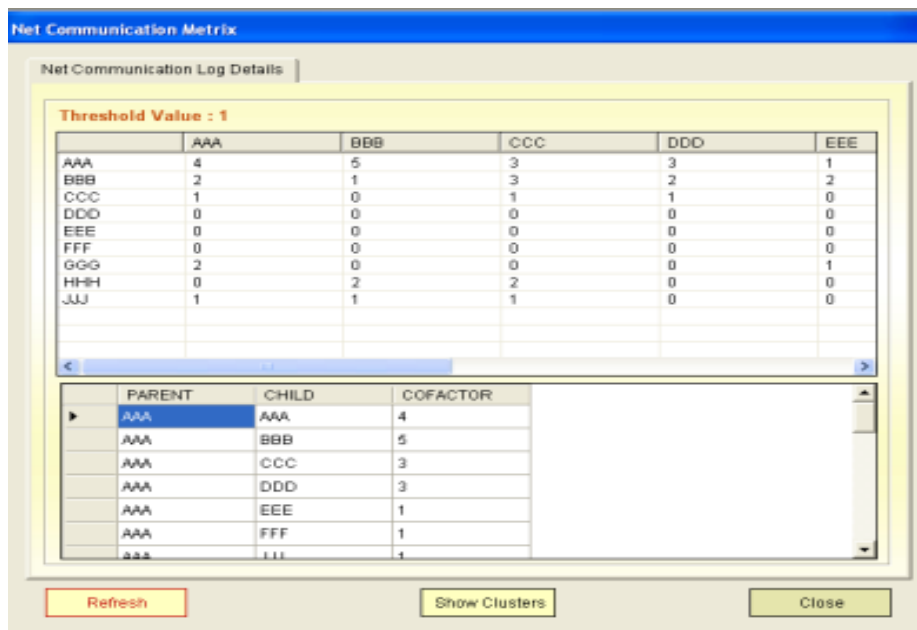


Fig 7: Net Communication Matrix

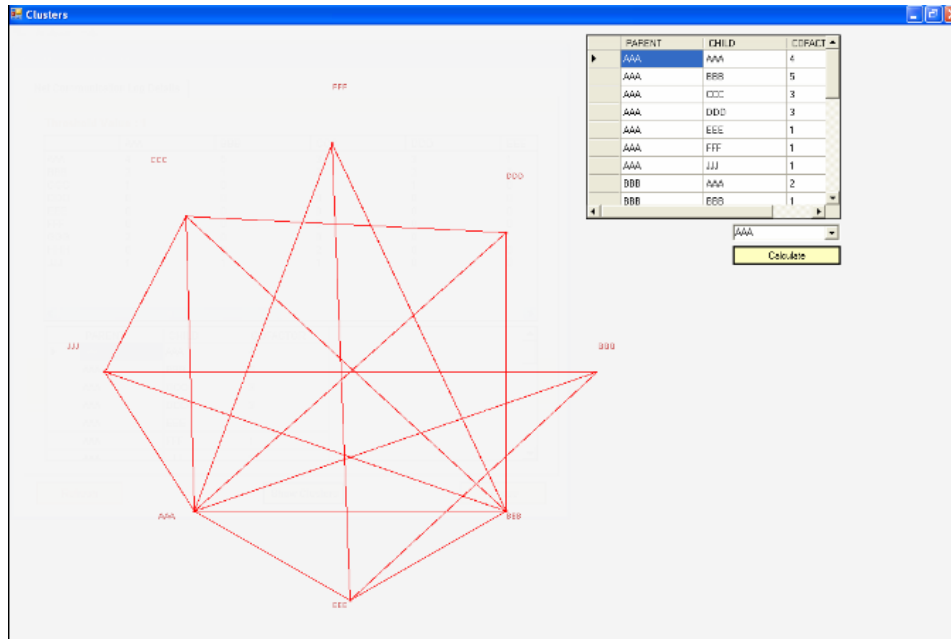


Fig 8: Cluster Analysis

## 5. Application Areas

Communication analysis tool helps the project manager in communication management. As in Email Log Matrix in figure 3 there is sending and receiving log and project manager by seeing this matrix can easily check who has sent how many mails and who have received how much no of mails. For example in figure-2 email matrix the employee having email id AAA has sent 7 mails and received 5 mails. So his sending log is 7 and receiving log is 5. Similarly mobile log matrix shows the sending and receiving logs against the mobile numbers and chat log matrix shows the sending and receiving log session of chat. These can be accessed by clicking the boxes of mobile log and chat log as shown in the figure-3.

By seeing the Email log details matrix in figure-4 there is detail information about the sending and receiving log i.e.; among these sending emails who has sent these emails, AAA email id has sent two emails to itself and two emails are sent by email id BBB and one email is sent by email id CCC and email id DDD has sent 0 email. AAA email id has received 2 emails by itself and 2 emails by email id GGG and one email by email id JJJ. As its receiving log were 5.

So by using the communication analysis tool the project manager can analyze that which employees are in communication. Similarly by seeing the log detail matrix for mobile and chat in figure-5 and figure-6, project manager can also analyze the communication relationships by mobile and chat.

A threshold value is applied on these matrixes. A threshold value 2 means that only those email ids will be selected that will have sending and receiving logs at least 2 and for logs below 2 will not be selected for analysis. Here in figure 2 we have selected threshold value 2.



The net communication matrix in figure 6 shows the relationship of parent node with the child node and the cofactor against these nodes. When the project manager wants to see the communication details of one specific employee, he will select the email id of that employee and that id will act as the parent node and the other employees, who have communication against this parent node, will act as child nodes and cofactor in figure-7 shows the no of times they communicated. Figure-8 shows the cluster analysis. By just seeing the graph, analysis can be made about the communication relationship. Graph against any node can be drawn and by seeing the graph communication analysis of the selected node can be made. So when the management wants to see the communication analysis they will just select the id of that employee, as shown in figure 8, and will get the communication graph of this employee with other employees.

So this communication analysis can help a lot in project management especially when team members are distributed against different geographical locations. The project manager can send warning email to the employees which have threshold value less than assigned and where activity one assigned to one employee depends on the completion of the second activity assigned to other employee and they need sharing of information for completion of their activities.

Similarly an automate job skill matching for the employees for assigning task or for hiring or recruiting can also be done by analyzing network analysis. In this case we will keep the employee names against skills instead of ids against ids for email chat or mobile. By doing this when management wants to assign tasks to employees they can find the employee which is best skillful for that specific task. It can also be helpful for recruiting and hiring the employees by having best match for the tasks of the jobs. The communication network analysis is also helpful for finding social issues i.e. friendship or other relationship patterns.

## 6. Existing Systems

Recently, researchers have used social networks for studying collaboration in software teams and have extracted data from different inventories such as software and email archives. Techniques of collaborative filtering and social networks have been developed for problem solving and viewing correlations among developers and their data [11]. Investigation analysis has been done for avoiding from failures and keeping the developer's work more focused and fragmentation free. Investigation has been made between the developer's fragmentation relation and failures after releasing the software. Developer module network which is called contribution network is used to measure network centrality and fragmentation degree of developer's contribution. Investigation and analysis shows central network more error prone [12]. Similarly a case study has been conducted on mature Nortel networking product over three million lines of code in which developer's collaboration network was obtained by the churning effect of code which can reveal failures at file level. Failure prediction models were developed using test and post release failure data which showed an important correlation existence between file based developer metrics and failures [13]. In another research, data has been extracted from software repositories to generate social networks for using task specific interaction among developers for making collaborations and integration. In their approach they found delays when used for IBM's JAZZ team repository for communication and collaboration due to project wide social network and information distribution among seven geographic sites. The work done is, however

independent from any specific repository and can be used for collaboration and communication information distribution. The work done in our case is different because we used social network for communication management which acts as analysis tool and make it possible for the executives to deal with the flaws and handling irregularities and is not limited to code development integration [14].

Social networks generated in these research papers are designed for different research purposes and comparing them is a difficult task. In another research done on the management of complex projects a case study has been done on the Expo 2010 in Shanghai China in which emphasis is made on the management of complex projects management. The study suggests that as the project size increases, its structure becomes more complicated and environment and circumstances become unpredictable. In these situations old and traditional management methods and tools cannot overcome the increased complexity and remains inadaptable. The study depicts that uncertain conditions, sociality, interdependent events and project dynamics are the root causes of project management complexity.

In this study a view of differences between traditional and social management approaches has been discussed and also an integrated social network model is suggested for dealing with complex projects and analysis has been done for Shanghai construction. The study builds the model for the analysis of subgroups, Centrality, Betweenness Centrality and responsibilities of large complex organizations [15].

However in our model metrics are used and analysis has been done on communication management and communication network model is used for analysis to ease the burden of project manager and purely handles the communication management for the teams working offshore and linked through email, mobile and chat and data is extracted from the email, mobile repositories and chat sessions. We also use a threshold value '0' for none and '1' for having communication. However this value can be changed and adjusted according to the minimum or maximum desired level, thus making it adaptable to the project's required communication level.

## 7. Potential Research Areas

Communication analysis tool is helpful in communication management and is perfect for communication analysis. But there is still a lot of work which can be done for improving communication management. An auto email message can be created as warning to the employees which have no communication or communication below a certain threshold or auto appreciation mail to the employees who have communication above specific threshold. Consider the situation when there are thousands of employees, and it would become very difficult for the project manager sending them emails individually. An auto email message will help in better communication management and will also lessen the burden of project manager in this situation.

Allocating timer that is the time remaining for the second activity to begin in the message box of the employee with the message showing that u should complete your work before second activity starts because beginning of second activity depends on the output of your activity. And timer shows the time remaining for the activity completion. Adding the functionality of message

received and viewed can be added for resolving the future issues, such as lame excuses in some situations for not receiving or viewing the emails, so making the management more effective to deal such issues.

We can further make subgroups of networks on inter city communication basis forming micro network and inter country network and call it macro network and then can analyze micro network and macro network communication patterns. We can research on group external and group internal ties and applying statistical formulas such as sampling and standard deviations among the external and internal ties, randomly distributed ties can be calculated. More over a lot of work can be done depending upon the requirements of the projects. The graph can be further analyzed by studying connectedness, hierarchies, efficiencies and least upper bound (LUB) on the nodes. The most sensitive nodes or the nodes which are of most interest can be treated by applying most appropriate algorithms which best satisfy the objectives which we want to achieve.

For example; to be a pure out-trees each node must be in-order of one. This means, each actor has a single boss. This is called "efficiency" because structures with many different bosses have un-necessary redundant communication of orders from superiors to subordinates. The amount of deviation from this aspect of the pure out-tree can be calculated by computing the difference between the real number of links (minus 1, since the ultimate boss has no boss) and the maximum possible number of links. If the difference is greater, then there is higher inefficiency. This dimension then measures the limit to which nodes have a "single boss."

Time sampling can be used which with combination of user ids as well as location can help to track who is doing what where and when. Thus having a system which has complete information and tracking. If we have this then this world is not so far from us and every one is at the next neighbor of the other individual (a little idea of this we can take from face book). By applying transitivity and homophile we can further broaden our research horizons.

## 8. Conclusion

The current era has seen the communication management of the projects even though the bodies are geographically distributed by just extracting the data of emails, chat and mobiles and applying data mining techniques and showing the graphs on the basis of their communication relationship. We form matrixes of emails chat and mobile which give information about communication exchange and apply threshold values on these matrixes. A matrix shows network in the form of an array of units arranged in rows and columns. The results show the communication taking place and also the details of communication. The project manager can track interesting information by viewing the communication details. We also generate communication network analysis which is the chart of nodes and ties that depicts the natural communication relationship among the people. In our case it will show the communication relationship graph. A picture is worth than thousands of words. Thus by just viewing the nodes on graph project manager can see which employees have a communication and which are not communicating. So in this way this acts as communication analysis tool and helps the project manager in managing the effective communication among employees even if they are geographically distributed.

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