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IBM Research Report

White Paper on

MANAGING DISTRIBUTED TEAMS: TECHNOLOGICAL POSSIBILITIES

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1. Introduction

In an environment which has become increasingly competitive, distributed teams offer multi-locational organizations with an opportunity to contain costs in activities such as software development, research and services. The falling costs of communication technologies and the availability of a variety of collaboration and productivity tools has greatly helped to facilitate the process. While the availability of these technologies has greatly reduced communication and coordination costs and increased the effectiveness of cross-locational teams, there is a long way to go before one can really achieve the same level of productivity in distributed teams as one does in co-located teams.

It is not uncommon to find problems and issues of various kinds in remote collaboration which often lead to quality and delivery slippage. The problems may be of interpersonal or technical nature or may be caused by limitations of the communication and collaboration technologies. The extent of such problems may vary but they do pose significant obstacles to global organizations who wish to realize the full potential of distributed team operations.

2. The Problem of Distributed Teams

The present work is aimed at identifying some of the shortcomings in the existing collaboration technologies that limit the productivity of distributed teams. The approach is to first identify the contributing factors to team productivity that are typically present in co-located teams but absent in distributed ones. For this purpose, we have relied on empirical inputs (brainstorming sessions and interviews with researchers in IBM's India Research Lab. who have worked on distributed teams in the past) as well as the published literature on the subject. Once a framework is in place and the gaps identified, we examine the technological challenges involved in filling the gaps.

3. Preliminary Findings

Brainstorming sessions involving researchers from IBM's India Research Lab. identified three issues that are central to distributed teams. These are:

1. **Spontaneous Communication**
   Co-located teams benefit from the ability to communicate spontaneously without prior planning or intimation. Examples of spontaneous communication include (a) walk to a

person next door and ask a question and (b) run into a colleague in the lobby which leads to a dialogue.

2. **Informal Channels**
   Co-located team members have the opportunity to interact more often and in situations which are informal or even non-work-related. Examples including: (a) go out on a tea-break and have a discussion on a topic or idea and (b) meet and chat over the lunch table or in a party or get-together.
3. **Commitment**
   It was felt that face-to-face commitments (or requests) are usually stronger and are more likely to be honored than commitments transmitted over electronic media.

In another effort to get some insights into the problems that distributed teams may be facing, a number of researchers from IBM's India Research Lab. who had worked on distributed teams (involving other IBM research labs or divisions) were interviewed to find out the problems that they had encountered. The key findings from the interviews are:

1. **Inadequate social bonding** between remote participants had often resulted in
   a. lack of mutual trust,
   b. poor information flow, and
   c. low confidence in each other's ability and commitment to meet timelines
2. **Spontaneous communication and awareness** of others' presence were critical to quick resolution of problems and thereby greater productivity.
3. Distributed teams were often faced with **control-related issues**, for example, those related to the ability to observe others, coordinate people and monitor progress. These functions were much harder to perform over a distance and much less effective.

The brainstorming sessions as well as the interviews seem to point out that a major shortcoming in the capabilities offered by collaboration technologies is the inadequate support for social processes and informal channels of communication. These appear to be linked to a common root - namely, awareness of people and their activities.

Based on the preliminary findings, the study has been positioned to focus on investigating further the role played by social processes and informal interactions in influencing the outcomes of distributed team efforts. In order to put things in perspective and assess how well do the existing collaboration tools measure up, a framework needs to be defined.

4. Distributed Teams: A Framework

A framework to understand how teams interact and how social processes play a role in influencing team productivity and morale is presented below.

4.1 The Role of Social Processes

Co-located teams benefit from many social processes, the importance of which is often overlooked. Figure 1 lists some of these processes and how they influence teas. Being co-located usually ensures that people are aware of one another's presence and that they can engage in free and unstructured conversations. They are often a part of unexpected encounters (when one runs into someone else at a lunch-table or in the corridor) and interactions which extend beyond official matters. Being co-located also offers greater chances of having a conversation and understanding each other better thru visual signs such as body language. These innocent-looking social processes are fundamental to development of healthy working relationships and mutual trust amongst team members. They open up informal channels and ensure greater and free flow of information. The result is better coordination, sharing of project commitments by team members and development of a work culture that tends to be accepted by all. All these go a long way in enhancing team productivity.

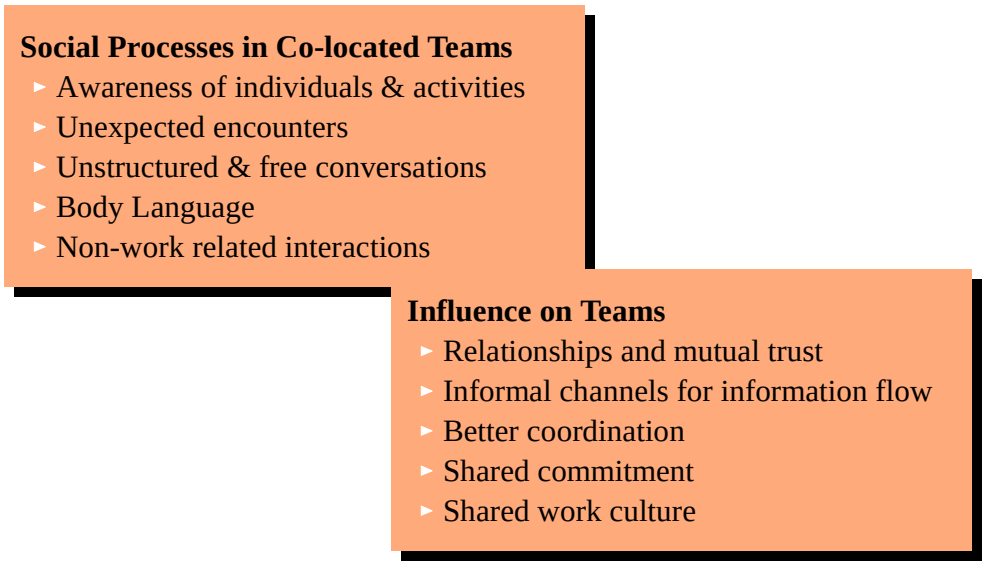

Figure 1: Social Processes and Their Influence on Teams

Distributed team members may be denied the opportunity to be a part of similar social processes involving their other team members due to the limitations of the communication technologies and / or collaboration tools which the teams must rely upon for any interaction.

4.2 Team Interactions and Productivity

Kraut et al.[1] distinguished four categories of interactions:

1. **Mutually Planned**: These include prearranged meetings such as a conference call, a review meeting or a project presentation.
2. **One-side Sought**: These are interactions initiated by one of the two sides. Examples are: calling up a colleague on telephone to ask a question, or walking upto someone's room to have a discussion.
3. **Anticipated**: These are interactions which are anticipated by one party but take place only when the two parties get to see each other. For example, one may wish to take up a matter with a colleague but may wait as he anticipates meeting him in the gym in the evening.
4. **Unexpected**: These are not anticipated by either party and happen unexpectedly. An example may be two people running into each other in the corridor and ending up having a discussion or a small chat.

The latter two categories are often referred to as *unintended interactions.* Kraut et al. estimated that such interactions account for upto 52 % of all the interactions that happened in the workplace that they studied. Isaacs et al.[2] conducted an internal study in Sun Microsystems and concluded that while people disseminated information through formal channels, they *retrieved* information through informal means (which included asking someone, waiting to run into someone, having unexpected informal conversations and using on-line tools).

We propose a framework for linking different type of interactions to team productivity. The framework is depicted in Figure 2. The leftmost boxes represent the four types of interactions described earlier. Of these, the mutually planned and the one-sight sought interactions are used by people to disseminate information and resolve expected issues. On the other hand, the anticipated and unexpected interactions are the primary means by which people receive information, discover or clarify things and develop relationships with colleagues. It turns out that both classes of phenomena are vital for teams for information flow, coordination, providing motivation, building mutual trust and commitment and having a shared culture. Therefore, enabling each of the four types of interactions is crucial for ensuring team productivity and project success.

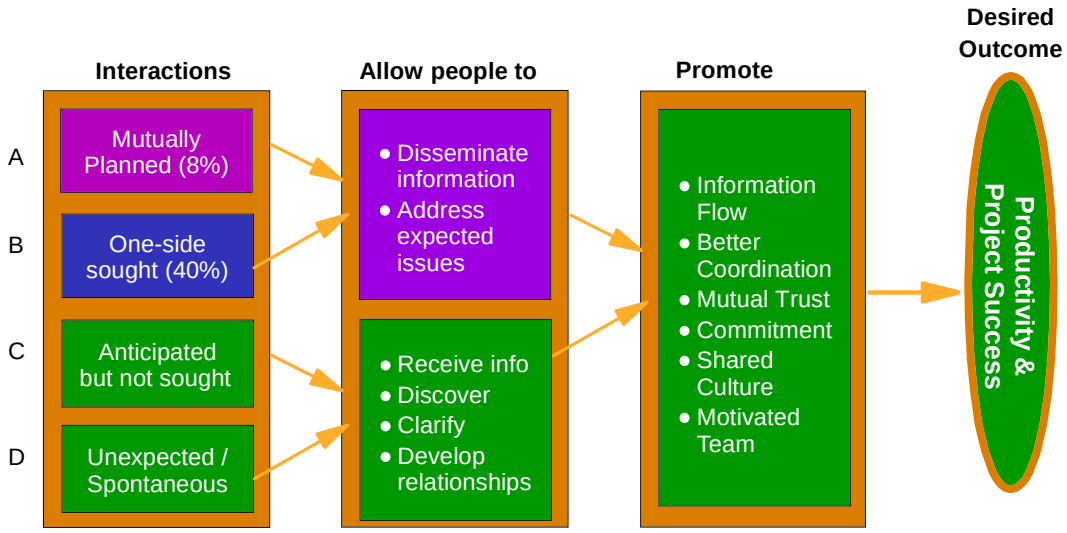

Figure 2: Framework for Interactions in Teams

4.3 Capturing and Reusing Knowledge from Interactions

The interactions between team members, whether planned, sought, anticipated or unexpected, all lead to creation of knowledge. This knowledge is typically not captured in the interactions in co-located teams due to the face-to-face nature of such interactions. This is particularly the case for informal interactions. On the other hand, all communication between remote participants must necessarily be technology-mediated. This presents the opportunity to capture knowledge with greater ease from the interactions that take place between members of a distributed team. Such knowledge may be captured even from unexpected or spontaneous interactions which is hard to do in a co-located team context.

The knowledge captured from interactions can be effectively reused in similar contexts that may arise within the scope of the same team / project or other teams or projects within the organization. While the opportunity to do so certainly exists, there may be potential privacy issues that may need to be taken care of.

5. Role of Technology

With the help of the preliminary findings and the framework, the roles that technology can play in improving the productivity of distributed teams can now be identified. Specifically, technology should provide capability to:

1. Enable all four forms of interactions (planned, sought, anticipated and unexpected)
   a. Provide means (capability)

b. Increase the probability of occurrence (facilitation)

2. Support social processes like:
   a. Awareness of individuals and their activities
   b. Unstructured conversations
   c. Non-work interactions
3. Provide tools for capture, organization and reuse of knowledge from interactions.

6. Existing Teaming Technologies

Figure 3 provides a mapping of some of the commonly used technologies on the dimensions of (a) the types of interactions supported and (b) extent of capture and reuse of knowledge from the interactions.

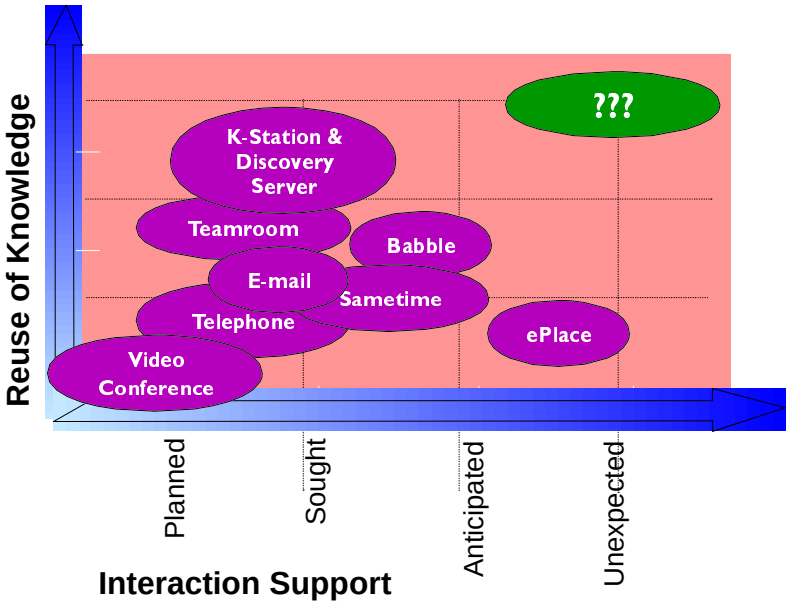

Figure 3: Capabilities of Existing Teaming Technologies

At the extreme left corner is *video conferencing* which is useful for planned interactions and where the capture and reuse of knowledge is not very effectively done without human intervention. *Telephone* and *e-mail* move up the chart both horizontally and vertically but are still limited to planned and sought interactions and offer very little knowledge management capabilities. Certain collaboration technologies from Lotus[3] like *Teamroom* and *Knowledge Discovery Server* (which uses a web-based front-end called *Lotus K-station* with *Lotus Discovery Server* as the back-end) move up the chart so far as knowledge management capabilities is concerned. The Lotus Knowledge Discovery Server also provides limited support for anticipated interactions through its integration with *Lotus Sametime* (which is a text chat software with recording capabilities and limited support for awareness).

There are at least two more technologies developed by IBM that deserve mention. One of them is *Babble*[4] which provides support for semi-structured conversations in a community or interest group setting. It also has some archiving capabilities, but does not offer sophisticated knowledge mining tools. The other is *ePlace*[5] which provides an online social interaction environment for electronic marketplaces (or Websites). The key aspects of *ePlace* include (a) spacial mapping of a given Website to a 2-D interactive site map, (b) support for social visualization (awareness) and (c) providing interactions mechanisms & enablers. While *ePlace* seems to provide the best capabilities for enabling anticipated and unexpected interactions amongst the technologies studied, the concepts and implementation would need to be adapted to a team context.

It is seen that there is no technology that supports unexpected and anticipated interactions and simultaneously provides capabilities for knowledge capture and reuse from the interactions.

7. Gaps and Opportunities

Two major gaps are identified from the discussion in the foregoing sections. These gaps and the associated opportunities are:

1. Absence of adequate (and controllable) support for enabling unintended (unexpected and anticipated) interactions amongst remote team participants in the same (or similar) way as they happen in co-located teams. There are opportunities for:
   a. enabling awareness of people and activities remotely, especially when there is a shared context,
   b. allowing people to be able to run into one another unexpectedly and have a free conversation and allowing then to be able to anticipate meeting someone at a given time in a given context, and
   c. providing ability to an individual to limit visibility and disturbability.
2. Nonexistence of technologies well suited for capturing information from interactions (especially from the unintended interactions) and tools for processing and reusing it in similar contexts in the organization. The opportunity is to create:
   a. tools for managing (capturing, preprocessing, classifying, storing and querying) unstructured information, and
   b. applications based on reuse of the captured information - such as labeling people with skills or for updating such labelings

8. Technological Challenges

The technological challenges relate to (a) the creation of the technological components that can fill the gaps identified above and (b) their integration with existing (and well used) collaboration technologies such as e-mail, chat, Teamroom etc.

We can discuss the challenges in the context of a hypothetical implementation scenario for the problem (Figure 4). It is expected that a remote participant (team member) may be accessible either from a desktop application (such as e-mail, Sametime (chat) or other collaboration tools in practice) or may be mobile and carrying a PDA or a cell phone. In either case, the information is captured from the formal and informal interactions that the team member engages in. On one hand, the information from the formal (structured) channels and the informal (unstructured channels) is preprocessed, integrated for further analysis and stored. At the same time, this (and stored) information is used to create awareness /context information and profile for the team member. The second step may be based on certain awareness and profiling models which may be customized for a given domain or context. The awareness information may be provided to the other participants and they thus have a feel for what the given team member may be doing and whether it is the right time and context for them to interact. It is evident that such an awareness of one another's presence and activities may lead to unintended interactions.

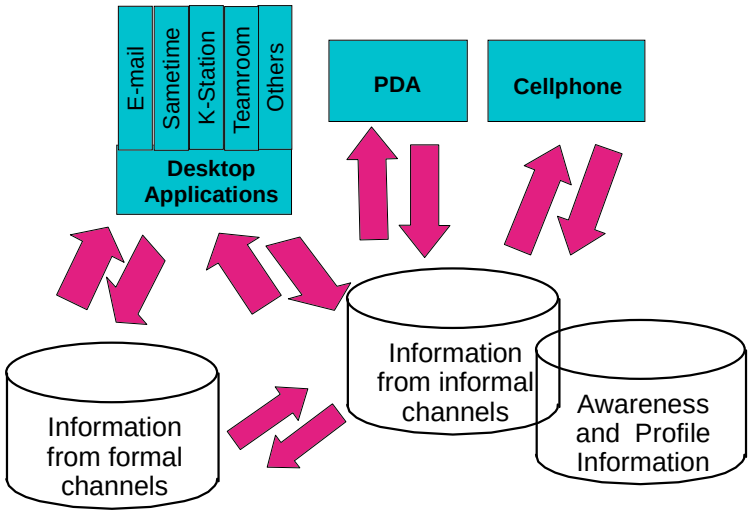

Figure 4: Hypothetical Implementation Scenario

Two sets of technical challenges are discussed, the first for enabling unintended interactions amongst distributed team members and the second for capturing and reusing knowledge from such interactions.

8.1 Enabling Unintended Interactions

As hinted in the preceding discussion, awareness of people and their activities is the key to informal exchanges, free flow of information and shared commitment. Therefore, the key technological challenges in enabling unintended interactions are likely to be:

1. Providing capability for capturing, managing and replaying awareness information on heterogeneous platforms. Implicit in this is a unified awareness model which will have to be worked out.
2. Providing the ability to be disturbed by others and also the ability to limit this feature.
3. Integration with collaboration technologies in use (e-mail, Sametime (chat), Teamroom, Discovery Server etc.).

8.2 Capturing and Reusing Knowledge from Interactions

The key technological challenges in capturing and reusing knowledge from interactions, especially those of informal nature, are likely to be:

1. Capturing knowledge from informal and unstructured interactions involving heterogeneous platforms and preprocessing of raw inputs (Natural Language Processing, Speech and User Interface issues)
2. Managing / organizing unstructured information and annotating / mining it for useful purposes (Knowledge Management and Unstructured Information Middleware issues)
3. Integration with document sharing technologies (Knowledge Discovery Server, Team Room) and other technologies that collect and analyze structured information (stored in relational databases).
4. Creating applications that reuse the knowledge - for example using the knowledge captured from informal interactions to update labelings of people with expertise/ skills.

9. Conclusions

The present whitepaper was aimed at identifying shortcomings in the existing collaboration technologies with the aim to improve the productivity of geographically distributed teams. For this purpose, we proposed a framework for analyzing how teams interact and how those interactions and supported by various social processes were linked to team productivity. By mapping the existing collaboration technologies onto the framework, it was found that they lacked in terms of their ability to support unintended (anticipated and unexpected / spontaneous) interactions and did not quite measure up as far as capturing and reusing

knowledge from these interactions was concerned. The study further identified that opportunities that were presented by these gaps and highlighted the technological challenges that may need to be overcome to realize them.

The whitepaper postulated that awareness of people and their activities is the key to informal interactions, spontaneous communication and shared commitment. Therefore, systems can support informal interactions by enabling awareness and providing means for team members to disturb one another (disturbability). This can be augmented with means for capturing knowledge from interactions and reusing then in similar contexts within the organization.

10. References

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