

# Supporting Payload Processing With Distributed Teams

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## **ABSTRACT**

*There are various technical and sociological challenges that face teams working in a distributed environment. These challenges must be addressed in order to enable the team to function properly and successfully achieve their goal. Communication advancements have enabled the implementation of spatially distributed teams. New and evolving technologies augment these capabilities. However, there is no single solution that guarantees a successful implementation. Furthermore, merely throwing technology at the problem may in some cases actually worsen the situation. It is therefore necessary to study the available technologies with respect to their situation specific application in a holistic and integrated way. Additionally, much consideration must be given to the human aspect of the team, and the necessary interaction between team members.*

## **INTRODUCTION**

In today's fast paced business environment, there are many drivers that create the need for distributed teams. Global competition is changing the scale of industry, and producing a need for quicker turn around, lower costs, and high technology. Additionally, the global market place is forcing many companies to distribute their operations and marketing teams.

For technology-based industries, the drivers are much the same, including some additional drivers. The complex nature of technology is creating a need for highly specialized skills and knowledge. In order to obtain these specialized assets, many companies are looking globally to fill the need. Moreover, in technology-based operations, such as the aerospace industry, companies are being asked to respond faster to more data with less people. Consequently, to increase speed and operational flexibility with smaller teams, distributed collaboration is inevitable.

Payload operations can utilize distributed teams to provide greater flexibility in operations, and communication platforms. Realizing the high costs associated with sending large teams of technical experts to the launch site, customers are requesting relevant test data be sent to their home locations. Launch sites must quickly embrace this capability in order to support globally distributed teams for payload processing.

One of the most manpower intensive portions of the pre-launch payload flow is the test and checkout function. This function occurs two and sometimes four times within a single flow. Due to the highly technical nature of this function, it is necessary to have a large number of technical experts on hand to assess payload health, troubleshoot, and correct identified problems. Based on this, customers traditionally send large teams of experts to the launch site for as long as five-month periods to work side-by-side with payload test engineers. If these customer teams could monitor the testing activities from their home plant, a large portion of the costs absorbed by the customer could be defrayed.

The processes at the payload developer's facility could be enhanced by employing distributed teams as well. Not only could the payload developer expand the team by employing experts not located at his development facility, but the experience of the experts at the launch site could also be brought into the team. Concurrent engineering practices could be used in the development of the payload, resulting in a higher quality, lower cost product.

There are many communications technologies available today which enable the functioning of distributed teams. In addition to the telephone, there is also email, videoconferencing, and the Internet. These technologies can be used in concert to orchestrate a distributed team-enabling platform.

The field devoted to studying and improving enabling technologies for distributed teams is Computer Supported Collaborative Work (CSCW). CSCW is defined as "a generic term that combines the understanding of the way people work in groups with the enabling technologies of computer networking and associated hardware, software and techniques." [1] Research has been ongoing in CSCW for more than 12 years. Closely coupled with CSCW is the use of groupware, which "is a generic term for specialized computer aids that are designed for the user of collaborative work groups." [1]

The reason that CSCW has a research field devoted to it that has been going strong for over 12 years is simple: it's a very complicated issue. No singular solution or technology has yet to be discovered which will serve the needs of all, or even most users. This is largely due to the fact that CSCW is addressing a problem which is "wicked." A wicked problem is described as one in which "the aim is not to find the truth, but to improve some characteristics of the world where people live." [2] Consequently, there is no "right" answer to the problem. Furthermore, the problem can only be understood progressively as more solutions are developed.

The human element injected into the problem requires the understanding of human relationships and how people work together to accomplish a task. It also requires an understanding of how knowledge is transferred. Knowledge is a uniquely human characteristic that cannot be duplicated by a computer. "What is read, seen, heard or felt isn't knowledge, rather it is the medium through which knowledge may be transferred." [7] Knowledge allows its possessor to "produce new and appropriate statements about a subject, not just reproduce the statements that were received."

Whether Knowledge is transferred from one team member to another is a function of two very subjective constructs [7]:

1. “The Similarity between the person’s context and the context described”
2. “The degree of congruence between how material is structured and how the structure of the domain appears to the reader.”

Consequently, it is very important to have a shared understanding of team members’ viewpoints.

As previously mentioned, there are many challenges with implementing and managing a distributed team. In the case of a Globally Distributed Team (GDT), there are cultural differences between team members, language barriers, and time zone differences. Additionally, of great importance to all distributed teams, especially distributed operations teams, are the issues of group situational awareness and team stress management and crisis handling. All of these factors influence the cohesiveness of the team. Another challenge is the task of managing the distributed team.

These challenges, in conjunction with the wicked nature of the problem, necessitate careful planning and forethought for the implementation of technologies and processes to support distributed teams. It is imperative that a planned, integrated approach be taken to solving this issue. All facets of the operations, as well as the effect of technologies on team members and on other technologies must be considered.

## **TECHNOLOGICAL SOLUTIONS**

There are many different technologies available to teams in meeting their needs for distributed operations. New technologies are emerging daily to further increase the technological options. The technology is developing so rapidly, in fact, that many companies fear implementing distributed team-supporting technologies due to a perceived lack of a stable platform.

### **Communications**

In order for teams to be successful, they must be able to effectively cooperate, or collaborate. The single most important key to effective collaboration is communication. Team communication can be divided into two classifications: direct and indirect.

Direct communication consists of the obvious, commonly used forms of communication such as phone, email, etc. The type of communication required for a particular situation depends heavily on the time/place matrix as seen in figure 2.

|                 |           |                |
|-----------------|-----------|----------------|
|                 | Same Time | Different Time |
| Same Place      | 1         | 2              |
| Different Place | 3         | 4              |

**Figure 2. Time/Place Matrix**  
(adapted from [1])

Communications in quadrants 1 and 3 allow for the use of synchronous communications (e.g. phone, videoconference), while quadrants 2 and 4 require only asynchronous communication (e.g. email, voicemail, fax). Likewise, quadrants 1 and 2 allow for the use of location dependant communication (e.g. white boards, shared computer workstations), while quadrants 3 and 4 demand location independent communication (e.g. application sharing, Internet).

Indirect communications refer to the information transferred by observing the execution of a task. For a distributed team, this could include observing a shared artifact being changed, or an event driven notification. In both cases, a direct communication link between group members was not established, however, the transfer of information was conducted.

## **Groupware**

The communication required for a team to complete a common task includes not only the exchange of information and the coordination of task-related activities, but also the coordination of the resources required to carry out the activities. More importantly, teams involved in command and control operations must possess a group situational awareness. This situational awareness is crucial to quick decision making and problem solving.

The best method of assisting in the coordination of activities, and providing a group situational awareness, is currently groupware. Groupware is an application, or set of applications that operate and interact over an intranet or the Internet. These applications can include shared workspaces, concurrent document editing, and event driven messaging to name a few.

Groupware is typically implemented through the use of agent technology. Various agents work autonomously and cooperate with each other to perform a global task. Basic agent functions include the execution of assigned sub tasks and the communication with other agents. This implementation works well with the event driven paradigm. An agent can monitor a specific set of tasks, and notify a master program when a given event occurs.

The master program will then compare the event with its rules to determine the proper action that should be taken.

The action that the master program generally takes is to notify interested users of the event. A more advanced function would be for the master program to interpret the meaning of the event through an expert systems program and then provide that information to the user.

Another promising capability of the event driven system, is the ability to record events, and then play them back later. This could be a great aid during troubleshooting. This historical data, could also help to compensate for the problems which arise from asynchronous frames of reference. Two team members working at different times would have access to the same set of information.

Filtering is a necessary attribute of this type of system. Not only does it prevent information overload by allowing the user to define the set of information he is interested in, it also provides the capability for security and privacy policies.

It is not as easy as it may seem to design a good groupware product – especially for a command and control environment. There are two basic types of tasks which a groupware program must be able to handle. Structured tasks are ones which can be planned out and are predictable. These are easy to account for. However unstructured tasks are inherently chaotic, and consequently cannot be predicted. These type of tasks could include trouble shooting and problem solving.

A good groupware product must take into account that a distributed team must perform these two very different types of tasks. The program must include different mechanisms to support the types of coordination necessary to carry out these tasks. The groupware should be capable of dynamically adapting, while possessing system freedom. Additionally, many applications require that the system capture as much information about the physical environment as possible, further complicating the requirements.

There is no abstract model that currently exists to describe an unstructured task. This makes designing groupware that will support the needs of a command and control distributed team very difficult. One model for designing CSCW groupware is the Locales Framework.

The Locales Framework recognizes that typical design methods are inadequate to deal with the complexity of lived cooperative work. The basis for the model is the unit locale. Rather than using the typical “space” metaphor for designing, the locale is a “place” which avoids a spatial view of the problem. “Locale is constituted in the relationship between a particular social world and its interactional needs, and the ‘site and means’ its members use to meet those needs, i.e., the space together with the resources available there.” [2]

In designing a system for distributed teams, it is important to focus on the relationships between team members and their environment. The pathways for information flow that were disrupted by physical relocation must be recreated through the use of computers.

## **The Internet**

The Internet has the capability to be one of the most powerful tools for enabling distributed teams to collaborate. One of its primary strengths is its platform independence. Most groupware products currently recognize this strength and couple their products with an Internet interface.

The Internet is not a perfect solution, however. Due to the inherent stateless nature of HTTP, the server retains no knowledge of the end user's status (such as what page he is viewing, or how long he has been viewing it). As we discussed earlier, the need for group situational awareness makes it necessary to have current information on what each member of the team is doing.

The need for this type of knowledge can be met through the use of JavaScript, cookies, and the Common Gateway Interface (CGI). Care must be taken, however, in the design of solutions. It is important not to interfere with the inherent advantages offered by the web, such as altering standards, platform independence, or requiring specialized client side software.

Another feature that must be accounted for when designing a CSCW system is tailorability of the user interface. This carries additional implications when dealing with a web interface. This tailorability **must** be accounted for in the design – it cannot be added later.

As systems mature and become more complex, the number of features and amount of information provided by the system tend to explode. Typically, however, the possibilities for user interface design remain limited. As a general rule, the more functionality a system provides, the more buttons, menus, icons, etc. must be used.

Comparing an experienced user with an inexperienced one, we can see an interesting contrast in the way users view and use the interface. A more experienced user will function more efficiently with everything “one click away.” This leads to a cluttered interface, which confuses an inexperienced user. An inexperienced user actually performs better with a simpler interface.

Additionally, different types of users will be interested in different data. Just as filtering is necessary on event based notification systems, tailorability of the user interface allows for customization of data presentation, and control of data volume, consequently leading to a greater degree of group situational awareness and greater team performance.

The primary fear of most businesses when utilizing the Internet is security. For this reason, security should be designed into the system as well. With the proper security

measures, a company should have no fear of using the Internet. It should be noted, however, that increasing security usually results in a decrease in usability. Because of this trade off, careful consideration of the user needs is required when determining a security policy for the system.

### **Technical Recommendations**

A comprehensive system should be designed to support the distributed team. It is vitally important that this system be designed in a holistic manner. The entire domain of the implementation should be scoped and accounted for in the design. The interrelationships between the various technologies should be considered and the system should be evaluated as a whole. Because the specific requirements for individual application will vary greatly, only a general set of recommendations will be provided here.

The system should be designed around its use, and heavy involvement from the end users will be required. As mentioned above, the true value of the system is to recreate the communication pathways that are destroyed by the physical distribution of the team. It is there to support the human element of the total command and control system.

Because payload processing involves command and control functions, the issues of group situational awareness and decision support are paramount. As mentioned above, a good GSS system can go a long way in providing group situational awareness. However, because of the nature of payload processing, the system must also support the distribution of the command and control displays used in processing the payload. This can most effectively be accomplished if the checkout system used in processing the payload supports this capability.

To further assist group situational awareness, notifications should also be sent out indicating the occurrence of important events within the testing procedure. For example the proper individuals should be notified when a power relay is switched on. These notifications should be filterable.

A very powerful tool that is currently under development by Command and Control Technologies (<http://www.cctcorp.com>) is the T-Zero<sup>TM</sup> Task Sequencer. This is an interactive module that presents the activities of the test in a Gantt chart format. The progression of the test is tracked and communicated to the rest of the team through this graphical interface. This capability is coupled with the ability to automate coordination of group activities. This also provides an excellent driver for event notifications.

One element not to be overlooked is the ability to transfer various forms of documentation in a real-time environment. In a distributed environment, it will not be possible for group members to gather around a drawing, use photocopied procedure changes, or share reference documents. For these reasons, all of the above resources should be maintained electronically in a single format for team use. Procedures should be run and updated electronically, and each team member should have the capability to view drawings and important documents.

Because of the wide variations in team member backgrounds, it is recommended that a high degree of tailorability be engineered into the system. Again this is most easily accomplished within the checkout system rather than through an additional layer of functionality. The notifications provided by the GSS should be filterable to allow the user to specify the volume of information that is desired. Another primary need for tailorability exists within the various graphical user interface (GUI) displays available to the team. These two areas of tailorability will help prevent information overload while allowing team members to optimize their performance based on their personal level of expertise.

Finally, the traditional communication mediums of audio and video should be incorporated. This can be accomplished through various means, including the implementation of streaming over the web. Voice communications can be supplemented by the use of instant messaging and electronic whiteboards. The video information can include not only payload operations but also team members via PC videoconferencing.

Obviously, bandwidth will be the greatest limiting factor in the design of the system. The ideal solution is the leasing of a T-1 or greater communication link for powered up testing operations. However, this is an individual design consideration that must be accounted for based on the specific system needs.

## **THE HUMAN FACTOR**

A large part of what makes the design and implementation of a CSCW system so complicated is the involvement of humans. Not only is this a human-machine system, but computers are merely acting as the enabling agents for the human team interactions. The injection of human nature into the system adds a component that is both unpredictable and uncontrollable.

In fact, the results of recent research indicate "the primary problems facing companies that use Globally Distributed Teams are not with the application of information technologies, but rather with their failure to effectively manage the human side of global teams." [9] A major contributor to this failure is the difficulty of building cohesive teams in the absence of face-to-face communication. One company struggling with implementing a GDT stated, "The combination of geographic dispersion of GDT members, lack of face-to-face meetings, and existence of multiple, important goals made it virtually impossible to establish a project team identity." [9]

Because of this, the human must be recognized and treated as an integral system element. The characteristics of human nature must be analyzed and understood, and the human

portion of the system must be bounded by removing the unpredictability and adding control. This can only be accomplished through proper training of the users.

## **Stress**

One of the greatest factors that influence behavioral response is stress. Stress can alter the thinking patterns of an individual, and lead to poor decision-making. Most people are used to dealing with stress on a daily basis, and therefore are generally adept at dealing with personal stress. Stress management can be taught if this is not the case.

One of the greatest dangers of stress, however, is that it will propagate throughout the team leading to a series of successively bad decisions based on faulty information. This is especially dangerous in command and control situations where critical decisions must be made in a very short period based on the individual's understanding of the problem, environment, and data.

In such situations, clear concise communication is essential to the successful solution of the problem. Human nature, however, works against such a happy ending. If we accept the Darwinian view of a diachronic change in language, then we accept that language is an evolved behavior and subject to adaptive pressures.

To further illustrate this point, prior to the relatively recent developments in communications, teamwork occurred in a common location at a common time. It can therefore be assumed that the members of the team shared both the same environment and the same general focus. Given a stressful situation under these circumstances, the most efficient means of communication is short, pronominalized sentences. For example, to a team working in a single location on a lifting operation the phrase "Look out. It's going to fall!" would have great significance, and communicate all the necessary information. Again, this is because the team is all co-located, and focusing on the same activity.

However, the advent of telecommunications and the physical distribution of teams makes just the opposite true. Team members no longer necessarily share the same location or focus, and consequently may not share the same stimulus or environmental context. Without this common context, short pronominalized sentences become ambiguous. This ambiguity leads to mistakes, and incorrect solutions to problems.

The addition of complex, highly technical systems further exacerbates the problem. Consider the true-life example of an airplane that loses one engine and becomes unstable. The pilot shouts to the co-pilot "Throttle it back!" Without thinking, the co-pilot reaches out and throttles back the one working engine causing the plane to crash and killing 47 people. This situation occurred in a common environment with a common focus. Imagine the further complications that can arise when individuals working on technologically complex systems are physically separated and focusing on different subsystems.

A study by the Space Coast Center for Human Factors Research at the Florida Institute of Technology [4] has shown that under stress, an individual's use of pronouns increases. Furthermore, the type of pronoun used is predominately exophoric (referring to a noun external to the context of the conversation), which further obfuscates the message.

Given that we know the affect stress has on human communication, and given that language is a learned behavior, it is not only conceivable, but advisable that members of distributed teams be trained in the proper use of language for their situation.

Furthermore, the antagonistic relationship of communication tends to increase the level of stress. The speaker wishes to say less to communicate his point, while the listener desires more information. Additionally, in the absence of non-verbal cues such as facial expressions, it is easy to misunderstand the tone of a team member's voice. For these reasons it is also necessary to communicate in a manner which clearly conveys the tone of the message, and verbal reassurances become much more necessary.

### **Situational Awareness**

In addition to effective communication, situational awareness, as discussed earlier, is essential to distributed operations and problem solving. Computers can both help and hinder this process. If the proper steps are not taken in the design of the CSCW system, the use of a computer will tend to conceal what people are doing, and how well they are doing it. Consequently, it is necessary to compensate for this using information flow.

Group awareness is defined as "an understanding of the activities of others, which provides a context for your own activity." [1] This type of awareness keeps the group members up to date with important events and contributes to the ability to make conscious decisions.

Greenberg [5] identifies four types of group awareness needed to collaborate effectively:

- **"Informal awareness** of a work community is basic knowledge about who is around in general, who is physically in a room with you, and where people are located relative to you."
- **"Group-structural awareness** involves knowledge about such things as people's roles and responsibilities, their positions on an issue, their status, and group processes."
- **"Social awareness** is the information that a person maintains about others in a social or conversational context: things like whether another person is paying attention, their emotional state, or their level of interest."
- **"Workspace awareness** is the up-to-the-minute knowledge a person requires about another group member's interaction with a shared workspace if they are to collaborate effectively."

These various types of awareness must be transferred to the user of a CSCW system in order to create situational awareness. To model this awareness in a program, an orthogonal array can be used as seen in Figure 3. It consists of two different

classifications of awareness. Coupling refers to a situation in which two users are focusing on the same work and are aware of each other. Uncoupled means that the two users are unaware of each other. Synchronous refers to being aware of current events, while asynchronous refers to knowledge of past events.

|                  | <b>synchronous</b>   | <b>asynchronous</b>   |
|------------------|--|---|
| <b>coupled</b>   | What is currently happening in the actual scope of the work? | What has changed in the actual scope of the work since last access? |
| <b>uncoupled</b> | Things of importance which occur currently anywhere else?    | Has anything of interest happened recently somewhere else?          |

**Figure 3.** Modes of awareness [1]

In addition to group awareness, individual awareness must be taken into account also. This can be described by two characteristics: nimbus and focus. Nimbus refers to the location that a user is occupying. Focus, however, refers to the location where the user is looking or providing his attention. This means that two individuals can have different nimbus but the same focus, and visa versa.

An extension of this concept is the metacognitive skill that allows an operator to understand and adapt to the frame of reference of other team members. In order for a team to work at optimum levels, each team member must maintain a mental model of every other team member's nimbus and focus. This will facilitate understanding between team members and greatly aid in communication and group problem solving. This skill should be taught to system users, just like the communication skills.

### **Teambuilding for Performance**

Teambuilding provides the foundation for the team to work effectively. It is commonly accepted that team development is important to the success of a team, especially one operating in a distributed environment. In spite of this fact, however, "a significant number of companies tend to neglect team building, failing to include it as part of the corporate philosophy, objectives, or reward system." [12] This is a fact that must be corrected.

In order for a team to function optimally, it must share common values and meanings among its team members. This is necessary to support the collaboration that makes teams powerful organizational tools. The team must be able to "think together" which requires a common basis for understanding concepts and discussing problem resolution.

A key concept that is supported by the Dialogue Theory [12] for teambuilding is the "container". This is the concept that all the ideas, beliefs, and comments that team members have shared are housed within a common container. The larger this container is, the easier it will be for team members to communicate and solve problems. It is vital that an adequate level of psychological safety exist within the team to allow a large container

to be constructed. Psychological safety refers to the freedom to brainstorm, present new ideas, and admit lack of knowledge without fear of ridicule.

A shared team vision can be a powerful tool in creating long-term commitment in team members, as well as increasing the cohesiveness of the team. A common vision ensures that everyone is working together toward the same end, which fosters unity. This cohesiveness is a critical factor in the performance of the team. Research has shown that team cohesion and conflict have both a reciprocal and a causal relationship. Furthermore, it has been shown that cohesion and performance are co-related.

Team building strives to take the individual skills of strangers and convert them into a group of interdependent team members. "Basics such as how to give and receive feedback, how to communicate concisely, and how to use effective listening skills are crucial to a group's effectiveness in tackling the challenge of team building." [13] Successful teambuilding will lay the foundation for a successful team.

## **Trust**

One of the major challenges of distributed teams is building productive relationships between team members. Because it is possible for team members to never meet face to face, barriers can form and it can be difficult to build trust. Additionally, there is little time for team members to interact on a personal level to get to know each other. This can lead to additional team stress, and decreased performance.

It can also inhibit the free interchange of information and ideas. It is necessary for team members to feel psychologically safe within the team. Additionally, trusted communications require less of a communication channel, since a common understanding between the parties already exists.

Trust can only exist in an environment where the team members believe the team will be mature and consistent in its behaviors and approach to problem solving. There must be mutual respect among the team members and they must feel valued by the team. "Trust increases as people learn (a) the rewards and punishments for trusting behavior, (b) who to trust and how predictable people are in their trusting behavior, and (c) the shared beliefs and values of the group's collective identity." [14]

Trust can be extremely hard to build in a distributed environment. However, research shows that in such an environment trust can be built through actions rather than relationships. One such method of creating trust is through the communication interactions of the team. The theory of swift trust [14] asserts that when an individual initiates an interaction, such as an email, trust can be built with those who respond to it. In other words, team members begin to trust that when they send a message to the team it will be responded to. It is not important whether the response is in agreement or disagreement - but rather whether the team acknowledged it. This acknowledgement signals that the team values his or her contributions. Trust is also built when members of

the team do what is asked of them. By demonstrating that they can be depended upon to complete the tasks that they are responsible for, trust is built with the team.

The issue of trust must be addressed and handled by management. Activities should be slowly transitioned from safe to risky as trust builds within the team. The proper use of communication technologies at the right time can also help in creating trust within the team.

### **Allegiance**

The manager has another important task when dealing with distributed teams (especially GDTs), which is to manage the team allegiances. Often the team is composed of members who work for different companies, live in different countries, and operate different subsystems. To pull all these different individuals together into a single team with a common goal is a daunting task.

The manager must be aware that networks rather than the overriding goal of the project usually motivate members of GDTs. Networks are groups of individuals who share common interests and jargon. It is usually more important to the individual to look good in front of this group of peers than to meet the project goal. The manager must find ways to provide team members network recognition while working toward the goals of the project.

### **Human Factor Recommendations**

Team building is a process and not an event. A process must be designed to intentionally create the behaviors desired from a team operating in a distributed environment. This process must be repeatable, and its outcome predictable. It must build trust, and create shared meanings, values and goals for the team. In this way the corporation can successfully and consistently create effective, high performing teams. This training is the only way to constrain the unpredictability introduced into the system by incorporating humans.

The team should be introduced in an informal manner outside the structured environment of the team. Since it is not possible to have such interactions prior to the start of a meeting - perhaps over coffee - another means must be provided. One possibility is for each team member to construct a personal web page. This page should include items such as hobbies, interests, age, gender, a photograph, even favorite jokes or cartoons. In this manner team members can begin to feel as if they know the other members.

Although the challenge of teambuilding in a distributed environment has been largely overlooked, a few technologies are emerging which may assist in this effort. Group Support Systems (GSS) such as Teambuilder use hyper-information environments to focus on the issues of coordination and delegation of responsibilities among distributed team members. This employs the use of multiple media formats - such as pictures, audio, and video - to increase the richness of the communication channel.

Desktop video conferencing is also beginning to show promise for use in distributed teams. Advances have been made which allow the video to be viewed over the Internet. This is still at a slow frame rate, however, and has a long way to go. Even so, desktop video conferencing provides another tool for increasing the richness of communication among team members, and for providing a forum for teambuilding.

The recommended solution is to arrange a meeting of the team at the onset of the project. The increased performance from the team may warrant the cost incurred, however, additional research is required to validate this belief. This initial meeting should be structured such that the team is taken through the teambuilding process.

Regardless of whether the initial teambuilding occurs in a virtual environment or face to face, the use of a facilitator is strongly recommended. The facilitator should work parallel to the team and serve to assist in the team forming while not interfering with the decisions made by the team. This facilitator should use dialog to assist the team in creating a large container of shared meanings and ideas. The initial meetings often set the tone for the team, and the facilitator must work to empower the team members and release their potential.

For teambuilding, it is necessary that the following conditions be met:

- Everyone on the team must be present.
- Adequate time must be set aside with no interruptions.
- The purpose for the training must be established with the team.
- A structured format with clear and measurable objectives should be used.
- Future actions for team members to take should be determined.
- A follow up to measure the results and determine the next step should occur.

Since the basis of teambuilding is good communication, the facilitator should focus discussion on the various aspects of effective communication. In this way, the group awareness of the attributes of effective communication will be elevated. Furthermore, the special demands placed on communication in a distributed environment should be pointed out. The expectations for the manner in which communication takes place should be set forth, and explanations of how interaction can build trust should be made. Additionally, the facilitator should focus on the concepts of leadership, individual/group goals, norms, roles, cohesiveness, and situation.

The individual goals of each team member should be aligned with the team's overall goal. The facilitator should ensure that the group agrees on its goal. A team member working to a hidden agenda can be very disruptive to the team and hinder productivity.

The facilitator should also help to guide the foundation of the team norms. The norms are the rules that the group follows. These dictate what behavior is acceptable and unacceptable within the team. Obviously this can have a direct affect on performance.

Role definition is another key aspect of teambuilding that can be furthered by the aid of a facilitator. Each team member must be aware of what his or her role is. The facilitator can help team members determine what is expected of them as well as what to expect from others. As discussed earlier, it is vital in a distributed environment for team members to live up to the expectations that the team has of them. This is the primary way to build trust in a virtual team.

The facilitator should also work with the team in performing activities that strengthen the cohesiveness of the team. These activities should emphasize compatibility of team members, cooperation, and acceptance of other team members. The environment of psychological safety should be established, and the team should feel open to communicate and contribute in a creative way.

Finally, the situation in which the team is to perform has a definite impact on the teambuilding process. Factors such as team size, location, gender makeup, setting, purpose, and time constraints for project completion can have a major impact on group communications. The facilitator should identify unfavorable aspects of situation and work to create an environment of creativity and mutual trust.

### **CONCLUDING REMARKS**

This paper demonstrated the various complexities involved in teambuilding within distributed teams. Because of these complexities, it is recommended that a carefully planned process be formed to meet the needs of the distributed team. The proper tool or tools should be employed to ensure the proper communication pathways are present and provide adequate group situational awareness and decision support. This tool should be designed as an integrated system based on the specific use and end user requirements.

Furthermore, the use of a facilitator to assist in teambuilding is highly recommended. The facilitator should have excellent communication skills, and be knowledgeable in the issues discussed within this paper. It is recommended that proper training be provided for team members, in the form of an initial teambuilding session. Obviously a face-to-face session would be the best means for conducting this training, but if this is cost prohibitive, current technologies should be designed into the process to compensate for the decreased richness of the communication channel.

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