# Communication in International Distributed Research Projects: Experience from an EC Project

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**ABSTRACT**
This paper links communication to effectiveness of international projects. It also highlights our experience in managing a large research project involving participants distributed over several European countries. In this study, first we discuss international projects and the impact communication can have on management and project success. We then present classifications of communication media, a review of the relevant theory, our experience in using several media in international research projects, and finally our recommendations as to media choice. This work reflects knowledge gained through managing such projects, and participation within similar efforts. These findings are supported through additional survey results.

**General Terms**
Management, Performance, Design, Human Factors.

**Keywords**
Distributed project management, project communication, communication effectiveness, communication in international project.

## 1. INTRODUCTION

In Europe, three trends have led to an increase in co-operative research projects involving more than one country. First, the trend toward focusing on core activities [16] led companies to concentrate on what they do best. They rely on other partners to supply all the other activities needed to address the needs of the end user. Such partnerships call for collaboration that extend the company borders and led to the emergence of the so called extended or virtual enterprises. Second, improvements in Internet communication technology makes it easier to co-operate with partners distributed geographically more than ever before. Third, cooperation is also driven by governments' desire to foster co-operation among its members in order to facilitate their integration as well as knowledge transfer between well developed and less. Several programmes partially fund the cost of such research co-operation.

Recent surveys of project managers [[7],[12]] as well as communication experience in international projects [14] indicate that adequate communication is one of the keys to successful project management. However, these surveys and research do not indicate what effective communication in such projects is. Some results of these surveys, and from an additional European Commission report, are presented in Section 2.

Project management is a process that is composed of four phases: initiation, planning, executing and closing-down. Frequent communication helps to assure project success [15]. Communication includes four key elements: sender, recipient, content and communication channel. Fitting the

style, and frequency of communication to the style and culture of the recipient, the phase of the project, and the purpose of the message, adequate communication channel is also of importance.

This paper reports our communication experience within international projects. Section 2 presents success factors in project management. Section 3 discusses communication characteristics. Section 4 links these characteristics to recent research. Then, section 5 presents our experience and findings. Paper concludes by summarizing our findings and point to future research directions.

## 2. LITERATURE REVIEW

### 2.1 Success Factors for Distributed Project Management

Organizations pursue co-operative research for many reasons. Brockhoff [1] indicates that sharing knowledge is the most often cited motivation. The co-operative motivations (share knowledge, focus on strengths, develop relationships) outnumber the financial motivations (share risk and pool funds) by almost 3 to 1 [1]. Attention to adequate communication among the participants will help this co-operation to deliver the hoped-for gains.

According to Brockhoff [1] pool funds is a determinant of cooperation within international projects. Distributed projects can be funded partially by an outside agency, or can be strictly an agreement between the parties involved. The first survey [[7]] discussed in this paper deals with the first type, specifically projects receiving partial funding from the European Commission. The second survey [[12]] is more general but focuses more on projects funded by the participants themselves. While, the funding agency may impose an additional burden upon project management, the results of the two surveys do show significant similarities. The next two subsections present factors identified as management issues (though they may be influenced by communication), and factors dealing with communication. This is followed by a subsection presenting additional concerns when these projects are international and co-operative.

Success factors for distributed project management could be categorized in management, communication and factors.

### 2.2 Management factors

With regard to management issues, both surveys [[7]; [12]] identified factors dealing with strong directed leadership as critical. In addition several books of project management insist on the vital role of leadership to achieve project success.

What may be the most important attribute contributing to a successful projects is having a common vision from the start. This further leads to a good match between the goals of the individual participants and the aims of the project as a whole.

When working in a project there are some tasks that need to be done on individual level, while some tasks are shared. Accordingly many people on the project will depend on the individual performance. Yet an individual is a member within a team and the team must work to achieve a common project goal. Working within a team must entail a certain amount of give and take. There are several dimensions of the cooperation and coordination that influence the project team work. The first one allow team member to share a clear understanding of the project's objectives. The shared vision helps team member keep their priorities straight and not all small items of little significance to become overwhelming and distracting. Member of high-performance teams work independently, relying on each others' strength, develop effective means of communication, give each team member the autonomy to do whatever he or she believes is best for the team and for the project. Perhaps the next most important factor is anticipation of potential problems, and having the means to deal with these in place before these occur. While this may start by documenting the shared vision mentioned above, it will include several more

steps: (i) A consortium agreement. Which is a document describing what the goal of the project is, what is expected of each participant, and what the procedures will be to resolve conflicts. (ii) An Intellectual Property Rights agreement, a document that describes what each partner brought to the project, and how the property developed in he project can be used. It further describes the access the consortium will have to background property in order to exploit what has been developed in the project. These management considerations were not specifically seen as questions of communication in past communication literature, but indeed require the ability to get others to share beliefs and goals. To share a vision requires a mutual understanding of goals and direction. Usually intensive interaction is needed in order to produce agreements acceptable to all participants. While not presented as communication issues, achieving these goals requires communication for success.

### 2.3 Communications factors

Both of the two surveys [[7], [12]] explicitly identify good communications as the second most important factor, once the project has defined both its common and individual goals, documented these, and put in place procedures to deal with the unforeseen events.

The second survey [[12]] contained many responses indicating a need for frequent, high-quality communication. Among these were: (i) listen and communicate well; (ii) enhance communication to improve relations with (contractor, partners, own firm); and (iii) hold frequent face-to-face meetings.

In fact, "'Listen and communicate well'" was the most frequently cited *critical success factor*, and "enhancing communication" was the single most frequent suggestion for improving relations with the customer or funding agency, among the partners, and with a partner's own organization. While these were the most frequently cited single responses, there were more separate suggestions dealing with goals and agreements. That is, the sum of suggestions dealing with goals and agreements exceeds the sum of suggestions dealing explicitly with communications, as seen in table 1.

Table 1: Critical Success Factors [12]

| Critical success factors | Frequency |
|---|---|
| Listening and communicating well | 14 |
| Enhance communication to improve relations with partners | 9 |
| Hold frequent face-to-face meetings. | 8 |
| Mutual objectives / or matched | 7 |
| Knowledge and passion | 5 |
| Mutual respect | 4 |
| Adapt to different cultures | 4 |
| Dedicated coordinator/ throughout project. | 2 |
| Reporting | 2 |
| Formal methods in place before conflict | 2 |
| Believe in project | 1 |
| Mutual interests | 1 |
| Budget control | 1 |
| Trust | 1 |
| Regular face-to-face meetings | 1 |

A CEC (Commission of the European Community) report describing experience within its Sprint research program [[2]] points out "... good communication : (a) reduces the likelihood of mistakes or misunderstandings occurring, (b) allows different viewpoints to be reconciled more readily, and (c) supports the strengthening of interpersonal relationships between network partners."

### 2.4 Communications in international projects

Co-operative research projects involving participants from several countries bring additional communications challenges. We pointed out that one of the goals of these projects was to bring together researchers and others from different backgrounds and countries. While this helps achieve many noble goals, it does introduce additional challenges. The CEC Sprint report [[2]] summarizes some of these factors in Table 2.

**Table 2 Factors hindering effective intra-network communication**

| Factor | Hinders network communication because |
|---|---|
| Cultural differences | Not all words will be understood fully by other network partners |
| Technical differences | Not all technical actions will be understood fully by other network partners |
| Differing levels of experience | Not all network members will have a similar level of understanding of events and tasks |
| Large number of partners | It is difficult to maintain regular contact between all partners |
| Geographical remoteness | It is difficult to maintain close contact with all partners |

Besides the aspects impacting co-operation in international projects identified above, we find that there are additional management differences. Development projects carried out by a single business unit will be able to use the management structure of the business itself. Even when these projects involve the co-operation of associated companies (in an extended or virtual enterprise) the larger business effort can lend structure to the project's management, by defining authority and responsibility. This may not be true in co-operative research projects. The project manager is responsible to the funding agency for the work defined but has little management authority over the participants employed by other business or government entities. This makes project communications, especially from project management to participants, more difficult and more crucial.

The CEC report concludes that face-to-face meetings may be the best way to deal with the problems it identifies, but that these can be expensive. Other means such as telephone, mail, and fax, should play a supporting role. However, several newer forms of communication have become much more widely used since the CEC document was written, in particular instant messaging and SMS technology. This paper will discuss the use of these, both independently and in combination with project meetings.

## 3. CHARACTERISTICS OF COMMUNICATION

Both surveys [[7], [12]] listed good communication as one of the most important factors leading to project success. However, the surveys do not discuss the characteristics of communication. Further, they give little insight into what good communication entails. In this section, we will present properties of communication messages, and classify available methods by these properties.

### 3.1 Properties of communication messages

Whether in person or electronically supported, messages have several characteristics that could impact their effectiveness. Among these are: (i) direction (one-way or bi-directional); (ii) number of participants (One-to-One "1-to-1", One-to-Many "1-to-M", or Many-to-Many "M-to-M"); (iii) timeliness (synchronous vs. asynchronous); (iv) activity (is the receiver active (pull) or passive (push)). In the context of this paper, "push and pull" are determined by who initiates

the information transfer to the receiver. *Push* is sent directly to the receiver from the sender, while *pull* has the sender first deposit content to an intermediate location where the receiver then retrieves it. Email can be referred to as a *push* medium. An email message is pushed to the receiver, while a comment posted to the web is pulled by the receiver.

To this list we can add two additional characteristics: Social presence and urgency. Social presence may at first appear to be binary (physical vs. virtual). However, the virtual methods vary in their ability to give the feeling of meeting or of social presence (see [[11]]). Therefore, presence may best be described as a scale, where presence of value 1 indicates physical presence (or the inability to distinguish from it) and total absence would be of a value zero. On this scale, a telephone call might have a presence value of 0.7, while instant messaging associated with a web cam may have a presence of 1. Urgency is an additional property of the communication media. In our management of international projects, it refers to the sense of urgency felt by the receiver when conducting a specific task. The greater the sense of urgency the more likely the receiver is to act within a reasonable time. Obviously, there are times the project manager would wish the participants to feel a reasonable level of urgency. As this is a subjective measure, we have provided a ranking in Table 3. Methods that give the highest sense of urgency receive a ranking of 1

Table 3, adapted from Nabeth *et al.* [[10]], links the six previous characteristics to different communication means.

The values for some of these measures are subjective, and reflect the opinion of the authors. These values are also static, in that they show neither interaction among the properties nor between the methods. There may indeed be such interaction. For example, an email from a project manager may carry greater urgency directly before a project review.

| Communications methods (Means) | Characteristics of communication | | | | | Goal |
|---|---|---|---|---|---|---|
| | Direction | Number | Synchronicity | Active/ Passive | Presence | Urgency |
| 1. Visit | ⇔ | 1-to-1 | S | P | 1 | 1 |
| 2. Meeting | ⇔ | M-to-M | S | A | 1 | 1 |
| 3. Telephone call | ⇔ | 1-to-1 | S | P | .7 | 3 |
| 4. Telephone conference | ⇔ | M-to-M | S | A | .6 | 4 |
| 5. Video telephone conference | ⇔ | M-to-M | S | A | .7 | 4 |
| 6. Fax | ⇒ | 1-to-1 | A | P | .4 | 6 |
| 7. Email | ⇒ | 1-to-1,1-to-M | A | P | .3 | 8 |
| 8. Web page posting | ⇒ | 1-to-M | A | A | .3 | 9 |
| 9. Letter | ⇒ | 1-to-1 | A | P | .2 | 7 |
| 10. Web newsgroup or forum | ⇔ | M-to-M | A | A | .3 | 10 |
| 11. Newsletter | ⇒ | 1-to-M | A | P | .1 | 10 |

**Table 3. Communication dimensions Nabeth *et al.* [10]**

| Rank | Ranking of communication for exchange of routing information | | Generating new ideas / brainstorming | |
|---|---|---|---|---|
| | Results from King & Xia | Results from WCSN | Results from King & Xia | Results from WCSN |
| 1st | Phone | Email | Group meeting | Group meeting |
| 2nd | Face to face (1to1) | Phone | Face-to-face | Face-to-face |
| 3rd | Email | Fax | EMS | Phone |

| | | | | |
|---|---|---|---|---|
| 4th | Group meeting | Message board | Phone | Message board |
| 5th | Voice mail | Voice mail | Email | Email |
| 6th | Fax | Group meeting | Fax | |
| 7th | Note | Letter | Note | |
| 8th | Electronic meeting systems (EMS) | | Letter | |
| 9th | Letter | | Voice mail | |

**Table 4. Preferred Media in WCSN and from King & Xia [9]**

Fit communication methods to management tasks

The choice of appropriate communication methods will be influenced by how effective a method is regarding its characteristics and its intended purpose. Kahai and Cooper [[8], p27] pointed out that the effectiveness of a communication system is the *fit* between the characteristics of the task and those of the communications methods. King and Xia [[9]] state that research into choice of media for communication has centred on two theories: *social presence theory* [[11]] and *media richness theory* [[3]].

Social presence theory refers to how well a medium allows users to perceive others as actually present, by transmitting information about "facial expression direction of looking, posture, dress and non-verbal, vocal cues" [11, p.65]. According to the theory, communication tasks differ in their needs for social presence. Appropriateness is determined by how well a medium's characteristics provide the level of presence required. For example, tasks involving interpersonal skills, such as negotiation, require high social presence.

Media richness theory refers to a medium's ability to convey certain types of information. Ranking media in terms of media richness (richest first) would yield the following [[9], p. 880]: face-to-face, telephone, email, written addressed documents, and unaddressed documents. Media richness then ranks tasks in terms of their analyzability. Media choice then matches rich media to unanalyzable tasks.

Tushman and Nadler [[13]] presented an information processing model. Kahai and Cooper [[8]] adapted their model and introduce four communication dimensions to be considered when fitting communication method to management task. These four dimensions are the following: time delay, language type, communication configuration, and number of messages.

*3.1.1 Time delay*

Time can occur in real time communication. For example, there is a time lag between sending and receiving mail. However, this delay is not intentional. Kahai and Cooper [8] refered to this as asynchronous real time communication. Delayed communication stores the message for later retrieval by the receivers. With *real time communication* "synchronous" the message is received directly by its receivers.

*3.1.2 Language type*

It refers to what types of languages do people use when they communicate Kahai and Cooper [8] adapted the concept of language type from Daft and Wiginton [[4]], who present a list of different types of language ranked in decreasing levels of ambiguity. The list may include art, nonverbal cues, poetry, general verbal expression, jargon (special language of accountants, engineers, etc.), linguistic variables (semantic differential, Likert scale), and computer languages.

*3.1.3 Communication configuration*

It combines the dimensions of number and active/passive users (how many users are involved in a communication). One-to-many refers to the example, when a manager communicates with its subordinates seeking reactions for a specific task. There are six configurations: One to One, One with one, Many to one, One with Many, Many to many, and All with all.

*3.1.4 Number of messages*

It refers to how may exchanges are required to complete a task. This requires few or many exchanges, depending of a single/ complex task. Request and delivery of a technical report (simple task) can be executed with just two exchanges. Negotiating a contract (complex task) may require many exchanges

King and Xia [9] pointed out that several empirical studies have failed to predict media choice based upon either of these theories. Their study looks at 11 communication tasks in a single

company, from resolving disagreements, to staying in touch, and nine communication media. Their results (see table 4) show that the preferred media are face-to face meetings and telephone over all tasks.

While the analysis and results of King and Xia [9] can be instructive, the setting limits the usefulness to us. We are concerned with distributed consortia, King and Xia dealt with a single office setting. Face-to-face meetings become less practical when the project participants are located geographically dispersed throughout Europe as the case of EC projects.

The above research states that effective communication requires a fit between the characteristics of the communication method and those of the task. We will now discuss the tasks, focusing on the international project environment.

## 4. COMMUNICATION IN AN INTERNATIONAL SETTING

### 4.1 Type of task in an international context

Communication within a project can support many different activities. Project management is often divided into project management and technical management (see table 5).

**Table 5. Technical tasks vs. Management control [8]**

| Characteristics of communication | Technical tasks | Management control |
|---|---|---|
| Time delay | Delayed | Real time (possibly delayed) |
| Language Type | Natural and special purpose languages | Natural (though some manager use jargon) |
| Number of messages | Few | Few to frequent |
| Communication configuration | Many with Many | One [ to *or* with ] [ Many *or* One ] |

Consistent with project management structure, we can consider two main tasks: Management control and technical tasks. Managerial control is principally concerned with how efficiently and effectively resources are utilized and how participants are performing. Technical tasks are related to how to carry the specific tasks fixed in the project by management, to evaluate new ideas, communicate new knowledge, and ways to distribute information to member participants. Such tasks require *co-operation* between participants of the project. The terms *control* and *co-operation* indicate that basic nature of these activities is quite different.

It is reasonable to assume that the communication methods to support these two activities would also differ.

Table 5 indicates that the characteristics of communication for managerial control often differ from the characteristics of communication to support technical co-operation. It would be reasonable to believe that the best methods to support such communication would also differ.

As international projects require both technical and management communication, let us use the above terminology for management control and co-ordination tasks.

Technical communication is used to address unstructured decisions to solving problems and help achieve co-operation among different involved parties. By definition, the project is many-to-many configuration. Co-operative technical tasks would often not be delayed, and may often require more messages to solve problems, and participants in the project may use natural and special purpose languages (e.g. flow chart, UML to generate different graphical representations). International projects also require management communication.

### 4.2 Communication Methods used in an international project

We now wish to compare the classifications presented in sections 3.1 “characteristics of

communication" and 4.1 "type of tasks" to our experience in participating in and managing an international distributed and Esprit project, World Class Standards Network (WCSN). This project lasted for two years with a total fund of €2.170.000 budget and included 11 partners from Europe. During WCSN, we used many different forms of communication media, coupled with regular project meetings. All the 11 communication media cited in table 3 were used.

The popularity of these communication media varied from partner to partner and by task. Because of limited space, figures 1 and 2 compared the use of two most used communication media by participants over the last year of the project WCSN. These media are email and postings to the web site's discussion groups.

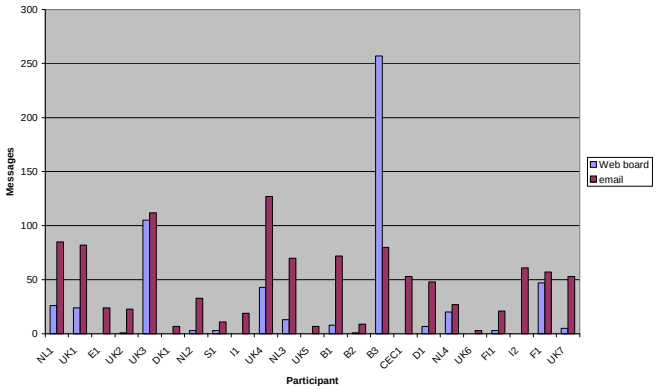


**Figure 1. Messages per project participant**

The above chart gives several insights into the use of electronic messaging by individual participants in the project. We must also note that participant B3 was also the web page developer, so his high web usage may reflect this duty. Results reveal also that email is generally the most popular media for participants originated from the 11 European countries: Netherlands (NL), United Kingdom (UK), Denmark (DK), Spain (E), Sweden (S), Italy (I), Belgium (B), Germany (D), France (F). For example, there are participants that only used email but none that only used the web board. It should be noted that there are those participants who did not use e-mail too (i.e. participants among the 11 who are not cited in figure 1). E-mail was used mainly to reach a common and shared vision of the project, assign participants to tasks, and solve technical problems.

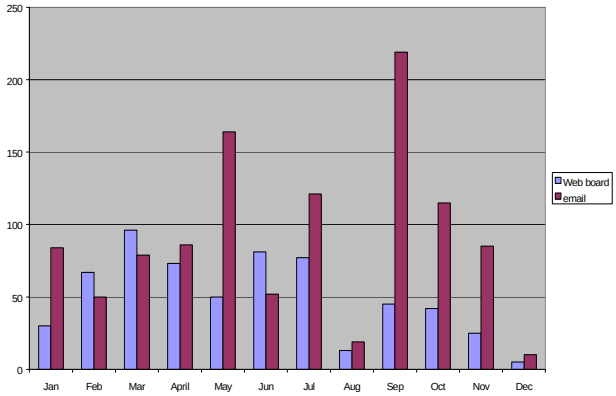


**Figure 2. Number of exchanged Messages per month**

The usage pattern for messages per month, presented in Figure 4, also indicates some findings of interest: (i) email is more popular, and (ii) email usage varies across time. It should be noted that there were major project meetings in June and October (see figure 2). Email traffic was especially heavy before these meetings. This is explained by the need to prepare the final documents required to review the project by the EC commission.

## 5. LESSONS LEARNED FROM MANAGING INTERNATIONAL PROJECTS

In this section we wish to offer our experience in the management of international projects, as it relates to communication.

Let us now compare the results from King and Xia [[9]] to our experience with the WCSN project. Table 4 offers such a comparison based on the rank of the 9 methods. The comparison is not based on any frequency or observed events, instead it is based on our experiences.

Note that while the results are almost similar, the impact of distance can be seen. WCSN preferred email for routine information, and would never use a face-to-face meeting for this. For generating ideas, the two groups preferred roughly the same media "group meeting", limited by what they had available. For this task, both groups preferred physical contact and richer media.

### 5.1 Management differs from technical work

If we take distributing information as a management task, and generating ideas as a technical one, we see that media choice differs between the two. "Speed" and "clarity" are preferred for management, richness for technical tasks. Even though the ranking (see table 4) differs between the two groups, these results seem to hold. The King & Xia study found face-to-face meetings ranked second for the management task, WCSN never uses a one-to-one meeting for this. However, in a single office building, a one-to-one meeting would be fairly quick. With a separation of 1000 kilometres they would cease to be.

For management tasks where distance and cost eliminate face-to-face meetings, the method we chose depends on the importance. To get commitment to complete an important task, we found a personal telephone call to be most effective. Further, we find this unaffected by the country called. If a telephone conversation has two parts, establishing contact, and performing the task, we find that culture impacts the social part much more than the task part. Once the social preliminaries have been dealt with, getting down to work remains much the same in telephone conversations throughout Europe.

Where the goal of a management task may be to get a commitment or to get a task done, the goals of technical communication tasks are to share information and ideas, stimulate discussions, and produce results. As these goals focus on information rather than commitment, transmission of content becomes more important. In the international setting, this can give asynchronous methods an advantage. When the project language is English, we find an important distinction among non-native speakers between depth of English language knowledge and speed of usage. We have had several partners from non-English speaking countries who demonstrated this difference. They may have been reluctant to speak in group meetings and a bit uncomfortable in telephone conversations. This is also a common observation in other international project [14]. However, the asynchronous nature of email and web postings allowed them the time to submit high quality, well-written comments in group communications

### 5.2 First speed then urgency

While speed may be the first consideration for management tasks, it is certainly not the only one. Often, a manager expects a response to a message. Response certainty is also a function of the perceived urgency of the message. Table 3 includes an urgency measure. If email, with a relatively low level of urgency, does not provoke the desired response, managers will use media with higher levels of urgency. This may progress from a telephone call or SMS or instant message to a visit, if required.

One critical negotiation over intellectual property rights became deadlocked. The partners involved communicated directly and through the project management, both by email and telephone. To break the deadlock, the method with the highest perceived urgency was used. The project managers visited the partners concerned. They reached an agreement. While the content of the in-person discussions may not have differed greatly from the telephone conversations, the direct meeting obtained the agreement sought.

### 5.3 Cultural fit

The WCSN is a wide project (includes 11 European countries). To manage the project, we adjusted of choice of communication. For

partners in the Nordic countries, often email was all that was needed for managerial control (i.e. driven by the the communication content). However, we have found that partners Mediterranean countries, such as Spain, act more quickly if contacted by telephone (i.e. driven by personal contacts). This result highlights a cultural difference between north and south of European countries. This observation is also shared by Rutkowski et al., [14].

The project ran for three years, Figures 1 and 2 present the results for the last year only. We found that email use in many of the SMEs increased significantly over the three years.

Besides impacting choice, culture can impact the effectiveness of communication. Within European Countries the relationships between management and workers can vary significantly. This can impact the use of, say, email and telephone. For example, we have found what a Spanish project manager finds as simple request can be perceived as unduly harsh in northern European countries such as the Netherlands.

### 5.4 Benefits of archiving in communication

While telephone and physical meetings may have many benefits, creating a record of communication is not one of them. An archive of email messages in and out establishes a communication record that can be used to resolve disputes or to use it as a work book. Most businesses also maintain copies of letters and faxes. Formal meetings also generally have minutes. However, a record of the content of a telephone conversation as well as informal meeting is difficult to produce or to track.

While not producing legal documents, this archiving function can quickly settle disputes. During a meeting late in a project, two partners disagreed about who had been asked to do what and by when. The argument ended quickly when one of the parties presented the requesting email from the project manager as well as an answer from the other party showing his agreement to the task and timing.

### 5.5 Role of meetings to foster trust teamwork

Meetings, either small group, or one-to-one, achieve many objectives. An initial, so-called kick-off, meeting establishes personal relationships that can be maintained through other means. Further, periodic meetings can stimulate individual performance. The flurry of activity before the major meetings, as seen in Figure 1, attests to this. Participants often sense a greater need to be on schedule for a group meeting.

Meetings are also a better method of dealing with subtle, strategic, or sensitive issues. This is consistent with the previous research cited above.

We were also involved in a project that had the participation of a professor at one of Europe's top business schools and one of the largest venture capitalists in Europe. The terminology and even languages used by these two differed significantly. However, upon meeting face-to-face at a project meeting they were able to adapt quickly to each other and establish goals for the project that made sense to each of them and met with their individual needs.

Meetings also have an advantage for team-building that other forms of communication lack. It is often said that the true value of an academic conference is not obtained from the sessions but from the casual meetings by the pool. So much of the success of co-operative international projects depends upon the trust and goodwill between the partners. Activities such as the dinners after a day's work help build this trust and goodwill.

### 5.6 Project phase

The choice and appropriateness of communication media is also influenced by the project life-cycle. Consider the following project phases: Proposal, kick-off, goal agreement, technical work, review and wrap-up.

Between project phases, milestones take places. A milestone is a checkpoint established to allow review of work progress so that management can take a decision. Before a co-operative project becomes a reality, it starts life as a proposal. While co-operative projects do require negotiation, the additional up-front cost of physical meetings may not be justified. Often, the entire proposal is generated through email and telephone co-operation. The partners need to assess the additional cost of actually meeting, against the benefits in terms of a greater chance of an accepted proposal and potentially fewer problems in the actual project.

The partners must meet at least once toward the beginning. If they did not get together for the proposal then they should meet for a *kick-off* meeting. Not only does this allow them to get to know one another and agree on common goals, but by matching a personality to a name, it improves the effectiveness of future communication. If the partners have not agreed upon goals at the kick-off they may wish to meet again. Alternatively, if adequate personal relationships have been established, they may be able to converge upon common goals through electronic media.

The technical work of the project must be such that it can be supported through electronic communication media. Otherwise, there is little point in a distributed project. Management can also track, monitor, and stimulate the technical work through email, telephone, and so forth. The evolving results should be available to the participants by accessing a common web site.

Projects funded by or performed for an outside party will be reviewed. Not only are such reviews physical meetings, but preparing for them should be also. It is a rare project where preparation for the review does not require a rehearsal, and a meeting to decide how best to present the results.

Once the project is completed, wrap-up and further activities may require further meetings or may be handled in a similar fashion to management control. This depends mostly on the nature of what activities are planned to exploit the project's results.

## 6. CONCLUSIONS AND RECOMMENDATIONS FOR PRACTICE

From our experience in the WCSN and other projects, we provide the following recommendations: (i) Use email as the first communication choice for management control activities. (ii) Escalate to media with a higher urgency and presence if email does not produce results. (iii) Provide a web based service, both as a discussion board and as an archive of project documents. (iv) Use meetings when appropriate. (v) Prepare video-conferences properly or instant messaging technology. A poorly planned video conference adds little benefit and is more difficult to set up than a telephone conference. However, a video or telephone conference linked with simultaneous electronic access to documents, drawings, or figures, can be more productive than a telephone conference alone. One-to-one telephone conversations can also be more productive with simultaneous electronic document access. (vi) Mix Media. One clear conclusion emerging from these experiences is that in many situations the question is not 'what is the best communication channel', but that of 'what is the best mix of channels'. Often a task will require a combination of types of communication, which is then best facilitated by using a combination of types of communication channel.

Two examples may clarify the above recommendations.

***First***, when drafting a complex document the basic principles regarding content and structure were defined in a face to face meeting. After a first draft was completed by one of the participants the document then went through a number of fast iterations with comments being exchanged by email on an hourly basis. Next a telephone meeting among three participants was

needed to iron out some difficulties after which a final version was produced.

Second, similarly, when finalising the program of a scientific conference, an initial draft was produced by the program chair which was sent by email to all participants. The next day an intensive email discussion started. At the end of it 78 email messages were sent by four participants over a period of 7 hours. Finally a 35 minute telephone meeting was needed to finalise the program. This experience was successfully repeated in one year after. In this way we succeeded in replacing the expensive and time consuming one day meeting that had been previously required.

Note that in both examples the phone meeting could only take place after the knowledge exchange of the email had been concluded. This allowed the participants to focus their minds, exchange relevant information and identify the remaining real issues. On the other hand the email did not provide the quick exchange of ideas needed to solve these final issues, for this the medium 'phone' was more suited.

Maintain good relationships among participants in the project. As stated above, projects require trust and goodwill between the partners to reach their goals. A manager in a distributed research project often has responsibility but little authority. The personal relationship between the manager and the partners is often the main motivating force. To assure success, a manager working in this environment must use whatever tools are available to build and maintain healthy relationships with the partners. If most partners prefer email but one responds best to telephone calls, then call that partner and call frequently. Do what it takes to build a team spirit, including meeting as a group from time to time. As the success of the project depends upon the team working together, this is time and money well spent.

Match *push* and *pull* to the receiver. *Push* may seem more appropriate for urgent messages because it does not require the recipient to seek the message. However, its effectiveness depends on the receiver. An actively involved project participant that also receives a high number of email messages per day may very well check for postings quite regularly and may resent additional email. The ability to retrieve information at will gives the receiver a greater sense of control.

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