A Taxonomy of Internet Applications for Project Management Communication

Steve D. Giffin, 120 35th Street, Hermosa Beach, CA 90254–2020 USA

The Internet is a worldwide communication system particularly suited for project management communication. Project management, as defined by the Project Management Institute (PMI Standards Committee, 1996), is a temporary endeavor undertaken to create a unique product or service. This temporary and unique nature creates a need for communication systems that can be deployed rapidly and used by diverse, interorganizational teams to share information with minimum training and administration (Giffin & Stankosky, 2000). Consequentially, the Internet and other electronic networks have facilitated the evolution of virtual project organizations: temporary organizations that depend on communication to accomplish projects from a distance (Guss, 1998).

Nevertheless, coordinated efforts to use the Internet to improve project management are only at an experimental stage in many project management disciplines (Giffin & Jefferson, 2000). For example, the architecture, engineering, and construction (AEC) industry has been targeted by several vendors offering a variety of specialized Internet-based services, known as project sites or project portals for project management (Doherty, 1999). However, only 1% of AEC firms have reported using this technology, and there is skepticism about its benefits as well as concerns about liabilities such as security issues (Roe & Phair, 1999).

In the field of project management research, there is a notable lack of peer-reviewed studies that demonstrate the effectiveness of Internet communication in a project management environment (Giffin & Jefferson, 2000). In fact, one study that measured the effectiveness of e-mail and other communication tools in virtual organizations determined that e-mail often is perceived as contributing negatively to project success (Enghavanish, 1999). Therefore, understanding how the Internet is best used in project management is an important consideration for firms attempting to improve the effectiveness and efficiency with which they execute projects. This issue can be addressed by creating a taxonomy that characterizes Internet applications according to their technological characteristics inside a framework that is relevant to project management communication.

Background

Traditional Categorization of Electronic Communication Mechanisms. Traditionally, communication has been defined as a basic four-element model consisting of a sender, a receiver, the medium, and the message (Figure 1). Although communication taxonomies generally include each of these elements to some extent,
they are concerned primarily with describing the selection of an appropriate mechanism, i.e., medium or channel, to encode, transmit, and decode the message.

Categorization of communication mechanisms is important as a means for describing the selection of the most appropriate channel given the requirements of a particular message (Robbins, 1998). The selection of a communication mechanism also can influence the quality of information received. The relationship between communication mechanisms and effectiveness is recognized presently in the field of knowledge management, where viscosity, or channel richness, is used to describe the ability of a communication mechanism to transfer information-rich content (Davenport & Prusak, 1998).

Some important research in the use of electronic tools for group communication preceded the widespread organizational use of Internet applications by several years. The taxonomies created by these researchers generally categorized communication tools in terms of time/synchronization and place/distance.

First, Johansen, Sibbet, Benson, Martin, Mittman, and Saffo (1991) defined electronic communication tools used by groups as same time/same place, same time/different place, different time/same place, or different time/different place (Figure 2). Electronic tools for same-time/place communication were considered synchronous because interactive communication occurs in real time. Theoretically, such communication can substitute for face-to-face conversation. With asynchronous, i.e., different-time communication, one party cannot respond until the other has finished sending. E-mail is an example of asynchronous communication.

In different-place communication, geographic separation prohibits face-to-face communication even if the participants are communicating simultaneously. Conferencing and other electronic technologies for remote communication are examples of different-place tools.

With same-place technology, participants either use the same electronic tools synchronously or asynchronously, such as with an electronic meeting room (synchronous) or a workstation used in shifts (asynchronous).

In another well-known approach, McGrath and Hollingshead (1994) characterized communication by the task being accomplished in addition to classifying tools according to dimensions of contiguity and synchronization. They described e-mail as a distal, asynchronous technology, which may cause the natural order of messages to be disrupted. They considered text-based e-mail a poor fit for tasks of increasing information requirements based on its relatively low richness. Technologies judged more appropriate for such tasks were audio or video systems and face-to-face systems.

Limitations of Traditional Taxonomies. One limitation of classifying Internet tools by time and distance is the decreasing relevance of these factors in the contemporary business workplace. When groupware taxonomies were introduced in the early 1990s, integration of local area network technology and Internet communication was not common. (Note that electronic networks are identified as same place/same time in Figure 2, while Internet tools are categorized as different place/different time."

However, in the late 1990s, Internet applications, particularly e-mail, became very popular business communication tools, even when traditional methods might be better suited due to factors of task, location, or relative effectiveness (Jefferson, 2000). The present popularity of e-mail and intranet-based Web technology has contributed to the realization that electronic networks and Internet tools currently are considered anytime/anyplace technologies—a concept considered futuristic by Johansen et al. (1991).

Internet tools that are useful in project management communication include e-mail, static Web sites, groupware, conferencing, and discussion group applications (Giffin & Stankosky, 2000). E-mail, Web sites, and discussion applications use client/server technology, while conferencing applications may be implemented in peer-to-peer or client/server configurations. Groupware is deployed on the Internet through database-backed Web servers that also may implement discussion and conferencing applications or employ other Internet technologies such as file transfer. The characteristics of these underlying technologies have distinct implications for the types of
project management communication for which each tool is useful. Some of these technological characteristics are discussed in Table 1.

**Proposed Framework for Categorization of Internet Applications**

**Requirements for Categorization Scheme.** Like the approach of the traditional communications model, there are advantages to making the message the central component of a taxonomy for Internet communication in project management. Primarily, this strategy allows communication to be defined independent of the project and its context, therefore creating the possibility that the new taxonomy can define many types of communication, all of which may be used at various times in a project. In addition to the message-centricity of the traditional communications model, the concept of synchronization from Johansen et al. (1991) also is useful. Notwithstanding the contemporary notion of Internet tools anyplace/anytime, there are still important differences between the tools in terms of their ability to facilitate real-time communication.

However, the traditional taxonomies did not address other relevant attributes of Internet applications and project management, e.g., the use of Internet applications in the send-only mode and the suitability of certain applications for this specific task, such as static Web pages. This consideration can be addressed by including one-way communication as a distinct class, the appropriateness of which is supported by the project management function of disseminating information or providing reference material.

Another consideration that should be addressed is the relationship between the utility of Internet tools and the number of recipients of the message. For example, a Web page may be a better method for delivering information to a large diverse group than e-mail, if the sender does not have an effective means of maintaining an e-mail distribution list. This and similar types of situations may be considered by including the number of senders and receivers as a dimension of the taxonomy.

Last, the proposed taxonomy must have a level of detail sufficient for describing a full range of communication needs in project management while having only the minimum number of categories necessary to differentiate between the available Internet tools.

**Proposed Categorization Framework.** The identified requirements include the synchronization between the sender and receiver, the number of senders and receivers, the possibility of one-way communication, and the ability to describe each of these about an individual message. Incorporating these into a two-dimensional taxonomy produces the framework of Figure 3. This scheme accounts for the consideration of one-way communication as a special category of synchronuousness. Combined with asynchronous and synchronous two-way communication, a full range of communication possibilities is provided on one axis.

On the other axis, the number of senders and receivers varies from one person communicating with one to many people communicating with many. The categories on this axis may be defined rigidly or loosely depending on the capabilities of the tools being classified. If justified, additional divisions on this axis could include one person communicating with a few, a few people communicating with a few others, a few people communicating with many, and so on.

The framework of Figure 3 also is independent of distance and location. For example, a group of people in one room could carry on many one-to-one conversations about different subjects. Because the subjects are different, each conversation represents an individual message, and the communication type would be synchronous one-to-one. However, if all were conversing freely about the same subject, the communication type would be synchronous many-to-many. In fact, both types of communication could occur simultaneously in one place because it is the message not the location that determines the communication type.

Nine categories of communication are defined by the basic framework of Figure 3:
- **One-Way 1:1.** One sender sends to one receiver;
- **One-Way 1:Many.** One sender sends to more than one receiver;
- **One-Way Many:Many.** More than one sender sends to more than one receiver;
- **Asynchronous Two-Way 1:1.** One sender communicates non-interactively with one receiver;

**Figure 2. Categorization of Electronic Tools**

<table>
<thead>
<tr>
<th><strong>Internet tool</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td>Electronic messaging service capable of sending text messages and attached files over local area networks and the Internet. Users receive messages in their inbox and can reply, forward, or store them for later use. To send a message, the user must know the e-mail address of the receiver.</td>
</tr>
<tr>
<td>Static Web pages</td>
<td>Documents viewed in a Web browser, which may include text, images, files, and hyperlinks pointing to other Web pages or e-mail addresses. Static pages exist as files and reside on a server, which may be attached to the Internet or an intranet. To access a Web page, users must know the address of the page, which commonly consists of a registered domain name, the name of the Web server, the name of an individual file, and a three-letter extension.</td>
</tr>
<tr>
<td>Web-based groupware</td>
<td>Web sites that implement traditional groupware features such as a personal task lists, calendars, integrated e-mail, private and shared folders, or scheduling. Examples may include e-commerce, search engines, “project sites,” and online communities. Web-based groupware typically requires a log-in process that identifies the user and provides tools to facilitate interaction with other members of the “community.” Contents of groupware sites are stored as entries in a database rather than a static file. Web pages are compiled as necessary by the server so they always reflect the most current data. Unlike static Web pages, users can upload data to a database-backed site.</td>
</tr>
<tr>
<td>Discussion groups</td>
<td>Specialized messaging system that allows many users to review and respond to comments or questions from others about a common topic. Also called online group forums, discussion groups may be implemented through Lotus Notes, Usenet Newsgroups, or as part of an online community or groupware package. Special features may include the ability to search for messages, receive e-mail updates, and assign different levels of access such as read-only, author, and moderator. To submit or read messages, the user must know the name of the forum and have write-access if the forum is protected. Because some forums are replicated in several locations, recent posts may not show up until the next scheduled replication, often the next day.</td>
</tr>
<tr>
<td>Video/audio conferencing</td>
<td>Transmission of interactive voice or video images over a private network or the Internet. May require special software/hardware, but the capability to receive video or audio also can be implemented through a Web browser. Users can initiate videoconferences provided they have the appropriate tools, or they can join multicast groups and view video playing from a server.</td>
</tr>
<tr>
<td>Text conferencing</td>
<td>Two-way interactive text conferencing with a potentially unlimited number of users. This includes “chat rooms,” “instant messaging,” “net meeting,” and other common applications. Conferences may be hosted on a server, where the users can join a group discussion, or they may operate “peer-to-peer.”</td>
</tr>
</tbody>
</table>

| **Table 1. Utility of Internet Applications in Project Management** |

- **Asynchronous Two-Way 1:Many.** One sender communicates non-interactively with more than one receiver;  
- **Asynchronous Two-Way Many:Many.** More than one sender and more than one receiver communicate non-interactively;  
- **Synchronous 1:1.** One sender communicates interactively with one receiver;  
- **Synchronous 1:Many.** One sender communicates interactively with more than one receiver;  
- **Synchronous Many:Many.** More than one sender communicates interactively with more than one receiver.

**Relevance of Proposed Framework to Project Management Communication.** The two axes of Figure 3 encompass several important criteria from the perspectives of Internet applications and project management. First, the axis that describes the synchronization of senders and receivers also describes the ability of the communication to include contextual cues and personal reaction. Therefore, it is a measure of the suitability of a tool for problem solving or knowledge transfer.

The other axis, which represents the number and relationship of senders and receivers, is important from both technological and management viewpoints. From the standpoint of management, an increase in message recipients implies an opportunity to reduce cost and risk by exploiting electronic communication. For example, the Internet is used in construction projects to reduce cost associated with revising and publishing blueprints (Tedeschi, 2000). The cost savings from this activity will consequentially be more attractive as more people need a set of plans. Similarly, the risk of someone not receiving an important update will be reduced if all use a common system.
From a technical standpoint, the cost of implementation and support also is related to the number of parties involved. For example, if only a few need to communicate, e-mail may be the least expensive form of communication. However, if the cost of implementing and maintaining a Web site can be spread out over many, the Web becomes a more efficient mechanism for providing information.

The Completed Taxonomy

**Categorization of Internet Applications.** To populate the taxonomy, the characteristics of Internet tools in Table 1 must be considered within the bounds of the framework of Figure 3. The optimal position of each tool in the matrix is a consequence of two factors. First, the technological characteristics of some tools may prevent their inclusion in certain areas. For example, the only tools that facilitate real-time communication are conferencing technologies. The others are either one-way or asynchronous-only mechanisms.

Second, the efficiency with which certain tools can be used in different organizational environments should be considered. For example, although it is possible to use e-mail to provide information to a large number of people, if the information is on a Web site, the sender is not burdened with keeping track of e-mail addresses. Additionally, if the recipients are unknown to the sender, the Web is the only mechanism that is suitable. Conversely, if two-way communication is required in large groups, a Web-based groupware system that allows participants to subscribe to distribution lists may be the most effective.

The justification for categorizing the Internet applications based on technical and management aspects (as summarized in Table 2) is:

- **Conferencing Applications.** Conferencing applications are the only tools in Table 1 that are capable of supporting real-time communication. Consequently, they are the most appropriate tools for each type of synchronous communication in the model. Conferencing applications may support text, audio, or video transmission, however audio and video transmissions are best suited for small groups with few connections due to bandwidth requirements. Additionally, as the number of active participants in video and audio conferencing grows, it becomes more difficult for individuals to follow the conversation. Text conferencing is less vulnerable to this limitation because all contributions to the conversation are displayed in the same window and participants can scroll upward to view previous comments. Therefore, text conferencing should be better suited than video conferencing as the number of participants increases.

- **E-mail and Web Communication.** Compared to conferencing, e-mail and the remaining Internet applications are not real-time. However, by virtue of their lack of synchronous operation, they allow the user to review and respond to messages at the most convenient time, thereby increasing efficiency. E-mail is well suited for individual one- and two-way communication and may be used effectively with larger groups, particularly if all participants are members of the same organization. However, as the number of e-mail participants increases, the challenges of maintaining large distribution lists and supporting individual e-mail clients and external programs for viewing attachments becomes a burden. In particular, Web-based communication is more effective when a group is not associated with a single organization. Unlike static Web sites, which are primarily suited for one-way communication, database-backed sites can implement two-way communication protocols and provide customized content, security, and user authentication. Because they are more efficient than conferencing applications, e-mail and Web communication are more appropriate for
### Internet application | Technical and organizational attributes
--- | ---
E-mail | Useful for sending individual messages; This is best suited for one-to-one communication. It also may be used for communication with several people with some success.  
Static Web sites | Useful for dissemination of information to large groups; it becomes increasingly useful as the number of people increases who need access to information.  
Web-based groupware | Best suited for structured communication within moderate to large groups; The only type of Web site that allows two-way communication.  
Discussion groups | Best suited for allowing large, unassociated groups to follow topics of interest; The only non-interactive Internet technology that truly facilitates collaboration.  
Conferencing (Audio/video) | Best suited for interactive communication of complex information; Best suited between two parties (May be used by more than two parties although effectiveness diminishes rapidly).  
Conferencing (Text) | Useful for interactive communication between larger/more diverse groups where audio/videoconferencing are not practical.

**Table 2. Attributes of Internet Applications**

asynchronous and one-way communication. Web communication is preferable as the number of participants increases. In the case of one-way Web communication, static pages are most efficient and are preferable. Database-backed sites are required for two-way communication:

- **Discussion Groups.** Compared to Web and e-mail communication, discussion group applications allow many senders to collaborate on the content of the message. Like e-mail, discussion group applications are message-centric, i.e., participants in the conversation can view a list of replies to each individual message and respond to any comment as they choose. Unlike e-mail applications, messages are not delivered automatically to a user’s in-box. However, as the number of users increases, this attribute becomes less inconvenient because discussion group applications allow users to select messages to be read before their contents are retrieved. Last, discussion group applications allow senders to provide information or submit responses without knowing the identities of the other participants in the communication. For this reason, discussion group applications are well suited for communication in which the participants belong to many organizations. If the participants wish to restrict access to particular messages or restrict communication to certain participants, discussion-group applications also can be implemented through database-backed Web sites that can provide both security and authentication. Based on their ability to support collaboration, discussion groups are most appropriate for many:many communication, except in real time. However, e-mail and Web sites are more convenient and, therefore, more appropriate when there is only one sender.

**Population of the Taxonomy.** To accommodate the attributes summarized in Table 2, a subcategory of communication must be added to the framework of Figure 3 between the 1:1 and 1:many classes. This additional class, represented as 1:few communication, is useful for describing the case in which the participants share some sort of relationship, e.g., they belong to a common organization. For example, a common association allows technologies such as e-mail to be used effectively, whereas unassociated groups would find e-mail less effective due to the absence of a common directory of addresses.

The completed taxonomy is presented in Figure 4. The areas where each Internet application was deemed most appropriate are depicted with shaded ovals. Areas where the ovals overlap depict the expectation that more than one application may be used effectively.

**Discussion**

**Application of the Taxonomy.** The completed taxonomy should be viewed as a tool for structuring project communication systems based on the synchronization and relationship characteristics of project communication requirements. For example, if the ability to collaborate by asking questions and reviewing others’ results is important to the success of a project, then technologies suited for asynchronous many:many communication should be provided. According to Figure 4, discussion group technologies suit these requirements.

If the ability to provide information to many parties is important to the success of the project, Web sites should be used for maximum efficiency. Conversely, if most of the project communication is expected to be 1:1, the use of e-mail should be encouraged and resources made available to facilitate audio/videoconferencing.

Table 3 demonstrates a hypothetical analysis that employs the framework of the taxonomy to categorize project information elements. In Table 3, the dimensions of synchronization are defined in terms relevant to project communication. One-way communication includes providing information, as well as the creation and maintenance of project documentation.
Two-way asynchronous communication is described as offline communication to represent communication that might typically take place through channels such as regular mail, facsimile transmission, or interoffice memos. Synchronous communication primarily contemplates information that would otherwise be exchanged or created in meetings or on the telephone.

The steps involved in preparing an analysis (Table 3) include identifying project information elements, identifying the personnel or teams responsible for creating or receiving each element, and categorizing the relationship of those involved as 1:1, 1:few, 1:many, or many:many.

The project information elements then should be plotted within the framework of the taxonomy, and Figure 4 should be employed to determine which Internet technologies are most applicable for the various project information and communication requirements. The completed table of information elements also could be used in conjunction with the project organization chart and schedule to identify the number of users and the phases of the project for which various Internet technologies might be employed most effectively.

Further Development. At present, the taxonomy meets the identified needs for project management communication based on the available Internet applications. However, it also can be expanded if the availability of applications supports additional categories. For example, if communication applications are dissected further according to their ability to carry information-rich content, a third axis of viscosity could be added to the scheme. In that case, e-mail with multimedia attachments could be considered a highly viscous mechanism for 1:1 asynchronous communication. Messaging that does not support attachments would rate lower on the viscosity scale.

The taxonomy primarily identifies one application as optimal for each type of communication. However, this list implies that the application indicated is theoretically the best suited for that type of communication, not that other applications cannot be used successfully.

Organizations that study the effectiveness of Internet communication may find that user satisfaction with Internet tools increases when the tools are used within their realm of suitability as defined by the model of Figure 4. In the absence of tools suited for specific tasks, individuals might substitute another mechanism of electronic communication that contributes less effectively to project outcomes. Therefore, firms also may benefit from providing a full complement of Internet tools for project management communication.

Conclusion

A taxonomy has been created to describe the ability of Internet applications to support different types of communication in project management. Because the taxonomy defines communication based on the requirements of an individual message, it can be used as a model for using multiple types of Internet applications with multiple types of communication in any given project.

The axes of the taxonomy describe the numbers of senders and receivers and the synchronization between them. Special cases of communication are used to describe one-way communication and to differentiate between communication with groups under common association with the sender and communication in groups without common association. The taxonomy differs from previous categorization schemes in that it supports the classification of Internet
<table>
<thead>
<tr>
<th>Type</th>
<th>1:1</th>
<th>1:Few</th>
<th>1:Many</th>
<th>Many:Many</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way (Providing information/Records)</td>
<td>- Meeting notes; &lt;br&gt; - Backup for proposal (cost, schedule, technical performance elements); &lt;br&gt; - Daily record.</td>
<td>- Project schedule; &lt;br&gt; - Project budget; &lt;br&gt; - Task descriptions; &lt;br&gt; - Status reports on same, e.g., timesheets, formal reports, etc.; &lt;br&gt; - Project tracking records.</td>
<td>- Announcement of contracts/Reports for Proposal/etc.; &lt;br&gt; - Organizational chart, directory; &lt;br&gt; - Project plans, specifications, project/System requirements; &lt;br&gt; - Public announcements.</td>
<td>- Bulletin board; &lt;br&gt; - Industry standards; &lt;br&gt; - Regulations; &lt;br&gt; - Central project file; &lt;br&gt; - Training/Reference material, e.g., standards, templates, etc.</td>
</tr>
<tr>
<td>Two-way/Asynchronous (Offline communication)</td>
<td>- Contract execution/Procurement; &lt;br&gt; - Approval of individual expenditures/Requests; &lt;br&gt; - Task assignment/Status of individual task.</td>
<td>- Development of information elements listed above prior to project, e.g., plans, specs, requirements, etc., and maintenance during the project.</td>
<td>- Bidding/Request for Proposal process; &lt;br&gt; - Status of projectwide schedule, budget, expenditures, etc.</td>
<td>- Development of project documentation; &lt;br&gt; - Development of regulations or standards; &lt;br&gt; - Industry or project forum.</td>
</tr>
<tr>
<td>Two-way/Synchronous (Meetings)</td>
<td>- Negotiation; &lt;br&gt; - Interviews; &lt;br&gt; - Conflict resolution.</td>
<td>- Status update meeting; &lt;br&gt; - Pre-proposal meeting; &lt;br&gt; - Project/proposal presentation.</td>
<td>- Training session; &lt;br&gt; - Pre-project briefing; &lt;br&gt; - Conference/lecture.</td>
<td>- Informal meeting, e.g., watercooler; &lt;br&gt; - Free-form meeting, e.g., brainstorming or problem-solving.</td>
</tr>
</tbody>
</table>

**Table 3. Common Project Information Elements by Communication Type**

tools as anytime/anyplace technologies and expands the concept of group communication to include one-way dissemination of information.

The taxonomy uses a graphical approach to depict the effectiveness of each application, with the region of the taxonomy encompassed by each Internet application defining the theoretical realm of its maximum effectiveness. Applications do not overlap except for the case of 1: few communication. Otherwise, only one application is considered to be a best fit.

By analyzing the communication requirements of the project management team and matching those requirements with the appropriate communication applications, organizations may improve their ability to meet their goals for effective technology use. This taxonomy may serve as a theoretical model for project management organizations seeking to improve their effectiveness and efficiency.

**References**


Steve D. Giffin, an employee of ExxonMobil Corp., recently completed his doctorate degree in engineering management at The George Washington University. He has been responsible for management of large-scale projects and has taught courses in telecommunications as an adjunct professor at the University of Baltimore's Merrick School of Business. He is a registered professional engineer and holds a bachelor's degree in civil engineering from the Georgia Institute of Technology and a master's in environmental engineering from the University of Maryland.