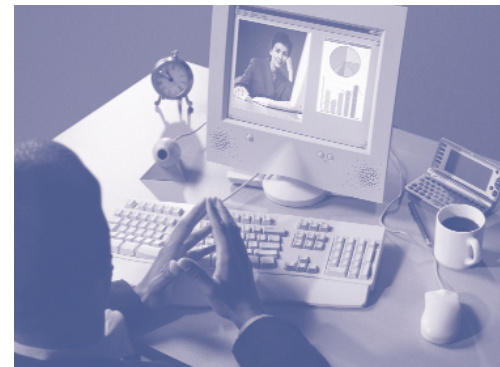


Using Virtual Teams to Manage Complex Projects: A Case Study of the Radioactive Waste Management Project



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The PricewaterhouseCoopers Endowment for
The Business of Government

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Foreword

August 2000

On behalf of The PricewaterhouseCoopers Endowment for The Business of Government, we are pleased to present this report by Samuel M. DeMarie, "Using Virtual Teams to Manage Complex Projects: A Case Study of the Radioactive Waste Management Project."

We believe that technology will have a substantial impact on how organizations operate and are managed in the future. In the recently published Endowment report by Gina Vega and Louis Brennan, "Managing Telecommuting in the Federal Government: An Interim Report," the authors explored the use of alternate work locations, including home offices, for individuals telecommuting.

In this report, we explore another potential impact from technology on organizations — the ability to work in teams when members are not colocated but spread throughout the United States and the world. The availability of technologies such as e-mail, common network platforms, telephone conferencing, and videoconferencing now make feasible the effective collaboration of workers in disparate locations. Professor DeMarie explores the challenges associated with managing virtual teams and provides insights into the benefits and limits of this approach. He offers valuable recommendations on how virtual teams might be better managed to accomplish team goals and objectives.

We trust that this report will be helpful to organizations either already using virtual teams or considering implementing them in their organization. While it brings many challenges with it, the concept of virtual teams appears to have much potential in the new world of work.

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Executive Summary

The purpose of this study was to investigate the challenges associated with managing virtual teams — teams with members who are not colocated — and suggest how and where they may be used in the future to improve organizational performance. It provides insights into the limits of new technology in terms of task environments and offers guidance to organizations considering similar initiatives.

Although this study only investigated practices at one unique organization, it did generate insights and recommendations that are likely to benefit a wide range of organizations, especially those struggling to integrate new technology into team-based environments. These insights and recommendations are summarized below:

- **Insight:** High-quality video interactions cannot completely replace the benefits of face-to-face meetings.
Recommendation: Virtual teams, whenever possible, should be launched with a significant face-to-face on-site meeting.
- **Insight:** Training for team members in both the use of new technology tools and the mechanics of effective teamwork can greatly improve team productivity.
Recommendation: Virtual team members should be required to complete formal training in the areas of team dynamics, interpersonal communications, and the effective use of technology tools.
- **Insight:** Virtual teamwork tends to increase members' workload more than anticipated.
Recommendation: Supervisors must closely monitor the number and intensity of employees' team assignments to avoid overload and eventual burnout.
- **Insight:** Gains to team productivity afforded by implementing new technology often are offset by time lost due to systems that prove to be incompatible or unreliable.
Recommendation: Keep systems as simple as possible. Make sure that your systems are adequate to your teams' requirements, but do not overload team members with bells and whistles that they are not likely to use.
- **Insight:** Competent, accessible, and timely technical support is critical to team success.
Recommendation: Do not underestimate the value, amount, and necessity of competent technical support personnel. Superior systems require top-notch technical support to turn potential gains into realized benefits.

Introduction

Time constraints and other factors, such as travel costs and the availability and high cost of specialized human expertise, have created an increased demand for organizations to explore the use of advanced new — virtual — technologies. These technologies offer a wide range of tools that allow team members to communicate and work as if they were colocated when they are actually geographically dispersed.

Just as the personal computer revolutionized the workplace throughout the 1980s and 1990s, recent developments in information and communication technology are forging the foundation of another new workplace. This workplace is largely unrestrained by geography, time, and organizational boundaries; it is a *virtual* workplace, where productivity, flexibility, and collaboration may reach unprecedented levels.

One of the most promising organizational structures to emerge from this new workplace is the *virtual team*. Virtual teams are groups of geographically and/or organizationally dispersed collaborators that are brought together to address a specific task or ongoing function, and whose members' primary mode of interaction is through a combination of communication and information technology.¹

¹ Anthony Townsend, Samuel DeMarie and Anthony Hendrickson, "Virtual teams: Technology and the workplace of the future." *The Academy of Management Executive*, 1998, v12, i3, pp. 17-29; Beverly Geber, "Virtual teams," *Training*, 1995, v32, i4, pp. 36-40.

Virtual teams rarely, if ever, meet face-to-face. They may be established as temporary structures, existing only to accomplish a specific task, or occasionally are more permanent when used to address ongoing issues, such as strategic planning. Further, membership is often fluid, evolving according to changing task requirements.

While virtual teams offer many potential benefits, such as reducing downtime and travel costs, organizations must learn more about how, when, and where to implement them in order to turn potential gains into realized gains. This study examined an actual government organization and its complex efforts to improve its efficiency and effectiveness through creating and managing virtual teams.

Research Setting and Methodology

This research was conducted in a field setting. It focused on actual teamwork being conducted by workers associated with the Department of Energy's Radioactive Waste Management Project at Yucca Mountain, Nevada (RWMP). Actual employees of the various organizations working on the RWMP that had been assigned to work as part of a virtual team were studied. Individuals who regularly work as virtual team members on the RWMP come from a variety of professions including research scientists, engineers, middle managers, clerical staff, and community relations experts.

The RWMP is a highly complex project that is designed to assess the ultimate suitability of a site

at Yucca Mountain, Nevada, to store nuclear waste. The Department of Energy is in charge of the RWMP. The Yucca Mountain site is approximately 100 miles northwest of Las Vegas, Nevada, in a sparsely populated desert environment. Specific information about the site and the work being done at the RWMP can be found at <http://www.ymp.gov/>.

The project includes seven separate government contract entities, two Department of Energy offices, two prime contractors, and approximately 40 significant subcontractors. A total of more than 2,500 people are assigned to the various areas of the RWMP. These employees are spread across the various organizations mentioned above and are located in six different states stretching from California to Washington, D.C. The complex scientific evaluations involving experts across multiple disciplines that characterize the majority of the work being done at the RWMP require collaboration among specialists spread across the U.S., making it a perfect setting to investigate virtual teamwork.

The breadth of employee expertise involved in the RWMP is impressive and unique. The organization requires experts from scientific fields such as nuclear physics, geology, plant and animal biology, and various environmental sciences to collaborate in assessing the risks associated with long-term storage of nuclear waste. It also involves engineers from a whole host of backgrounds including the specialty areas of nuclear, mechanical, structural, civil, and electrical, to name a few. Because the subject matter of the project is one that engenders high public interest and sometimes controversial and impassioned interpretations, the RWMP also must employ media and public relations professionals to ensure that accurate information is provided to all stakeholders. Finally, the complex communications network required to connect and support the work of these employees, and the very serious need for security in issues related to the handling and storage of nuclear materials, required collaborations among a team of information technology specialists.

The primary data collection method used in this study was structured, open-ended field interviews. These interviews, for the most part, were recorded and transcribed word for word. In three cases, the

interviews were actually conducted in text form by using a series of e-mail messages. These data were supplemented by archival data (primarily in the form of press releases and printed news stories), and to a more limited extent by observational data (in the form of meetings on-site with managerial personnel). Field interviews were chosen because the topic of virtual teamwork is a recent phenomenon that has not been thoroughly researched. In addition, interviews provide flexibility and often lead to richer insights on topics that are not well understood. For these reasons, interviews were deemed more appropriate than a structured survey for this project.

There were several important considerations in selecting interviewees. A primary concern was to select individuals who were knowledgeable about and had firsthand experience with the issue of virtual teamwork. Only organization members who were currently participating as a member of a virtual team were included in the pool of interviewees. Members of both the administrative and managerial staffs of the primary managing organization (MO) were instrumental in identifying personnel who had experiences most relevant to this study. Final selections of interviewees were made based on the participants' range of experiences in team settings at the RWMP, and the willingness and availability of individuals.

Another important concern was the need to obtain a sample that represented different perspectives of the issues surrounding virtual teamwork. To accomplish this, interviewees were selected from multiple managerial levels, functional backgrounds, and geographical locations. The final group of interviewees included scientists, engineers, managers, administrative staff, and media specialists. This group also represented four different managerial and administrative levels of the RWMP organization.

The sensitive nature of this government project made it necessary to guarantee complete anonymity to participants. It also required that interviews be focused on the process of virtual teamwork as opposed to the content of the teams' work. Thus, references to specific areas of expertise and information that could possibly be used to compromise security were deleted. The final group of

interviewees included 16 people. They either participated in and/or supervised a total of 78 separate teams; of these, 34 teams met the definition of being virtual teams (i.e., they included members who were not colocated). Each interviewee was associated with at least one virtual team.

The Technology Infrastructure

All members of the RWMP organization were provided a personal computer that was connected to a network through a common server platform. Most of these personal computers were selected from a single vendor through a centralized purchasing program. Each computer was configured to accommodate custom applications and usage criteria provided by each user. The software system used to coordinate communications over the network was Lotus Notes. The interviewees continually stressed that this common network platform was invaluable to their day-to-day work. In fact, several people mentioned that work seemed to come to a halt on occasions when the network system was not functioning. Team members use the Lotus Notes platform for much more than e-mail. It provides bulletin board type postings, scheduling for meetings, archiving hundreds of imbedded databases, and some highly specific applications.

The wide range of scientific disciplines involved in the project led to a large number of application programs in the overall system. It seems that each discipline has evolved a set of applications that are customized to their particular needs. Many of these application programs were not designed to interface with other systems/formats. Thus, the overall information system was highly complex and somewhat unique to this organization. The system support personnel seemed to be highly competent and have designed both security and ease of use (as much as possible) into the network system.

Virtual team members also regularly use telephone conferencing and videoconferencing in dedicated conferencing facilities. At the time of the study, the organization members did not have desktop video-conferencing available to them. Several individuals mentioned that this technology could be beneficial to their work and that they believed the organization was considering adding it to the

existing system. When asked about the frequency of use of the various technology tools, members reported that e-mail and Lotus Notes databases were used every day. Teleconferences were used weekly on average, with videoconferencing used less frequently, ranging from one to three times per month.

Virtual Teams: A Case Study of the RWMP

Teams in Use at RWMP

It was difficult to ascertain the exact number of teams operating at the RWMP at any given time. Administrative records, in terms of typical human resources data, were kept only on teams that had an expected long-term duration, for approximately one year or more. Many of the virtual teams described by the interviewees did not meet this criterion in that they were formed on an ad hoc basis to meet a pressing need and disbanded when their work was completed. In fact, over 40 percent of the virtual teams studied were assembled for a period of less than 12 months. Organizational members called some of the teams that were designed with a shorter life span “task forces” or “ad hoc committees.” By combining data given by managers from several parts of the organization, it was estimated that between 900 to 2,000 virtual teams were operating on any given day at the RWMP.

As the interviews progressed, it became apparent that three different kinds or archetypes of virtual teams were used most commonly at the RWMP. Table 1 provides an outline of the team archetypes, which include administrative teams, cross-functional project teams, and task force teams. The teams are delineated according to their work scope, membership characteristics, level of geographic dispersion, communication practices, primary goals, planned duration, and biggest challenges. Each of the three archetypes is briefly discussed below.

Administrative Teams

The administrative teams were primarily designed to monitor overall organizational progress across the various areas of the RWMP and to allocate financial and human resources. These teams were moderate in size (falling in between the other two archetypes), ranging from five to eight members. The membership represented multiple organizational units and tended to be geographically dispersed across two to four locations. The makeup of these teams was less fluid than the other types in that membership rarely changed once it was established.

Administrative teams met on a regular schedule, the most typical frequency being either monthly or quarterly. This meeting frequency was lower than the other team archetypes. Meetings of these teams were predominantly face-to-face, although they sometimes accommodated a member who could not attend by using videoconferencing.

Administrative teams were assumed to be ongoing for the life of the RWMP. Despite the assumed duration, occasionally these teams were disbanded or substantially reconstituted. One of the administrative teams investigated herein was disbanded during the course of this study when the organizational reporting relationships were significantly changed due to a restructuring initiative. This team was later replaced by one that more closely matched the new organizational structure.

Table 1: Team Archetypes at the RWMP

	Administrative Teams	Cross-functional Project Teams	Task Force Teams
Scope of work	Monitoring and assessing progress towards overall RWMP goals	Complex projects requiring multiple areas of expertise	Special projects contained within one department or discipline
Approximate team size	5-8	6-12	3-7
Membership	Across multiple units	Across multiple units	Within a single department/unit
Members' home locations	Geographically dispersed across 2-4 sites	Geographically dispersed across 3-6 sites	Colocated, or spread across 2-3 sites
Meeting frequency	Regular intervals: monthly/quarterly	Regular intervals and as needed: weekly/bi-monthly	Primarily as needed: daily to weekly
Primary communication media	<ul style="list-style-type: none"> • Face-to-face • Videoconferencing • E-mail • Phone conferencing 	<ul style="list-style-type: none"> • E-mail • Phone conferencing • Videoconferencing 	<ul style="list-style-type: none"> • E-mail • Face-to-face • Phone conferencing
Primary goals	<ul style="list-style-type: none"> • Cross-unit coordination • Resource allocation • Inter-organizational communications and relations 	<ul style="list-style-type: none"> • Cross-functional assessment of complex choices concerning materials or design of facilities and their long-term impact 	<ul style="list-style-type: none"> • Assessments that usually become input into later, more complex cross-functional projects
Planned duration of teamwork	Ongoing	Six months to two years	Three to nine months
Biggest challenges	<ul style="list-style-type: none"> • Managing multiple constituencies and conflicting interests • Establishing a hierarchy among resource allocations 	<ul style="list-style-type: none"> • Determining which data are most critical • Facilitating communication across disciplinary specialists 	<ul style="list-style-type: none"> • Meeting aggressive deadlines

The primary goals of the administrative teams included cross-unit coordination and planning, resource allocation, and inter-organizational communications primarily concerning effective community and media relations. These teams' biggest challenges tended to center around issues related

to estimating the time required to complete ongoing work in the various scientific areas, allocating adequate resources to ensure that the overall project could meet targets determined by the Department of Energy, and managing communications with the general public and press.

Cross-functional Project Teams

Cross-functional project teams were assembled to deal with highly complex scientific issues. An example of this would be assessing the environmental impacts of proposed site developments. A team dealing with this issue required animal biologists, plant scientists, geologists, hydrologists, and climatologists, among others. These teams tended to be the largest teams involved in the RWMP, ranging from six to 12 members for those included in this study. Team membership was geographically dispersed, ranging from three to six separate home locations. Cross-functional team membership was highly fluid, with members being added as new issues were uncovered and dismissed as their portion of the work was completed.

Cross-functional project teams met weekly and bi-monthly on average. These teams favored asynchronous communications (primarily e-mail with attached documentation) when possible. The complex nature of the tasks often created interdependencies among the various experts. For example, some members needed input from other members' work product before they could begin to assess issues in their specialty. In other cases, several experts needed to work together and integrate their data and analyses to create rigorous assessments.

For the most part, these teams were formed with a planned duration, the completion of a specific assessment. However, several of the teams included in the study completed their original charge only to be recharged with additional assignments related to assessing new issues that were uncovered during their original work. Thus, in practice, many of these teams became ongoing entities that continuously dealt with evolving issues related to the complex nature of their work. In fact, three team members interviewed for this study reported that they did not believe that their teams' work would ever be completely done.

Cross-functional teams' biggest challenges related to resolving conflicts among the various expert members. The complex nature of the tasks often created conflicting interpretations. Assessing the likelihood of alternative interpretations in a rigorous manner was difficult and often led to emotional interactions among team members. Achieving a level of consen-

sus while at the same time providing appropriate recognition of dissenting views became a daunting task in several teams.

Task Force Teams

Task force teams were assembled to deal with issues contained within one discipline or functional area. A task force team, for example, might evaluate a choice of materials to assess their structural properties. These teams typically are made up of members from a single department or organizational unit. Task force teams tended to be smallest in terms of numbers of members, ranging from three to seven. Because of the small size and limited scope of their tasks, these teams often were colocated, or involved members from only two or three home locations. Because of their relatively close proximity, task force team members used face-to-face communications more frequently than members of the other team archetypes did. Team members also reported a high level of e-mail usage, sometimes e-mailing information to someone who was located only a few paces away.

Task force teams dealt with fairly specific issues and thus were disbanded once they completed their mission. Many of these teams were formed to provide critical input to cross-functional teams dealing with more complex topics. When this was the case, the task force teams were given relatively short time frames to complete their assignments. Almost all interviewees mentioned the aggressive deadlines as a cause for concern.

Task force teams were the most informal in terms of their meeting schedules. Because most, if not all, members were colocated, they would communicate as needed to facilitate the work at hand. Some interviewees reported communicating face-to-face several times a day with task force team members. In addition, most of the teams had a regularly scheduled weekly meeting to assess overall progress and deal with unexpected issues that may have come up.

The biggest challenge that task force teams faced was meeting aggressive deadlines for completion of their work. Most interviewees understood why the deadlines were necessary, especially when other teams were waiting on results to complete

other projects, yet many felt that they could have been more thorough had they been given more time. The time pressure that members felt may also have been related to the number of different teams that each individual was assigned to. Most interviewees reported that they believed they were assigned to too many teams and that this affected their ability to perform up to their full potential.

Motivations for Virtual Teaming

A foundational assumption guiding this study was that virtual teamwork would provide real organizational benefits beyond those associated with traditional teamwork. In fact, many writers have espoused a wide range of advantages that organizations might achieve through virtual teamwork.² The potential advantages afforded by virtual teams include:

1. increasing productivity by enabling simultaneous in addition to sequential work;
2. improving work quality by providing members continuous access to the latest and best information;
3. increasing the pool of potential team members by allowing members to participate from their home office (or even their homes in the case of teleworkers);
4. decreasing organizational costs by avoiding travel costs and downtime;
5. efficiently training and socializing new team members by using an online record of ongoing work; and
6. increasing the impact of teamwork by capturing the work electronically so it can be accessed by other segments/members of the organization as needed.³

Thus, a primary aim of the study was to evaluate if in fact the focal organization did benefit from virtual teamwork, and alternatively if there were hidden

² See, for example, Jessica Lipnack and Jeffrey Stamps, "Virtual teams: The new way to work." *Strategy and Leadership*, Jan-Feb 1999 v27, i1, pp.14-20; Deborah L. Duarte and Nancy T. Snyder, *Mastering Virtual Teams*, 1999, San Francisco: Jossey-Bass.

³ Grenier, R., and G. Metes, *Going Virtual*, 1995, Upper Saddle River, NJ: Prentice Hall.

costs and/or barriers to overcome in implementing virtual teams. Table 2 provides some simple questions to test whether your organization might benefit from virtual teamwork.

Benefits Achieved

It was very difficult to get members of the virtual teams to assign a measurable metric to the benefits that virtual teamwork afforded. Most members did, however, express the view that their particular teamwork would have been impossible without the ability to regularly connect with distant members. In relation to the six potential benefits of virtual teamwork just described, five seem to have been achieved to some degree at the RWMP.

Increasing productivity

Interviewees consistently reported that the work done in virtual teams tended to be a more efficient use of their time than work done in face-to-face teams. It seems that communicating primarily through the network interface with virtual team members required teammates to carefully consider most communications. Over time this led to more efficient interactions. Additionally, the virtual team setup strongly encouraged team members to break work assignments down into sequential and independently manageable units. This allowed members to schedule their particular workload at times that were convenient, given their other commitments. This also allowed virtual teams to avoid one

Table 2

Might your organization benefit from virtual teamwork?

If you answer "yes" to all of the questions below, then your organization should seriously consider implementing virtual teams in the future.

1. Are your employees geographically dispersed?
2. Is travel time limiting the productivity of key employees?
3. Do you regularly use teams to tackle important projects?

of the biggest complaints associated with traditional teamwork at the RWMP, which was time wasted at team meetings discussing issues that did not affect all members.

Improving work quality through access to the latest and best information

Benefits related to work quality were seen to be somewhat indirect. Members of teams that relied on timely updates from other units of the project felt strongly that they benefited from the design of the information infrastructure that allowed access to Lotus Notes databases in a manageable format. They believed that the use of the network computer system to archive up-to-date information had helped to improve the overall quality of work by immediately updating members when critical new data became available.

Increasing the pool of potential team members

A majority of virtual team members commented that the communications facilities afforded by the common computer network allowed them to bring specialized expertise into their team projects that otherwise would not have been available if team membership had required regular travel to face-to-face meetings in a central location. This is a critical advantage at a project such as the RWMP where a wide range of scientific specialists are required to interact with people outside of their regular professional environment. There also is some evidence that members with highly specialized skills were used more productively by eliminating a large percentage of their travel requirements.

Decreasing organizational costs associated with travel and downtime

It was not possible from the interviews to derive an accurate estimate of the amount of cost savings related to decreased travel and downtime. However, most interviewees believed that the savings were substantial. Related to this, several virtual team members suggested that some critical work may have been impossible to complete or severely delayed had key specialists in high demand been forced to travel to team meetings. Thus, members suggested that the largest cost savings might have come from avoiding delays rather than from the actual reduction in travel-related expenses.

Increasing the impact of teamwork by capturing the work electronically

A consistent theme throughout the interviews was that the organization seemed to benefit from various teams putting the output from their efforts into an accessible location and a manageable format on the information network. In most cases, this meant creating databases on the Lotus Notes system. Nearly all (more than 90 percent) of the teams studied regularly used databases on the network to communicate their progress to organizational stakeholders.

The exception

The one area where the RWMP did not realize any of the potential advantages associated with virtual teamwork was “efficiently training and socializing new members by using an online record of ongoing work.” In fact, most members felt that virtual teamwork made the training and socialization of new members more difficult. This may be at least partially attributable to the relatively infrequent use of videoconferencing and the lack of desktop video facilities, although members did not believe that increased online video interactions would have significantly improved training and socialization of new members.

Problems Encountered

While virtual teamwork did provide some significant advantages to the RWMP, virtual team members also identified significant challenges and problems encountered with this kind of interaction. In fact, in a minority of cases (less than 20 percent), members believed that the problems encountered may have totally offset the gains afforded by virtual teamwork.

Communication Difficulties

Difficulties encountered in communication were a common theme throughout the interviews. Virtual team members found it frustrating that messages often were misunderstood or not received by important constituents, which understandably led to inefficiencies in workflow. Areas that were identified as causing communication difficulties included: e-mail slang and informalities, technical jargon, confusion concerning teleconferencing protocols, and the lack of an up-to-date listing of constituents (including members and non-members) to include in the distribution of information.

E-mail has become a ubiquitous component of the workplace and was in fact the most frequently used means of communication among virtual team members at the RWMP. While e-mail provides many benefits in terms of convenience, cost and accessibility, it also has some downsides. It seems that as people become more familiar with e-mail communications, they tend to use more informal language, abbreviations and slang terms. The more informal the language becomes, the more likely that the content of the message may be misunderstood.

Beyond just language choice, because e-mail is a text-based communication, it does not include the non-verbal cues that make face-to-face communication so rich and effective. Thus, it is difficult to portray tone, emphasis, and humor in e-mail communications. Virtual team members across almost all teams cited cases where a misunderstanding related to an e-mail communication hurt team productivity.

Similar to language choice in e-mail messages, virtual team members also cited the use of technical jargon as a barrier to effective communications. Most teams in this organization are cross-functional and involve specialists from multiple professional backgrounds. Each discipline has its own set of commonly used and widely understood abbreviations, acronyms, and buzzwords. This kind of technical jargon became troublesome in interactions with members from another discipline, and often resulted in communication difficulties because team members did not understand the terminology common to areas outside of their own specialty.

Another frequently cited problem was the lack of explicit protocols to use in conferencing situations. Members expressed frustration at both teleconferencing and videoconferencing because communications became awkward when people were unsure of how and when to speak up and be recognized. This led to situations where two people talked “on top” of each other and other times when long periods of silence occurred when members tried to allow others the chance to participate. Several members reported that these kinds of protocol difficulties were the main reasons why conferencing was used infrequently.

Finally, virtual team members cited ambiguity about whom to include in communications as another significant problem that inhibited effective communication. Virtual team membership in the organization was more variable than in face-to-face teams, especially in the case of task force and cross-functional project teams. Team members were not always kept informed as to the addition or removal of team members. Related to this, many of the virtual teams worked on projects that had an almost immediate impact on other parts of the organization. In some cases, the teams themselves did not fully appreciate how their work would affect the other parts of the organization. Thus, they may have inadvertently left important constituents out of the communications loop. Both of these conditions led to situations where individuals (both members and non-members) did not receive critical information in a timely manner.

Overload of Assignments

Virtual teams allow organizations to use their personnel more efficiently by avoiding downtime associated with travel and scheduling face-to-face meetings. There is a downside to using people more efficiently, however; it usually entails increasing the number of assignments given to each individual, which was in fact the case at the RWMP.

Virtual team members consistently identified unrealistic workloads given to members across multiple team assignments as a significant barrier to team success. Interviewees in this study averaged 3.8 team memberships, and some supervisors identified people under their direction who belonged to as many as eight separate teams. Without exception, interviewees felt that conflicting team responsibilities impaired their ability to perform at the levels expected of them. Unrealistic workloads, in terms of multiple team assignments, increased members’ feelings of stress and burnout.

Ambiguities Surrounding Reporting, Evaluation, Responsibilities

A unique challenge associated with the RWMP was that teams often included members from several different parent organizations. As such, it was not uncommon for a person’s direct supervisor to have

little or no involvement with that person's RWMP team assignments. Similarly, designated team leaders often had little or no input into a person's home organization evaluation of performance. While this challenging setup was necessary to assemble the range of specialized expertise required by many of the teams, it caused confusion among team members when trying to prioritize assignments. Several interviewees reported that the most critical work they performed for RWMP earned them little recognition within their home organization in terms of advancement opportunities and salary raises.

In a related area, coordinating the actual work of the virtual teams in some cases proved most difficult. Members felt that the reporting requirements of the team (i.e., whom to report to and what specific information to report) were not clearly communicated and seemed to change on a fairly frequent basis. A similar situation existed *within* some of the virtual teams. Members reported that they were unsure at times about who was responsible for administrative issues such as team minutes and following up to make sure that members were on track with assignments. Members, almost unanimously, believed that team performance could be improved by making the formal responsibilities of each team member more explicit.

System Downtime Due to Upgrades and Inconsistencies Across Locations

The final problem area identified by virtual team members was related to frustrations associated with interacting with the actual communications system. Most interviewees reported significant time lost because of problems using the technology, ranging from the overall system being off-line to problems with individual hardware and software configurations. While the computer network was reported as being mostly reliable, members did identify instances when the system was not operating at times critical to meeting work deadlines. Interviewees suggested that some sort of backup or redundant system architecture would have facilitated their teams' productivity. Several interviewees also cited instances where incompatibilities in the hardware and software across multiple member home locations led to significant delays. The differences among the various site infrastructures at times made it difficult or impossible for critical

team members to meet deadlines for important work. Most members, however, did suggest that a major computer upgrade initiative at the RWMP within the last 18 months had corrected many of the long-standing incompatibility issues. However, a key problem remains, because the wide diversity of applications used across the various units makes incompatibility issues an inevitable outcome as existing applications are upgraded or new ones are added.

Lessons Learned and Recommendations

In many ways, the RWMP has broken new ground in the area of virtual teamwork. By necessity, it has integrated professionals in multiple disciplines and across many locations into teams. Like any venture into an uncharted area, it has had to learn from trial and error. In Table 3, the most important lessons learned from these complex organizational challenges and the resulting recommendations are summarized to help organizations attempting similar initiatives.

Lesson 1: Face-to-face interaction should not be totally replaced.

Perhaps the strongest message that came from the interviewees was that high-tech tools, including videoconferencing, could not totally replace the advantages of in-person face-to-face communications. Virtual team members reported that some initial face-to-face meeting was necessary to establish the high levels of interpersonal trust required for effective teamwork. This issue of trust is one that frequently seemed to be discounted, but should not be overlooked. Team members on teams that did not have at least one in-person meeting believed that their productivity and the overall quality of the team's work suffered. Several virtual team members also suggested that an ongoing occasional in-person meeting regularly scheduled (quarterly or annually) could help with coordinating and communicating future directions for the team.

This finding may be at least partly due to the fact that teams were reluctant to use the videoconferencing systems available. They found these systems awkward to manage since they required technical personnel to operate them. If the organization was to provide desktop video systems in the future, these strong feelings may be moderated to some extent. Desktop video systems allow video interaction without requiring special facilities and outside technical assistance. However, given the strong feelings expressed, it is doubtful that even high-quality desktop video systems could totally replace the value that members attributed to in-person face-to-face meetings.

Recommendation 1

All new teams should be launched with a significant face-to-face interaction. These launching meetings need to focus on establishing team goals, setting milestones, clarifying the roles to be filled by each member, developing meeting schedules, and setting norms and standards for team communications. If possible, a schedule for future on-site meetings should be established. These meetings can be quarterly, semiannually, or annually depending on the task environment and the degree of geographic dispersion among the team members. For teams that are widely dispersed, additional face-to-face meetings may be impossible to schedule. If this is the case, the initial meeting should be extended into a format that allows for

Table 3: Lessons Learned and Recommendations from the RWMP

Lessons Learned	Recommendations
Lesson 1: Face-to-face interaction should not be totally replaced.	Launch virtual teams with in-person meetings to help establish trust that provides the basis for productive working relationships.
Lesson 2: Training is critical to team success.	Invest in training related to both team dynamics and effective use of conferencing technologies.
Lesson 3: Virtual teamwork tends to increase members' workload more than anticipated.	Limit team assignments and plan for learning curve effects related to team formation and changing team membership.
Lesson 4: Technology must be compatible and reliable.	Keep systems as simple as possible. Do not rush to add new features if they provide marginal benefits. Select vendors that provide high quality support relationships.
Lesson 5: Technical assistance must be competent and available.	Do not underestimate the value of providing adequate technical support people. State-of-the-art systems require outstanding support personnel.

some social interactions in addition to dealing with organizational issues. These teams should also strongly consider scheduling regular videoconferencing sessions or implementing desktop video communications if possible.

Lesson 2: Training is critical to team success.

Virtual team members consistently expressed the viewpoint that additional training could improve team productivity. Interviewees identified two areas in particular where training could provide significant benefits: team communication dynamics and the use of new technology tools. Somewhat surprisingly, a majority of virtual team members believed that training in the mechanics of effective teamwork could provide a common body of knowledge that would greatly improve team communications. A slightly smaller number of team members cited training in the use of new technology as having the potential to provide gains in team efficiency and effectiveness. Members noted several instances where basic training related to new software applications would have allowed their team to avoid some obstacles to their work.

Virtual team members frequently expressed frustration at the difficulties of managing communications across the electronic media. Several team members cited situations where they had insights to contribute, but refrained from joining a discussion because they were unsure about the proper method of gaining the attention of their peers. Members were reluctant to appear rude or overbearing. These situations involved both telephone and videoconferencing. Other asynchronous methods of communications, such as e-mail and bulletin boards, did not produce the same frustrations for obvious reasons.

Members believed that their team could have benefited from discussing and establishing norms for team members to follow in obtaining and yielding the floor during real-time conferencing sessions. While this seems to be a simple and possibly obvious solution, none of the teams in this study had conducted a session to set norms and protocols for team interactions prior to attempting real-time conferencing. Several teams had, however, come to an informal understanding of preferred methods for gaining the floor and identifying oneself, only after experiencing a series of sessions with unsatisfying interactions. Virtual team members, almost unanimously, suggested that their team could have saved

much time and effort had these issues been formally discussed early on. They also suggested that once established, norms and protocols should be recorded and that members must be held accountable for adhering to them.

Recommendation 2

Virtual team members should be required to complete formal training in the area of team dynamics and the effective use of conferencing technologies.

Much training in this area focuses too heavily on the technical issues of how to operate the systems. To be effective, this training should emphasize interpersonal communication skills and how to overcome the challenges that conferencing technologies pose for effective teamwork. Many organizations underestimate the value of training people in the area of team dynamics and methods.

Assigning a group of people to a common project does not make them a true team. Effective team members need to understand what it is that makes teams successful and unsuccessful. Finally, the training must be consistent for all organization members so they can draw from a common body of knowledge during the formation of new teams.

Specific training in the actual use of communication and information technology is also critical. Many organizations seem to underestimate the training necessary to allow members to effectively use specific new software applications and upgrades to existing applications. This often leads to a situation where team members underestimate the value of their technology tools because they have not learned the range of possibilities offered by the new tools. Basic training in the benefits afforded by new applications and upgrades can provide a surprising return in increased productivity.

Lesson 3: Virtual teamwork tends to increase members' workload more than anticipated.

Virtual teams are relatively easy to assemble. They allow organizations to avoid much of the inconvenience and cost associated with traditional teamwork. Several team members expressed the view that the convenience and cost efficiency of *forming* virtual teams frequently resulted in supervisors underestimating the workload necessary to *participate* in the teams. A majority of the team members

that participated in this study felt that they belonged to too many teams and that their combined teamwork responsibilities exceeded reasonable expectations. Supervisors in the study supported this view by expressing concern about workers performing below expectations due to being overburdened.

It may be that the RWMP as a whole simply has a challenging workload and aggressive schedule, and, in fact, some interviewees supported this insight. However, there was a consistent message in the interviews that suggested that the challenges associated with virtual team assignments were seriously underestimated. Interviewees believed that supervisors must closely monitor the burden associated with multiple team assignments and fight the tendency to underestimate virtual team responsibilities if they hope to avoid burnout among employees.

Recommendation 3

Do not underestimate the time it takes to develop a team into a high-performing organizational unit.

Effective virtual teams do not just happen. They take a tremendous amount of time and effort to coordinate and manage. Much of this time and effort occurs soon after a team is formed; it is similar to the concept of a learning curve. Members must learn the personalities and work styles of their team members and establish norms, protocols, goals, and milestones. People who join a new team must plan for this drain on their time and schedule their other commitments accordingly. Supervisors must also recognize the effects of the learning curve and resist the temptation to assign high-performing employees to multiple new team assignments. Finally, changing the makeup of a virtual team also has some commonly underestimated costs. As existing members leave and new members join, all team personnel must acquaint themselves with the new people, and help to educate the newcomers concerning team norms, standards, history, and goals. If possible, team membership should remain stable to ensure higher levels of productivity and lessen the chance of overburdening members with off-line work.

Lesson 4: Technology must be compatible and reliable.

Virtual team members consistently expressed frustration at time lost to technical problems. Some

team members went as far as to say that technical problems more than offset the advantages that the communication technologies afforded. Despite the fact that most members acknowledged that the organization had improved over time in managing and maintaining its technology infrastructure, most interviewees believed that technical problems remained a significant concern.

Some level of technical problems is probably unavoidable. That is, the organization may have to actually experience a requisite number of technical problems before it can develop effective ways to solve those problems and ultimately prevent similar problems from occurring. Several members expressed the view that new technology (including system upgrades) should be tested on a subset of the organization prior to widespread adoption. This kind of solution may not be possible, however, when changing (upgrading) the system infrastructure.

Recommendation 4

Keep systems as simple as possible. Make sure that your systems are adequate to your teams' requirements, but do not overload team members with bells and whistles that they are not likely to use. Each new application or feature added to existing systems seems to exponentially increase the likelihood of technical problems and system downtime. Carefully assess the potential benefits of upgrades and new applications. Those that offer only modest advantages may not be worth the potential problems that they might bring about. Similarly, whenever possible, deal with vendors that have a reputation for excellent technical support. Vendors who actively track customer problems and develop close working relationships with their customers have access to a wide range of experiences from other organizations. It is possible that some other customer organization may have already found a solution to the problem that you are encountering. Vendors can help to bring those solutions to your organization in a timely and less painful manner.

Lesson 5: Technical assistance must be competent and available.

Related to the previous point, several interviewees believed that the RWMP had seriously underestimated the level of technical support necessary to

facilitate such a complex organization. Common complaints seemed to focus on two viewpoints — that technical support people were not available when needed and that some technical support people lacked the qualifications to deal with difficult problems. Interviewees who had resource allocation responsibility also felt that determining the appropriate allocation for support personnel was extremely difficult. Several interviewees believed that they had underestimated the technical support necessary to facilitate new investments in both hardware and software systems.

Recommendation 5

Do not underestimate the value and necessity of competent technical support personnel. Many organizations spend a tremendous amount of resources on purchasing state-of-the-art technology only to undermine the value of these technical tools by not providing adequate support to implement and maintain them. In most cases, organizations would be better served by using slightly out-of-date technology that is adequately supported if their budgets do not allow for first-class support of new technology.

Summary

It is interesting in this world of rapidly changing new technologies that virtual team members primarily recognized the “softer side” of organizations as providing the largest potential impact. Very few interviewees expressed the need for newer or better technology. Alternatively, issues such as the need for more in-person face-to-face meetings, the establishment of communications protocols, the support and maintenance of existing technologies, and increased training for team members were consistently identified as high priorities. Organizational leaders may be able to learn from these insights. Many organizations seem to have a bias in resource allocation toward investing in new hardware and software. While these investments often are necessary, some organizations could provide greater return for their investment by focusing on the softer issues discussed here.

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Samuel DeMarie is an Assistant Professor of strategic management in the Department of Management, College of Business, Iowa State University. Professor DeMarie earned his Ph.D. degree from Arizona State University, Tempe. He also earned an M.B.A. degree from the University of Nevada Las Vegas and a B.S. degree in accountancy from Northern Arizona University, Flagstaff.

Professor DeMarie's current research focuses on the effects of new technologies on competition and the workplace, including the emerging phenomena of virtual organizations, virtual teamwork, and e-commerce. He also works in the area of large-scale organizational change initiatives, such as restructuring and downsizing.

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