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COVER STORY

HOW TO MAKE DISTANCE WORK WORK

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You very likely work with someone off-site. Research from the Institute of Corporate Productivity stated in 2008 that 67 percent of the companies surveyed felt their reliance on virtual teams would grow in the next few years. For larger companies, this figure rose to 80 percent. Even in academics, work is not solitary by any means. The proportion of papers at CHI 2013 that were coauthored by people not from the same institution is an amazing 53 percent. To accomplish distance work, people typically manage a string of emails with Word document attachments with Track Changes on, talk via audio or video conference, and use Google Docs and Dropbox for sharing files. There is discussion about whose turn it is and when one person will get back to another because no one can see what's going on at the other location. And though this succeeds in some sense, it is not easy. Distance matters.

For more than 20 years, we have been doing research, reading the literature, participating in distance work, and interviewing and observing people in all kinds of situations: big science, co-authorship of grant proposals, consolidating monthly worldwide sales figures, collaborating on developing software—we have been there. And now we know some things. Here, we would like to summarize that knowledge so that with the right technologies and social practices, although distance will still matter, it will matter less.

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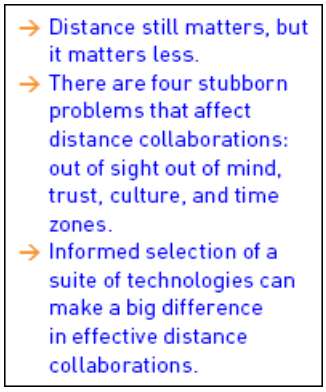


We know a team is likely to succeed if it:

- assigns independent work modules to locations so they don't have to communicate much;
- is made up of people who have worked together, have common ground and common work styles, and like working together;
- adopts an explicit management style that makes decision-making clear, promotes an open, inclusive atmosphere, and has details worked out; and
- uses technologies to support communication, coordination, the sharing of data/knowledge, and is supported by an infrastructure powerful enough (both in networking and computational power).

This situation is rare.

Distributed teams are more likely to:

- be working on new things that require constant communication to work out the details;
- be made up of people from different backgrounds, both to generate diverse ideas and to fit the product or service to the people it is designed for;
- be put together by management or dictated by a funder;
- be casual about the specifics of management and oblivious to the important kinds of information they are no longer privy to because other team members are "out of sight, out of mind"; and
- choose only the technologies they are used to, such as email, missing the opportunities afforded by others (like shared documents and calendars, standardized repositories for shared data, etc.) and failing to support rich enough communication technologies when they are most needed.

These teams will encounter stresses that interfere with success and, sadly, either meet the challenges with great effort or fail.

In what follows, we will first list the kinds of general stressors distance work consists of and then give practical recommendations that our research suggests. We provide recommendations at three levels: to a member of a distributed team, to the manager of a distributed team, and to the organization that supports distributed teams. We intend to provide research you can use.

What Matters About Distance?

We have found that what could make distributed teams more effective is usually simple: good people, good management, the right problem to solve. But because of distance, distributed teams face additional stressors, which we will discuss here.

Blind and invisible. People on distributed teams are invisible to people not at their location. Symmetrically, these same people are blind to the activities of the remote people. This means that necessary information must be communicated explicitly, through the heavy use of email, blogs and/or wikis, and audio or video conferencing. Coordination must be made explicit: People have to say what they are working on and convey to others when they are stuck or when they found a felicitously easy solution. Coordination needs to be explicitly arranged: It is almost impossible to have a spontaneous meeting—one that would, for example, discuss the next actions in response to some unexpected event.

Second, people working with remote colleagues are often unaware of the detailed context of the current work. There is no "looking over the shoulder" of one's colleagues. Awareness must be tracked explicitly, by making visible acts of recording (like entering things in GitHub or using Google Docs with revision history) and then looking at that record (to see what has changed recently that impacts one's work).

There are additional levels of awareness related to daily context. Two examples are relevant here: Once we observed a manager in Michigan working with people in France allow a

Friday-morning meeting to extend into France's afternoon. France's Friday afternoon is a time most people do not work; it's like the U.S.'s Saturday. The French were misunderstood in their scowls at the ideas being presented. The scowls represented their displeasure at simply being at work, not their reactions to the ideas being presented.

A second example comes from research we conducted with people in the U.S. communicating with those in Asia. In this case, the people in the U.S. were at headquarters, the largest mass of people in the company. The conversations with those in Asia often included references to local politics, sports events, and even weather, as if they were communicating only with those in their home location. This created an apparent imbalance of power: those in the know and those not in the know, an in group and an out group.

Time-zone differences. When distance increases, time zones are crossed. The difference can be as small as an hour or as large as having no time when the workdays overlap. We found the former merely requires adjustments to accommodate the remote locations' work hours and break times; the latter requires difficult scheduling and someone being inconvenienced, usually the site with fewer people, not the "headquarters."

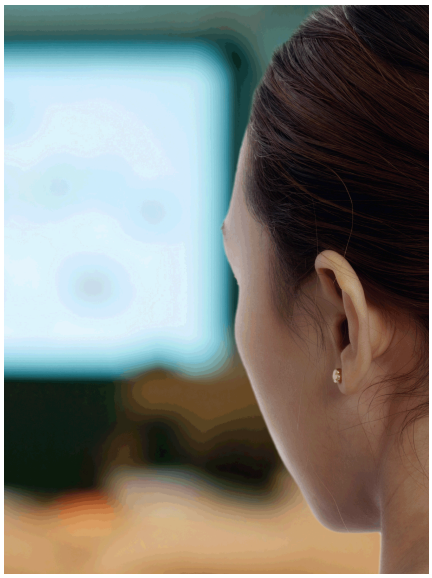
Crossing institutional or cultural boundaries. In science, the collaborators often belong to different institutions, each with their own internal regulations, including how participant safety is reviewed with the institutional review boards, and often with differences, likely contentious, in how intellectual property ownership is decided. In the corporate world, often the distant colleagues are from the same institution, but even within the same organization, local cultures and practices of interpreting the statutes may differ.

We have seen that in crossing national cultural boundaries, many subtle conversational or decision-making practices and expectations differ. Many discussions go awry from misinterpretations. In one case we witnessed the seeming cowboy bravado projected by those from the U.S. cause those in France, who were more experienced in the topic under discussion, to decide finally to "take their toys and go home."

How to Deal with Distance Matters

In what follows, we group the recommendations into clusters according to who has the power to change things: the individual on a distributed team, the manager of such a team, and the organization that would like to help make their distributed teams more productive.

For the individual on a distributed team. Three major categories of factors are under the control of the individual. The first has to do with the personal characteristics that lend themselves to working well with distributed colleagues, the second with the motivation to work together, and the third with what we call *technical readiness*, the knowledge of how to communicate and coordinate through technology, including the willingness to learn.



First, we have seen that people who score as extroverts on personality inventories and have high social intelligence do well on distributed teams. They are aware of the situation, the attitudes and actions of others, and how best to react for the good of all. Those without these skills should recognize the difference and seek assistance in dealing with remote others. An important part of dealing well with others has to do with trust. A trustworthy colleague is respected and sought after. Trust is an important binder. Therefore, behaving in a way that engenders trust is vital.

A second aspect of personal effectiveness has to do with the motivation to work with those who are remote. The motivation is intrinsic for some of the successful collaboratories we've

studied, such as the Zebrafish Information Network (ZFIN), which involved people who went to school together, had a common cause in honoring their deceased advisor, and liked working together. Motivation can come from believing in the goal of the project, or it can come from explicit incentive structures, which involve credit on performance reviews. This latter factor involves decisions on policies determined at the organizational level, discussed later.

The third important aspect an individual can influence has to do with technical competence and readiness to learn new technologies and the social behaviors that surround effective use. There are two components to this: a propensity for learning new technologies and the training appropriate to make the learning easy. At the individual level is the openness to explore new ways of working that, for example, make explicit the actions that one normally doesn't have to consider. Then the individual has to commit the time to learn the new technologies, both to get started and then to ask and share best practices as the technology gets adapted to the specifics of the work. At the organizational level, this involves choosing the technology suite that fits the work, is easy to use, and is compatible across other applications in use.

For the manager of a distributed team. There is a lot a manager can do to make distance work work. As we detail later, the manager can select the right people for the team, help them develop common ground, help motivate their working collaboratively, divide up the work so that those distant from each other do not have to communicate constantly to manage their goal setting and project plan, and help make sure that everyone is heard in meetings.

In the corporate and nonprofit worlds, teams are put together primarily by a manager trying to get the right expertise on the team, secondarily because someone is a good team player (extroverted and with good social intelligence, as described earlier). Trustworthiness might or might not play into the selection decision, if indeed this is known. In academia, individuals either self-select into a team or are asked by other researchers to collaborate. As in the corporate and nonprofit worlds, most likely this is because of a particular area of expertise, not because they are particularly good at being a team player. We recommend assessing both these factors and putting together the team according to expertise *and* personality traits.

Because individuals are from different locations, their experience bases are likely to differ more than those of collocated individuals. We find this is both good and bad. If they have worked together successfully in the past, they are likely to have worked out vocabulary and working-style issues. If not, then it is suggested they engage in activities with the explicit goals of establishing common vocabularies and work style. We recommend working through a covenant relevant to these topics. This is especially important if the team members come from different institutions and/or cultural backgrounds. We also recommend explicit assessment of habits and expectations and follow-up discussions of differences and ways to resolve them. We have found that an online cultural assessment and training application called GlobeSmart can provide guidance.

If the team involves members from different disciplines or subdisciplines, it is important to work on shared vocabulary and concepts. In one medical collaboration we observed a dictionary of terms, developed early in the project. Using the same words to mean different things, or not even knowing some terms, can easily derail a project.

Individuals on a distributed team may have intrinsic motivation to work together, either through personal ties or the realization that they need one another's expertise in order to succeed. Both of these behaviors generate respect; when people feel they are respected, they are more likely to be motivated to contribute. If these conditions don't hold, then we recommend that the manager design explicit motivators for the team, including group rewards and individual incentives that reflect how well a person contributes to a team. Some people adopt a "360-degree review," in which individuals are evaluated not only by those who manage them, but also by their colleagues and those who work for them.

We recommend two other activities for managers to bolster the chance of their team's success. First, since trust is slow to develop in a distributed team (there are fewer occasions for people to get information about how trustworthy someone is, and the ancillary activities of getting familiar with a person's personal life are fewer), managers should generate exercises or activities for developing trust. In the corporate world, this sometimes involves ropes courses. It could also involve less physical sessions, where people are encouraged to talk about their non-work lives, sharing things about themselves that indicate vulnerability, an essential ingredient to trust. This is one of the primary reasons to have a face-to-face meeting with all participants at the outset of a project.

Second, we find that group self-efficacy, an attitude of "we can do it," is often a key to success. This attitude provides incentives for people to do extra work and make extra contributions when obstacles arise. Again, team-building exercises can help engender this attitude.

One determinant of whether a distance collaboration is going to be successful is whether the work is routine (where people know what to do and what others are doing to coordinate their

work). If the work can be divided into modules so that most of the coordination and discussion happens among people who are collocated, success is more likely. In a hierarchical organization, the role of designing the work to fit the locations falls to the manager. In less structured organizations, such as academia and some nonprofit organizations, this recommendation falls to the team members themselves, their project manager (if there is one), and/or their oversight board. Because of the stresses of distance to awareness, communication, and coordination, the design of the work is critical. The more essential communication required across locations, the less likely the collaboration will succeed.

We offer a number of additional prescriptions for the manager of a distributed team to help the team achieve success. Helping the individuals come to agreement about their goals, agreeing to the overarching group goal while acknowledging the secondary individual goals, is paramount. Aligning the reward structure to fit the group goal additionally ensures that people will understand the priorities of the project and how their behavior affects their personal rewards. Developing an explicit management plan (roles and responsibilities) and outlining how the team is expected to communicate and coordinate helps the team members act appropriately. Having the decision-making process open, free of favoritism, and inclusive both fosters trust and respect and motivates everyone to contribute to the goals.

One of the important management activities for distributed teams occurs in meetings. First, wherever the manager resides is often considered the seat of power, especially if a majority of the team members are collocated there. Meetings present a challenge because of the unreliability of video/audio conferencing and the lack of cues about who would like to speak next or people's reactions to what is being said. The manager must explicitly solicit comments and contributions from everyone, even polling locations for commentary. This ensures not only that needed information and opinions are heard, but also that those at the smaller locations feel respected. Also, with real-time meetings among people who reside in disparate time zones, it is important that the manager be fair in sharing the inconvenience of working outside regular business hours.

It is essential the manager be proactive in finding out what people are up to. In a collocated setting, this is done by management through walking the hallways. In a distributed team, this requires regular contact with all team members. Frequent email checks, IM chats, and voice or video contacts are all critical. This also helps team members know that they are valued members of the collaboration. There is a growing literature on how to manage distributed teams (e.g., [1,2]).

Part of putting together a skilled team is selecting those who are comfortable with existing technology and willing to learn and adapt work practices to new technologies. In addition, providing adequate training and ongoing support will make the use of the required technologies easier. There are also resource issues in providing the technology necessary for successful distance work—the shared repositories, the video conferencing, the shared calendars, and so forth that have the right price and the required security. Nonprofits may have the hardest time with the resource issues, and corporations with the security issues.

For the organization that wishes to support distributed teams. A number of the issues faced by the manager of a distributed team fall at the organizational level. For example, the incentive structures a manager can use are often dictated by the organization. The culture of collaboration/competition is often a result of the entire organization or even the profession—not something the manager can control. Often the project design, designating how many people are at each site, is dictated by the organization, not the individual manager. And budget for technical capabilities and support is often dictated by the project budget, which is ultimately determined by the funding agency or the organization. It is incumbent on the project manager to argue for the importance of these factors, but often it is the keeper of the funds who makes the final allocation.

When multiple organizations are involved, as is typically the case in long-distance collaborations, then there are additional issues to work out. It is at this level that we see explicit activities around aligning the goals of the project, fitting the institutional-specific goals into a secondary role. There may be legal issues that have to be negotiated, and financial issues as well (even down to the distribution of allocated funds being done differently in different countries). In academia, in large projects there is the matter of who gets credit for the results—not just the publications, but at the organizational level, who gets credit for the funding award and who owns the intellectual property.

What Technology will be Used, and Says Who?

In corporations, the answer of who says is often simple: You use what the company provides. But in academics or nonprofits, choices abound, and working across sites often presents compatibility challenges. Often no one dictates the suite of technology the distributed team members will use; each stumbles into offering some that they are used to and accepting, or not, the offerings of others. Because of this murkiness, we propose here the categories of technologies that cover the needs of collaborations, shown in Table 1, and then propose the factors that will help determine which of the many options fit the work at hand.

Communication tools. Clearly, remote team members have to communicate. Email is the default. People differ in how they use email, however, with some, like us, answering it frequently throughout the day and others only once every few days. Knowing what to expect through a "communication covenant," a document stipulating email and other communication habits as well as how the products of work will be shared (e.g., Dropbox, Google Docs, Sharepoint, etc.) is essential to smooth distance work. Audio conferences have also been de rigueur for decades, and now that there is cheap video through Skype and Hangouts, it is getting more common to see the team members and their environment, important antecedents to the development and maintenance of trust. People mean it when they say, "It's so good to see you."

Some have found chat to be a primary mode of larger-scale communication in the moment. One particularly "slow science" we studied, upper atmospheric physics, found persistent chat particularly useful since those coming on the scene later (because of time-zone differences) could quickly get into context by scrolling back and reading what had been happening over the past few hours. Wikis have been successfully used as a place to deposit best practices, interview protocols, successful IRB applications, and the like as communication that borders on shared documents. The use of virtual worlds is rare but has been used successfully in "all-hands meetings" and particular occasions of outreach to the community.

Coordination tools. In addition to the conversation about the work, people have to *coordinate* their work—call meetings, know when someone is interruptible for a quick question, and orchestrate the flow of a meeting so that all agenda items are covered and all people are heard. Shared calendars help greatly with the first, although some people are reluctant to share what they are doing because of privacy issues. Technologies to help others be aware of what one is doing range from simple signals on email (e.g., activity signals in Gmail) to more formal "check in/check out" processes in taking sections of a large code base to work on. Managers often orchestrate meetings without technical help, but services like GoToMeeting help people coordinate what they are looking at, whether it be each other or a shared presentation or document. In some meetings, it helps for the manager or "scribe" to keep publicly displayed notes on what is transpiring, especially people's commitments, handing off note-taking duties when he or she wishes to speak. These visible growing "minutes" are also known to help non-native speakers of English understand better what they are hearing.

Some large science or corporate coordination tasks, like monitoring network services or launching a satellite, benefit from having a large visual display. This could be when collaborators are collocated, as in a control room, or distributed, as when monitoring a whole bank of instruments during a sun storm to predict and verify its effect when the waves hit our upper atmosphere. Like the shared visual displays in desktop sharing (as in GoToMeeting and Google Hangouts), collaboration is made easier when people converse over the shared objects of their work.

In addition, some large endeavors require specialized equipment, such as test machinery or electron microscopes that need to be scheduled for maximum effectiveness. Recently, economists have been recommending various bidding schemes for the time on these instruments that both get people to be honest about their needs (as opposed to trying to game the system) and maximize satisfaction in use of the instrument and in people's variously important needs [3].

Information repositories. The "stuff" of work needs to be stored when not in use and accessible to those with permissions, often in what are called *information repositories* of various ilks. Without an up-front agreement about how a particular team will work, things get messy. When the work is "ordinary office work," without the need for high-end data amassing or computational resources (as in some big science), there are a number of off-the-shelf solutions. Dropbox, Google Docs, Sharepoint, and Windows 365 are just some of the options. Unfortunately, they are not identical; actions that do something in one are not the same as actions in another (e.g., moving a document from the store to one's desktop either makes a copy or *moves* it so that others cannot see it). We have seen people talk about "thunder in the cloud," reflecting the myriad confusing solutions available currently for storing and accessing one's work in the cloud [4].

Computational infrastructure. This speaks to the different infrastructures that are open to people for whom technology suites are not dictated. Some of the shared work is in the cloud (not housed on site) and some is on site. Companies often keep their computational resources behind firewalls for security purposes, as do scientists who have both extremely large amounts of data or data for which security is paramount (e.g., medical data). These architectures have different work implications, having to do with what is needed for access, and include virtual private network connections, accessed anywhere through WiFi and the cloud, and so on. Similarly, there are network requirements for very high transfer rates for big science and corporate data, whereas for more modest transfer of ordinary office work, requirements are likewise modest. But, like the Verizon commercial, "Can you hear me now?" translates to "Can I get my data now?"

Computation itself comes in different sizes and speeds as well. Munging on the terabytes coming from CERN concerning the Higgs-Boson project requires in-house supercomputing.

Large corporations have both server and computation farms. In science in general, the National Science Foundation has recognized the specialized needs of some work and has set up special programs for research instrumentation.

The idea of *human computation* is actually quite old [5], but modern computing and networking has made the idea of crowdsourcing some kinds of problems popular. Services like Mechanical Turk enable thousands of people to do small human tasks for a small amount of money or access to something. Another example is ReCaptcha [6]. Some difficult-to-read characters are shown to someone who is trying to access a sensitive website. These are characters from optical scanning of documents. People figure them out, and across large numbers, end up cleaning up scanned documents.

Choosing technologies. For each one of the categories of technologies—communication, coordination, information repositories, and infrastructure—there are a lot of choices. And the choices have consequences. In choosing the suite of technologies for a collaboration, there are considerations of:

- the speed of response
- the size of the message/data or how much computation is required
- security
- privacy
- accessibility
- various kinds of control of who can read/write
- the richness of what is transmitted
- the ease of use
- context information like who is doing/did what
- cost
- compatibility with other things used.

You can imagine that a large-scale scientific collaboration, connecting 13 institutions with the goal of collecting standardized data on schizophrenics' functional MRIs, might have different requirements on these factors than, say, a distributed team of automobile designers in the U.S., Mexico, and Germany designing the user interface for an interactive display on the dashboard.

The science collaboratory is primarily concerned with deciding how to standardize the situations in which the images are collected and with moving large amounts of data around and making it accessible to all the potential users. They have needs for rapid, rich communication at the beginning of their project to decide on standard protocols and data formats, but once decided, the collaboration is fairly routine. The data and search/accessibility is paramount as the collaboration develops. Cost is a concern only insofar as they have to fit within the budget proposed at the initial stage of the project.

In contrast, the corporate collaboration is very conscious of security—they are competitive with other automobile companies and need to keep their prototypes and design considerations secure. There is a need for rapid, rich communication throughout the design process. Cost is less of a concern.

We do not provide a decision tree to help distributed organizations choose the suite of technologies they need. However, the taxonomy of types of technologies (a taxonomy of purpose of use, not platform or manufacturer) and the list of considerations here, if used conscientiously, should provide good guidance.

In the Future, will Distance Matter?

We have reviewed a number of factors that pertain to success in distributed collaborations and have noted measures that can be taken to aid that success. In spite of all these advances and increasing awareness of the difficulties in distance work, distance still matters. We feel there are four stubborn problems that continue to stand out:

- *Out of sight, out of mind*. Without co-presence or open video, all communication must be deliberate. Even we, experts in this area, have been tripped up by this.
- *Trust*. Like being invisible and blind, trust takes explicit effort. It doesn't come free like it does when one is collocated.
- *Other cultures*. Understanding others who have very different perceptions and habits requires effort and knowledge about how to come to a common understanding or decide on appropriate action.
- *Different time zones*. Adjustments are needed, and often power differences create needless tensions about these.

So, distance still matters, but some aspects of working in this way will get easier. Distance work can work.

Acknowledgment

This article was adapted primarily from Chapters 9 and 12 of *Working Together Apart: Collaboration over the Internet* [8], which itself has origins in an earlier edited book [7] and

the first article in this series [10].

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Tables

Table 1. Classification of technologies to support distance work.

Sidebar: Assessing Collaboration Success

We have recently created an online assessment tool to help those engaged in geographically distributed collaborations. It is called the Collaboration Success Wizard, and it is based on our ideas developed earlier [7,8]. We have administered it to more than a dozen projects involving more than 200 respondents; reports from those projects have indicated that it is quite helpful.

More information is in Bietz et al. [9] and at hana.ics.uci.edu/wizard/

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