



THE DIGITAL ORGANIZATION

How Virtuality Impacts the Way Teams Work

By PAUL M. LEONARDI, DIANE E. BAILEY & STEPHEN R. BARLEY

E-mail, instant messaging, Web conferencing: These are just a few of the digital tools that organizations routinely use in today's workplace to communicate and coordinate tasks between teams. The benefits that these tools offer, in facilitating organizational processes and reducing costs, are well understood. Much less appreciated are the disruptions that technological advances can place on a company's operations – exacting a heavy toll on the bottom line.

During a decade of research, we have learned that digitally mediated relationships can give rise to as many problems as solutions. Whether concerning issues of trust, coordination difficulties across time zones and cultures, or communication challenges from working remotely, new technology portends major

ramifications for organizational structures and work arrangements. Such ramifications are becoming more palpable as companies increasingly virtualize their work processes.

In this article, we will discern three different types of virtual work arrangements that companies often use today, and we will discuss the impact of these different arrangements on organizational processes and structures.

In particular, we will focus on the case of a U.S. auto manufacturer that opted to offshore some of its engineering work, illustrating how virtuality is changing the practice of offshoring: Work is not just being transferred, but the very nature of that work is being transformed. We will provide tips for what companies dealing with similar dynamics can do to address the organizational challenges that virtuality brings.



Three Types of Virtual Work

Since the earliest days of the computer revolution, the lure of the virtual has seduced thinkers, writers, designers and others with the idea that we might someday accomplish with computers that which we have historically done only physically. The hope is that, eventually, we may even be able to dispense with the physical altogether.

Indeed, the possibility of working virtually is fast moving from the realm of science fiction to reality. Already, doctors can operate on patients, and military personnel can control drone aircraft from half a world away, using only digital representations that stand for, or in some cases completely substitute for, physical objects, processes or people.

In today's workplace, there are three dominant kinds of virtual work, each of which has a certain impact on the way work is organized.

1. VIRTUAL TEAMS: OPERATING WITH OR ON REPRESENTATIONS. The first and most widely discussed type of virtual work in organizations is characterized by the use of geographically distributed teams. In such teams, teammates are spatially separated from each another, so they have to use digital representations to communicate with one another.

By representation, we mean something that stands for something else. In computer terms, this can be Voice Over IP, e-mails, instant messaging or images via a Web-conferencing tool, which all act as "indices" of a real person.

Team members operate *with* these representations – that is, they read e-mails and respond to them as a way of conversing with distant colleagues. They also operate *on* these representations – writing a report, calculating a spreadsheet or drawing a building using software all involve some degree of manipulating or crafting representations.

However, even though people's physical access to one another may be restricted, the essence of their work is not fundamentally altered, nor have virtual teams necessarily changed people's roles.

For example, managers may form a virtual team because they require the expertise of distant individuals. However, in joining the team, the new members do not normally assume new duties simply because they are now working virtually. Rather, they perform their roles as before; the only difference now is that they have to use digital representations to collaborate with teammates and accomplish their tasks, instead of doing it in person.

This is not to say that interacting via indices does not present a variety of problems. Establishing trust between team members becomes more difficult – and without trust, people are less likely to share information.

Virtual teams may also struggle with the mechanics of getting work done. Highly interdependent tasks require frequent coordination, which is harder when team members cannot gain physical access to the individuals on whom they depend.

2. REMOTE CONTROL: OPERATING THROUGH REPRESENTATIONS. A second type of virtual work involves digital technologies that mediate our relations with objects rather than people. People whose work entails controlling objects remotely are best thought of as operating *through* rather than *with* or *on* representations.

For example, operators in continuous process plants, such as paper mills and oil refineries, use data collected from sensors located throughout the plant to issue commands from computer terminals to activate effectors that change how the machines work, all from a control room located away from the actual factory floor.

Historically, the idea that manipulating a signifier could affect the signified was tantamount to magic, like sticking pins in a voodoo doll to incapacitate an enemy. Today, the re-

■ EXECUTIVE SUMMARY

The possibility of working virtually is fast moving from the realm of science fiction to reality. Yet as companies increasingly move toward virtualizing work processes, the authors find that digitally mediated relationships can give rise to as many problems as solutions. This article discusses different types of virtual work arrangements that exist today and the impact that various types of virtual work can have on organizational processes and

structures. Taking an example from the U.S. automobile industry, the authors highlight how a traditional industry must come to terms with the new organizational challenges occasioned by today's digitally mediated relationships. This case offers cautionary advice and lessons for other organizations that would turn to the virtual in the hope of reducing costs by replacing humans and objects with data and representations.



How Virtuality Impacts the Way Teams Work

ality of remote control is so prevalent as to be mundane.

Yet, as with virtual teams, remote control brings its own set of problems. Evidence shows that manipulating physical objects through digital interfaces prompts changes in the organization of work and alters the way people make sense of, and come to trust, the objects with which they work. Operating through representations also transforms workers' roles.

Take paper mills: Before the widespread introduction of computerized information systems, operators relied on their senses when interacting with machines and materials, to gain information about the production process. They would judge moisture content by running their hands over rolls of paper; they looked for weight variation by banging wooden sticks on the finished product.

With the advent of remote control, workers were relocated away from the loud, towering machines to air-conditioned rooms. The isolation was figurative as well as literal, placing analytical distance between the operators and the objects that had previously served as the source of their knowledge and understanding.

Indeed, studies have shown that, in their struggles to come to terms with this new "informed" work, operators often had to resist

the urge to leave the control room to check production equipment. They had to learn to trust the technology rather than only that which they could sense directly.

Other studies have shown that working virtually with a complex, tightly coupled technical system not only increases an operator's cognitive load but also requires different forms of organizing, precisely because complicated representation interfaces change the nature of an operator's work.

Some experts have counseled that organizations should pay more attention to the work of industrial engineers, psychologists and computer scientists who study the physical, cognitive and social demands of working with digitized control systems. Unfortunately, such proposals have generally gone unheeded, largely because it implies that managers might have to abdicate some of their power and authority to those on the shop floor.

3. SIMULATIONS: OPERATING WITHIN REPRESENTATIONS. A third type of virtual work also entails an altered relationship between representations and physical entities, but rather than mediating relationships with objects or people, simulation technologies purport to eliminate the need for a connection altogether, moving us closer to the realm of science fiction.

Doctors increasingly use computer simulations of the body to teach anatomy, dissection and surgery in lieu of actual cadavers or patients. Similarly, firefighters use simulations to study how fire and smoke move through a building, and how people are likely to evacuate. In these cases, virtual no longer means working with distant people or objects via representations that stand for them; it means working solely with representations that substitute for the person or object.

One of the biggest problems arising from the growing use of simulation technologies is the massive gulf between verification and validation. Verification involves checking the assumptions behind the equations, parameters and algorithms that compose a mathematical problem. Validation, by contrast, means checking a simulation's predictions empirically against reality – namely, the performance of the actual objects under the conditions being modeled.

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■ ABOUT THE AUTHORS

Paul M. Leonardi is the Pentair-Nugent Associate Professor at Northwestern University. He teaches courses on the management of innovation and organizational change in the School of Communication, the McCormick School of Engineering and the Kellogg School of Management. His research focuses on how companies can create organizational structures and employ advanced information technologies to create and share knowledge more effectively.

Diane E. Bailey is an associate professor in the School

of Information at the University of Texas at Austin. She studies technology and work in information and technical occupations.

Stephen R. Barley is the Richard W. Weiland Professor of Management Science and Engineering and the codirector of the Center for Work, Technology and Organization at Stanford's School of Engineering. His research interests include work and occupations, technological change, and corporate power in representative democracies.