

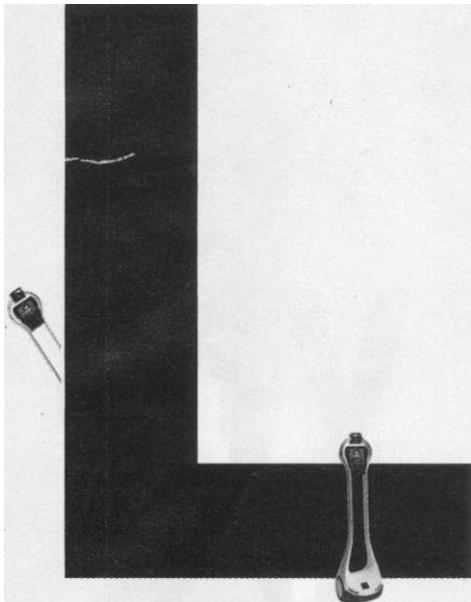
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# I'll Have My Robots Talk to Your Robots

Telepresence—communications tools so fast and vivid that people thousands of miles apart can “meet” in the same room—is finally coming of age

By Drake Bennett  
Photograph by  
Fredrik Broden

→  
Vgo Communications'  
\$5,995 telepresence robot  
stands in for remote workers



Last year, according to the Global Business Travel Assn., Americans took 427 million business trips. They traveled to make sales presentations, do site visits, check in on branch offices, meet with suppliers, placate clients, lobby politicians, man job fair booths, interview applicants, and lay off employees. They traveled to attend corporate retreats, trade shows, continuing-education conferences, and bald-faced junkets. Then they traveled more to get back home.

The bill for all this was \$228 billion, along with untold gallons of jet fuel, tons of carbon dioxide, hours spent in traffic, and missed family dinners. All of it because of the belief that there's no substitute for face-to-face contact. We can easily and instantly project parts of ourselves over great distances: The phone carries our voices, e-mail sends our writing, videoconferencing transmits our images. But none of these provide a sense of human presence—the feeling that a person is actually right in front of us. To size people up or win their trust or smoothly collaborate on a complex, dynamic task, you still need to be there.

In the past few years, a set of technologies has emerged with the potential to change that calculation. The term the creators of these new tools use is "telepresence." Some are custom-built meeting rooms with a bank of high-definition screens and cameras, others take the form of vaguely humanoid robots. None of them fool people into thinking their distant interlocutors are right there, any

more than viewers at a 3D movie really think they're in danger during an on-screen car chase. The moviegoers still flinch, though.

"You can look somebody in the eye," says Rich Redelfs, a partner at the venture firm Foundation Capital, which uses a telepresence suite built by Cisco Systems to meet with companies—many of them in India—that the fund is thinking of investing in. "A lot of what we do in venture is, we invest in people. You want to look somebody in the eye and say, Do I trust this person enough to write them a multimillion-dollar check? We feel we can do that with telepresence."

Already, Fortune 500 companies such as Bank of America, PepsiCo, Procter & Gamble, and Royal Dutch Shell have installed Cisco's "immersive suites," which cost upwards of \$300,000, for management meetings. P&G is also trying them out for consumer focus groups. The software company Autodesk has 20 telepresence suites worldwide and has cut travel by 16 percent since installing its first ones three years ago. The social game developer Zynga uses immersive units made by Polycom to coordinate far-flung designers and programmers; the CBS show *The Good Wife* conducts bicoastal writers' meetings through them. Hospitals are setting them up to allow neurologists to remotely diagnose stroke patients who show up in the emergency

room. Polycom Chief Executive Officer Andrew M. Miller says a fellow CEO has installed a suite in the garage of his vacation home in Hawaii. "I can't tell you his name, of course, but he's one of many," Miller says.

Thanks to their mobility, telepresence robots are being used by managers to walk factory floors. Health-care organizations are looking at employing them for home care; so are storage companies for security. Cisco and some of its partners are creating telepresence retail displays to ensure that a salesperson is always on hand to sing the praises of a particular product to a browsing consumer. Telepresence has even come to the coffee break: Four of Cisco's European offices have wall-size telepresence screens constantly on in the office canteen, so that co-workers hundreds of miles apart can "meet" there for a drink.

"You're able to virtualize people and resources," says Martin De Beer, the Cisco executive who led the development of the company's telepresence offerings, in an interview conducted between two telepresence suites. De Beer now spends much of his time in a suite at Cisco's San Jose headquarters, clicking from one distant locale to another as if flipping through TV channels. "I'm frequently in five or six cities a day, and it would be impossible to get on that many planes," he says. "Rarely a day goes by when I'm not in at least three or four telepresence meetings."

Cisco and Polycom are currently the two biggest players in the field—a third, the Norwegian company Tandberg, was bought by Cisco last year—and the market they're battling over is growing. According to the technology consultancy Wainhouse Research, sales of immersive telepresence units are up nearly 60 percent over the past two years, and the total revenue for all high-definition teleconferencing will grow to \$2.3 billion in 2015.

It remains to be seen what effect that growth will have on how much and how far we travel for work—and how vulnerable airlines, hotel chains, and rental car companies might be. Not every telepresence product has been a hit: The Umi, a \$600 home high-definition telepresence unit Cisco launched last fall, was dismissed by most tech reviewers as a prohibitively expensive bauble unlikely to lure households away from free video chat services such as Skype. And no

**Shell, Pepsi,  
and BofA  
have all  
installed  
Cisco's  
\$300,000  
telepresence  
suites**

## The Art and Science of Telepresence

The lighting is carefully balanced to highlight facial expressions while creating a sense of 3D space onscreen

The curved desk creates the illusion that the people in the room and onscreen are all sitting around one table

The chairs and wall color are standardized to unite the sites



What's onscreen can be a composite of feeds from different, diffuse suites

The microphones activate the screens, which shift between feeds as people chime in

Transmitting all this data takes 20 to 40 times the bandwidth of a basic Skype video call

matter how well the technology works, it's hardly the first invention to promise to obliterate distance: The 19th century had the telegraph, the 20th the fax machine and the Web, yet we travel more today than ever.

Still, the experience that telepresence provides is qualitatively different from other remote technologies—richer and more immediate. Trying them out, I found both the telepresence rooms, with their high-definition immersiveness, and the robots, simply by providing a remote body to take for a spin, defused many of the cues that make distance feel distant. The technology has its limits, but it will almost certainly get better even as it gets cheaper. Just as most people 15 years ago felt uncomfortable shopping or dating online, it is easy to imagine that interactions now understood to require physical interaction may soon become perfectly acceptable to do by telepresence. Even today, expensive as the technology can be, for many users it's being there in person that's beginning to feel like a luxury.

**Being in a telepresence suite is a bit** like being in a TV studio. This staginess is partly by design. Cisco suites, for example, are built to be nearly mirror images of each other, with six identical chairs arranged around an identical

semicircular table facing a triptych of 65-inch plasma screens (larger suites have a second row of chairs around an outer table). A hood-shaped "light shroud" frames the screens like a proscenium arch, emitting a white glow to highlight the facial features of the people sitting before it.

When the screens come on, a user sees people seated around the other half of the table he's sitting at, in the same chairs, in front of a wall that's the same khaki hue as the one behind him—whether he's connecting to Chicago or Oslo or Seoul. Or all three: The rooms can simultaneously patch in participants from multiple locations.

This combination of factors gives telepresence meetings an odd sense of placelessness. A sales meeting I sat in on at the Cisco suite at Autodesk's Waltham (Mass.) office included employees from Sydney, Singapore, San Rafael, Calif., and Manchester, N.H. The only evidence of anyone's location were small printed signs in front of each participant, as if they were in Model U.N. During the telepresence meetings I attended, I would occasionally experience a fleeting claustrophobia, a sense that the entire world had collapsed into a single, infinitely iterating conference room.

This sensation is a testament to the power of the technology. Both the image

and sound are sharper and more fluid than traditional teleconferencing technologies and far higher-resolution than services such as Skype or FaceTime. As advertised, I found I could look into people's eyes as they talked to me, and they could look into mine. I could gauge from their facial expressions when they were bored or discomfited, interested or surprised. Watching people's reactions as they listened to others talking, I could get a sense of the mood of the "room." Because there's no transmission lag, it's easy and natural for people to interrupt each other. Comments can be cushioned or emphasized by body language and small gradations in tone. And, inevitably, from time to time I found myself distracted by a strange bump on someone's lip, or the size of a person's wristwatch, or by trying to make out what someone sitting on the other side of the country was writing in his notebook. In short, it felt very like the many hours I've spent attending meetings in person.

Fundamentally, the technology varies little from Skype. Aside from the high production values, the real difference is bandwidth. The biggest telepresence suites have three video cameras and three screens, and when two or more rooms are connected to each other over a data network, each camera transmits separately to a corresponding

screen in the other room. A processor called a codec instantaneously compresses the stream of video and audio data as it's sent and decompresses it as it's received.

Even with the compression, however, immersive telepresence needs fat pipes: A Cisco immersive telepresence room operating at its highest resolution requires a network data transfer rate of about 12 megabytes per second. Polycom's newest codecs can cut that number in half, but that's still roughly 20 times the bandwidth of a non-HD Skype video call.

As rich as the stream of visual and audio data is, the illusion does occasionally break down. When people stand up from the table in a standard Cisco suite the camera can't follow them, so they look headless. (Polycom suites don't have this problem, and Cisco has addressed it in customized rooms such as the "virtual collaboration spaces" it designed for General Electric engineering teams.) When I used the suite in Cisco's New York office to interview Marthin De Beer, he and the two company spokespeople sitting with him in San Jose spent the hour looking not at me but at a spot in space two feet to my left—even as they remained in perfect sync with everything I said and did.

These are quibbles, though. The real barrier to widespread use is cost. While prices are dropping, the technology is still expensive, especially the units that most closely mimic actual proximity. Polycom's immersive rooms run from \$200,000 to \$600,000, along with a service plan that's around 10 percent of the price of the equipment itself. The monthly bill for the extra bandwidth can easily run into the thousands of dollars. And since the units are meant to communicate with each other, there's little point in buying just one. Until very recently, the only way most people could use a telepresence suite was to work for a company that had one.

Cisco and Polycom are both trying to change that by pushing into what they call "public telepresence": telepresence suites, available for rent, in high-end business hotels and executive suites around the world. In essence, these are immersive phone booths. The suites usually rent for \$400 to \$500 an hour—that's per room, so a call between two public rooms is double that. It's not cheap, though compared with plane tickets and

time lost to travel for five or six employees, it can be the better deal. The primary users have been companies such as Foundation Capital without a suite of their own, or remote employees of companies that do.

Some at Cisco have an even more ambitious idea of what public telepresence might accomplish: They believe it can help change what it means to go to work. The proof of concept they point to is in the Zuidas district in Amsterdam, a thicket of expressionistic skyscrapers—some jagged, some undulating, some Lego-like, all of them new—a few miles south of the canals and 17th century houses of the city's iconic Grachten-gordel neighborhood.

Nestled at the feet of the office and apartment towers is a two-story establish-

ment called Amsterdam Bright City that's a hub of a nationwide social engineering experiment. The first floor is an airy cafe; the second has conference rooms, meeting nooks, an open area with long desks and colorful high-design office furniture, and a Cisco telepresence suite.

Amsterdam Bright City is one of over 100 "smart work centers" that have been set up around the Netherlands since 2008, under the aegis of a coalition that includes Cisco, ABN Amro, and the City of Amsterdam. It's a network of venues, each with the amenities and resources of an office—from copiers and fax machines to coffee bars and child care—but located right where people live.

The hope is that, rather than commute en masse to downtowns and office parks, a sizable segment of

↓ Research suggests that people are quick to humanize robots, even when they don't look particularly human



PHOTOGRAPH BY FREDRIK BRODEN FOR BLOOMBERG BUSINESSWEEK

the workforce will, at least part of the time, go to work at their neighborhood smart work center, just as they shop at their local grocery store or drink at the corner bar. People from different companies would work alongside each other, connecting to their colleagues remotely—driving less, spending less time in traffic, their cars emitting less carbon dioxide. (Set almost entirely below sea level, the Netherlands is particularly attuned to the ramifications of climate change.) The eminently Dutch goal of the smart work center coalition is to build enough of them that everyone in the country lives within 15 minutes of one-by bicycle.

"We claim that we've been living in the Information Age for 20 years, but you could easily argue that that's not the case," says Bas Boorsma, a director of Cisco's consulting arm, the Internet Business Solutions Group. Boorsma is one of the driving forces behind the smart work centers. We were sitting in the center's telepresence suite after a meeting he'd organized. "We have merely utilized information technology to optimize the Industrial Age, and we're acting as if we're still commuting to our factories," he says.

Twelve of the centers are scheduled to have telepresence suites by the end of 2011; Bright City is the first. The suites seem to be, in part, high-tech enticements to get workers, or their employers, to pay the \$500 monthly membership fee. But they also serve a more central purpose: The richer and more realistic the tools available to connect to other offices, the more willing people will be to work remotely. "It allows people to do their work independent of where they are, to participate even in sensitive negotiations and performance reviews by network means rather than having a real physical meeting," says Boorsma.

Even for a country as doggedly progressive as the Netherlands, the sort of wholesale reorganization of work that Boorsma is talking about is hugely ambitious, and unprecedented. The two smart work centers I visited, in the Zuidas and the Grachtengordel, had people spread around the workstations and meeting rooms, but also plenty of empty seats. At the same time, there is some evidence that people are starting to use telepresence as they would in a smart work center: to replace much of the daily interaction of a workplace.

## Some have begun to use telepresence to replace not just flights but car trips across town



Alexandre Pelletier handles European telepresence sales for Tata Communications-Tata provides network connections and maintenance for Cisco's suites in much of the world. Some of his clients, he's noticed, are using the suites to replace not just transcontinental flights but car trips across town. Separate engineering teams at the carmaker Peugeot, for example, will routinely convene by telepresence, even though the offices where they're working are all right around Paris.

**Only so much work can take place** within the walls of a conference room, real or virtual. Just ask a road warrior. "Most of my clients, when I go in the building, I'm saying hi to 10,12,15 people before I even get to the meeting I'm going to," says Mark Fetner, an account executive at Blackbaud, a Charleston (S.C.) company that sells specialized software to nonprofits. Fetner spends two weeks a month on the road, enough to earn Platinum Medallion status on Delta Air Lines. "Every organization has a social network that you have to understand and build a relationship around to get a program off the ground," he says. "And every time you go back you build more rapport. It's like the old Peter Drucker 'management by walking around'-you learn a lot that way."

A whole swath of the global economy is based on people like Fetner.

While numbers vary from airline to airline and hotel chain to hotel chain, few among them would survive in anything like their current form without business travel. Half of American Airlines fliers are business travelers, and although the airline won't specify exactly how much, they provide significantly more than half its revenue. Avis Rent A Car System derives 60 percent of its time and mileage revenue from business travelers. High-end restaurants rely on business travelers on expense accounts. So do sports franchises—all those revenue-generating corporate boxes for entertaining clients. And all the bachelor parties and benders in the world couldn't save Las Vegas if no one went to its conventions.

"Certainly the profitability of the travel industry at large comes from business travel," says Mike McCormick, executive director of the Global Business Travel Assn.

McCormick, for one, doesn't see telepresence as a threat to those industries. Business travel dropped sharply during the recession—from 269 million trips in 2007 to 223 million in 2009—and hasn't yet recovered. While some environmentally conscious firms such as Autodesk have used telepresence to make permanent cuts in travel as part of a carbon emissions reduction strategy, many more were simply reacting to the economic climate. Over the past year, travel numbers have started climbing back.

"Telepresence isn't a replacement factor," McCormick says. "To put it simply from a business perspective: The first time you lose a customer because you were there in telepresence and your competitor was there in person is the last time you use telepresence."

For those such as McCormick who believe that business still requires shared confidences over expense account dinners and brief conversations through open office doors, there is at least one attempt to capture technologically that dynamic over distance: the telepresence robot.

Telepresence robotics is a far smaller corner of the tech world than immersive telepresence. Rather than being the battleground of Silicon Valley giants, it's the province of small startups. And analysts are sharply divided over how big it can get. Andrew W. Davis, the co-founder of Wainhouse Research, doesn't see much potential. "When you look at the value added by mobility [vs.]

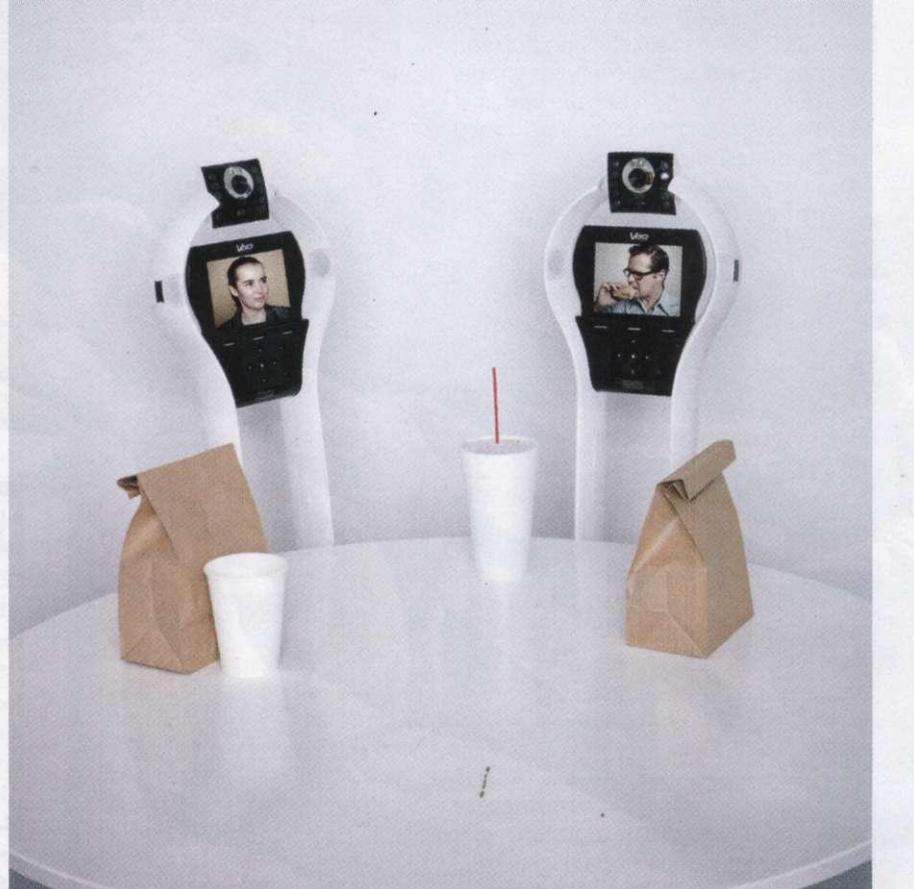
the cost of mobility, I believe it's going to remain a small niche market," he says. The tech consultancy ABI Research, however, published a study last fall that predicted that the worldwide market for telepresence robotics would grow from \$556.1 million in 2010 to \$13.1 billion in 2016. Larry Fisher, one of the study's co-authors, argues that the uses for the robots will shift as the market grows, from security and surveillance—which he includes under the umbrella of telepresence—into remote meetings and virtual collaboration.

There are a few models of robot currently available, and they are in high demand—one company, Vgo Communications, quickly sold out its first production run of 100. Another, Anybots, currently has an order backlog of a month and a half. One of Anybots's clients is an Arlington (Va.) energy efficiency software startup called Opower, which is still awaiting the delivery of its \$15,000 robot. "I call it Skype on a Segway," says Daniel Yates, Opower's CEO. "I'm prepared for it to be a gimmick and not pan out. I'm hopeful that it won't be."

Vgo's robot is smaller than the Anybot, and, at just under \$6,000, significantly cheaper. (There is a \$100 per month service fee.) Four feet tall and shiny white, it looks like an apprehensive, undernourished ghost. Two shapely plastic stems rise out of a wheeled base and meet in a bight of tubing inlaid with microphones and rounded like a head. The robot's face is a video screen and its single eye a video camera; its base has headlights and sensors to alert it to obstacles. The whole apparatus is pitched slightly backward, as if recoiling in surprise.

Reporting this story, I was incarnated as a Vgo on multiple occasions, sitting in New York at my laptop while conversing and moving around Vgo's offices in Nashua, N.H. The employees there seem accustomed to stepping around poorly controlled Vgos, stopping only to offer good-natured advice about not oversteering. As they bent down to speak to me, they saw my face projected from my Webcam onto the robot's video screen, my expression one of concentration mixed with embarrassment.

And, at times, frustration. Because of a problem with the Internet connection between my computer and the robot, during my initial attempt I could hear only faintly what was being said to me,



↑ Telepresence technologies in office cafeterias allow workers in different countries to share a meal or a coffee

often with a delay, and my link cut out completely after a few minutes. Then, after I had wheeled painstakingly up to the desk of company co-founder Tom Ryden and raised my camera so I was looking at his face rather than his solar plexus, my microphone went dead. I had to resort to a feature that allows users to type things out for the Vgo to recite in its monotonous robot voice. It made for a stilted conversation—Ryden was speaking, I was essentially texting—and through my cyclopean robot eye I watched him gamely simulate a facial expression of equanimity.

My second try, the next day, was a very different experience. A blizzard had settled over New England that morning, and Ned Semonite, the marketing executive who was supposed to coordinate my visit, couldn't make it to the office. He told me to go ahead and log into my loaner Vgo, that my interviewees there were expecting me to come find them.

I set out to do so, at first moving hal-

tingly and then with a bit more confidence—the Vgo's top speed is about that of a leisurely walker. I wandered the office kitchen, then browsed shelves of robot parts. I used the video camera to take a picture of myself in a wall mirror. But I didn't see any people. What I encountered were other Vgos. One cut across my narrow field of vision with a Dopplerized whine, then another, going the other way. I saw a third pass a doorway a little ways off. I found a fourth standing by the entrance to the kitchen and eased shyly up to it only to realize it wasn't on. The whole thing was wonderfully surreal: I could have been in any one of a thousand office parks, except that the workers were four-foot-tall white lollipops with human faces, whirring purposefully to and fro. So was I.

It was a shock when an actual human being loomed up in my monitor. It was Ryden, who had come to continue our aborted conversation of the day before. Because of the blizzard, he was one of

the few employees to show up that day. Some of his colleagues were arriving later. But some, he explained, were just staying at home—at least in their corporeal form. They were at the office as their Vgos, roaming from cube to cube.

"On snow days we'll have well over half the guys on Vgos," Ryden later told me. "They'll stop and chat with each other, robot to robot. You'll be walking down the hall and see two guys just chatting away, and they're both in some other location."

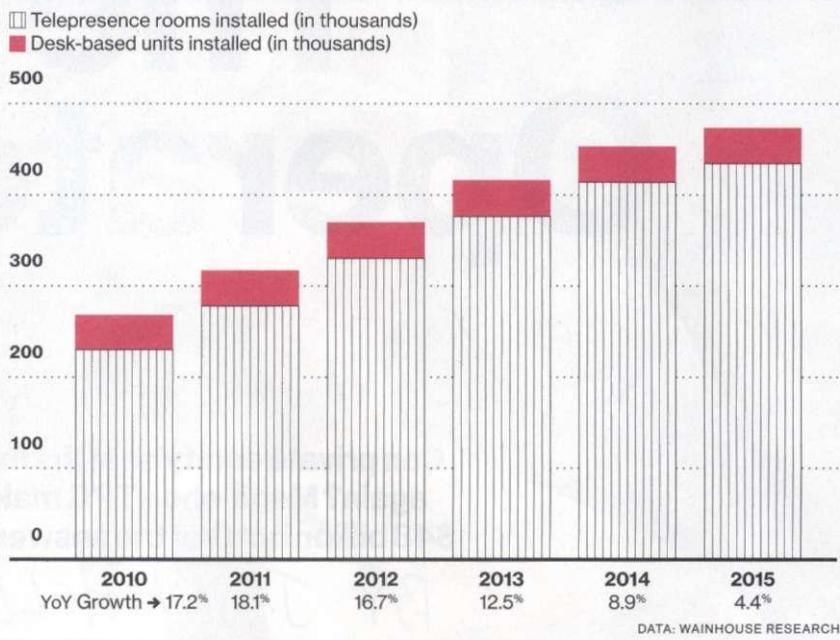
There is a body of research on human-machine interaction, on how people relate to the increasingly smart devices that surround them. One finding is that it doesn't take much to get people to bond with a robot, even one that doesn't look or sound anything like a person. Pamela J. Hinds, a Stanford University professor of organizational science, has looked at how doctors and nurses interact with HelpMate robots that transport drugs and other supplies around hospitals, and how a team of researchers working in the U.S. treated the remote rover they used to collect samples in the Atacama Desert in Chile. "I think one of the things that surprised us the most was the extent to which they were anthropomorphized, even when they were these big, boxy file-cabinet-looking things," Hinds says. All a robot had to do was move around in a purposeful way, and people thought of it, in some ways, as a co-worker. People invariably give their robots names and talk about the robots' moods and tendencies. Hinds recalls seeing one HelpMate to which hospital workers had attached a pair of googly eyes.

Hinds also studies "distributed work": the dynamics of work teams divided by geography. Perhaps thanks to her particular intersection of interests, she sees in telepresence robots an intriguing, potentially powerful solution to some of the difficulties those teams face. "With telepresence robots, there's a number of things that I think are incredibly cool," she says.

Mobile telepresence isn't just a gimmick, she argues—it qualitatively changes what a remote user can do. It allows people to recreate the sort of serendipitous social encounters so common in flesh-and-blood office life. "I don't depend upon other people coming to see me, I can run into people and have spontaneous conversations with them, and

## Growth in Telepresence Sales

Sales of telepresence rooms are projected to grow in the next few years, but growth will slow as cheaper products begin to provide many of the same benefits.



that is really important," she says. The lack of those informal conversations—the sort of communication that doesn't find its way into e-mails or phone conversations or meetings—is a large part of why working remotely for a sustained period can be so difficult.

If Hinds's robot research is to be believed, mobility isn't just useful, it's also humanizing. The mere fact that telepresence robots move, however stiffly, is what makes them such effective stand-ins for people.

Some of Vgo's customers tell a similar story. One of them is Reimers Electra Steam, a small company in Clear Brook, Va., that manufactures boilers. Last July the company's electrical engineer, Erwin Deininger, moved to the Dominican Republic when his wife's job transferred her there.

At first, Deininger would attend meetings back in Virginia through Skype. If he needed to see something on the shop floor, which he often did, a colleague would carry around the laptop Deininger had connected to, pointing it where he asked. Someone had to be essentially tasked as Deininger's remote body, and if no one was available he was stuck. "It tied up manpower, and it didn't give him

the flexibility he needed," says Roger L. Burkhart, Reimers's president.

Burkhart did some research and found out about Vgo. The robot arrived in December, and now Deininger wheels easily from desk to desk and around the shop floor, answering questions and inspecting designs, often using the robot's photo feature to examine wiring in detail. Burkhart and other senior managers also occasionally use the Vgo to check into the office from home.

If Burkhart has been pleasantly surprised at how useful the robot has proven, he's even more struck at how he acts around it. To a remarkable degree, he says, he now conflates the robot with its user. He finds it hard to not think of the robot as, in a very real sense, Deininger himself. "Little Erwin comes rolling into the office at 10 a.m. every morning," Burkhart says. "When you're talking to Skype, you're always talking to a computer. When the robot is there, because it turns around and faces you, it takes on the personality of the individual. You're hearing his voice, you're seeing his face through the video, you've got movement involved."

"After a while," he says, "it's not a robot anymore." ©