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Web3D: The Next Major Internet Wave

by Erica Driver

for Information & Knowledge Management Professionals



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EXECUTIVE SUMMARY

The Internet is on the cusp of its next major evolution: Web3D. Within five to seven years, Web3D will deliver an interactive, immersive experience much richer than the static, text-oriented or even interactive graphical interfaces of today's Web. In the new world of work that Web3D will enable, people will be represented visually by avatars that can move in space, communicate with others, and interact with objects and information — making the digital world seem more like the real world. Yet Web3D won't leave the old world behind; it will integrate with the Web technologies we use today as well as existing and not yet invented business applications. Workers will use Web3D to teach and learn, innovate collaboratively, communicate and network, interact with and present information, and manage real-world systems.

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Related Research Documents

"Getting Real Work Done In Virtual Worlds"
January 7, 2008

"The Seven Tenets Of The Information Workplace"
November 26, 2007

WEB3D: THE NEXT WAVE OF THE INTERNET EVOLUTION

The World Wide Web has become an ingrained part of the way we work. No one ponders, these days, the fact that the Web links a vast system of documents, data, social networks, and applications running on servers all around the world. But in 1990, the Web that we take for granted today seemed unbelievable and unachievable. Again, a similar leapfrog jump in the Internet's capabilities will culminate during the next five to seven years when a 3-D, interactive, immersive Web emerges to make the Information Workplace — digital work environments that are seamless, contextual, visual, individualized, multimodal, social, and quick to create and modify — even more of a reality.¹

Investors are already pumping tons of money into virtual worlds, immersive workspaces, and immersive learning simulations — some targeted at business and some at consumers. According to Virtual Worlds Management, a media company tracking the virtual worlds industry, venture capital, technology, and media firms have invested nearly \$1.5 billion in virtual world companies in just five quarters from Q4 2006 through Q4 2007.² This is one of many indicators that we are in the very early stages of Web3D, which we define as:

The next major wave in the Internet's evolution. Web3D is a system of linked interactive 3-D and 2-D environments that will include everything from use-specific, private applications like immersive learning simulations to virtual worlds open to anyone who wants to join — and people will move among these in a seamless, natural way. Web3D will deliver an interactive, immersive experience that increases motivation and engagement compared with the static, text-oriented or even somewhat interactive graphical interfaces of today's Web. People will be represented visually by avatars that can move in space and communicate with others via voice and text, gestures, user-directed motion, animation sequences, and social networking tools. Web3D will integrate with Web 1.0 and Web 2.0 tools and technologies, as well as business software applications.

WHAT'S PROPELLING WEB3D FORWARD?

Web3D will change the way many of us “go to work.” We will no longer be constrained by commuting to a physical work site or getting on an airplane to conduct meetings or business. We will be able to do almost anything we can do in the physical world using a powerful-enough Internet-connected computer or mobile device, anywhere we happen to be located. Why within the next five to seven years? Because of:

- **A relentless focus on innovation in today's business environment.** You'd be hard-pressed to find a CEO today who wouldn't say that increasing innovation isn't one of his or her top objectives. That's because while efficiency is important, it's hard to compete on efficiency alone, and competition increasingly hinges on a company's ability to innovate.³ This means innovating not only with products and services but also with business culture, organization, processes, and business models — plus getting everyone involved in the innovation process. To gain a long-lasting competitive advantage, business managers will rely on bottom-up innovation and draw on

people both inside and outside the organization as sources of creativity, ideas, input, and perspective. In Web3D, people — and not just engineers — will collaborate on 3-D product models and interact with each other over multidimensional representations of data. Organizations will increase the frequency of “water cooler” conversations, which sometimes result in new ideas and innovations, by enabling them in the virtual world, not just the physical world.

- **Rising expectations due to Technology Populism and Social Computing.** To support their jobs, today’s information workers can provision their own software tools, information sources, and social networks via the Web.⁴ Consider that an individual worker can now set up his or her own Web-based communications, personal productivity, information feeds, workgroup collaboration tools, and 3-D immersive workspace from the comfort of the office in an afternoon, without the intervention of skilled IT staff. A confluence of forces — including ubiquitous broadband, a growing technology-native workforce, wide availability of cheap or even free Social Computing tools, and increased mobility — drives this trend. Today, businesspeople can hold discussions and meetings in Second Life for free and can rent persistent virtual workspace in-world for about the same monthly cost as Netflix. Or for a few bucks a pop, they can rent Web-based Tomorrow Spaces from Transmutable for one-time meetings.
- **A changing workforce that requires a technology refresh.** The first round of Millennials, those born between 1980 and 2000, are entering the workforce. They expect and demand a different kind of work environment than prior generations.⁵ Members of this generation have an innate ability to use technology, are comfortable multitasking while using a diverse range of digital media, and literally demand interactivity as they construct knowledge. Millennials grew up playing interactive video games and now hunger for rich visual experiences. But the arrival of Millennials is not all we mean by the changing workforce. At the other end of the age spectrum, some baby boomers are moving to retirement communities and working part-time, and they need to stay connected to their organizations and teams.

Plus, individuals, regardless of age, working either within companies or outside them are increasingly functioning as freelancers — or at least have their own franchise and personal brand to manage. Web3D gives people the ability to create avatars and workspaces that they feel express themselves, a rich interactive video-game-like experience, and an ability to stay connected when they are not physically together. Our Web3D virtual workspaces will provide contextual information about who we are so that a colleague or customer can expand his or her level of intimacy and trust with us.

- **Investor, vendor, and early adopter activity.** We mentioned earlier that nearly \$1.5 billion had been invested in virtual world companies from Q4 2006 through Q4 2007. How about since then? Chinese game company 9You received \$100 million in funding after launching GTown, a virtual world that integrates the company’s existing online games, which combined have more than 1 million peak concurrent users.⁶ Virtual event provider Unisfair raised \$10 million;

Gizmoz, which has a platform people can use to take Flash-based avatars into social networks, instant messaging (IM) tools, and videos, raised \$6.5 million.

Large technology-savvy companies with distributed workforces, such as Sun Microsystems and IBM, are building out virtual work environments. IBM announced in November 2006 that it would invest \$100 million during the next two years pursuing 10 new businesses, one of which was 3-D Internet.⁷ IBM is all over this stuff — Mike Rhodin, until recently the general manager of IBM Lotus software, listed the virtual workplace as the first of his top five predictions during a speech at VoiceCon in March 2008, highlighting that social networking tools and virtual world meeting experiences will simulate the feeling of being there in person.⁸

BUSTING OUT OF TODAY'S "WALLED GARDENS"

Linden Lab's Second Life virtual world is perhaps the closest thing to Web3D that exists today. Second Life is an interactive 3-D virtual world in which anyone can create an account and an avatar (become a "resident") for free and can create scripts and 3-D spaces and objects. Second Life residents can buy or rent "land" (server space) and build whatever they want: businesses, office space, items for sale, homes, games, playgrounds — anything. But Second Life as it exists today isn't the end game; rather, it's an indicator of things to come. If Linden Lab plays its cards right, focusing on issues like openness and integration with other Web3D environments, security, and identity, Second Life will become part of a much bigger virtual universe.

- **Remember AOL's "click here to access the Internet?"** AOL and CompuServe preceded the Web as graphical interfaces to networks that connected people to each other and to documents and applications. Do you remember when AOL first placed a button on its service that said something like, "Click here to access the Internet?" Similarly, residents of Second Life may one day soon be able to teleport from inside it to other virtual worlds and Web3D sites, taking their inventories of items with them — and vice versa. In fact, IBM and Linden Lab put out a press release in early April 2008 saying that IBM plans to pilot a solution internally that will allow IBM employees to explore the Second Life mainland and, without having to log on and off, seamlessly cross over into IBM's custom-built world behind the firewall.⁹
- **Multiple vendors will provide Web3D servers, which can live anywhere.** The system of servers linking together all the Second Life simulations (which Linden Lab calls "the Grid") reside only in Linden Lab data centers today, whereas Web3D servers will reside anywhere. Early indicators are the efforts underway to reverse-engineer the Second Life client and the way it communicates with the Second Life simulator servers, as well as efforts like the Ogoglio project, OpenSim (which implemented servers that are compatible with the Second Life viewer client), the OpenSource Metaverse Project realXtend, and Sun Microsystems' Project Wonderland.¹⁰

- **People will be able to traverse Web3D — an expansion of browsing the Web today.** Workers will “teleport” from one Web3D environment to another — assuming they have permissions — similar to the way we type a URL to go to a Web page or Web application today. We will also be able to wander from one Web3D site or world to another, much as we do today when we surf the Web via links or teleport or fly from one Second Life island to another. People will use Web3D (which, remember, integrates with the Web tools and technologies we are familiar with today) to search for and interact with information and people.
- **You’ll be able to create 3-D objects using standard tools and then import them.** In Web3D, people will be able to create 3-D (and 2-D, for that matter) content using a variety of tools not connected with any particular virtual environment. We will be able to create 3-D objects (e.g., avatars, spaces, furnishings, models, etc.) and new forms of business tools (e.g., new tools for delivering business presentations or displaying and working with complex data, or communicating nonverbally during meetings) and easily import them. The Multiverse Technology Platform and Qwaq Forums are examples of Web3D solutions that allow external object creation today.
- **It will be easier to create content than it is today.** For virtual environments that use 2-D more than 3-D, Adobe Flash and other rich Internet application technology will likely be widely used — Gizmoz is an example of a company working on this. And plenty of companies are working on ways to use regular old Web browsers for 3-D content creation. According to Trevor F. Smith, CEO and co-founder of Transmutable and founder of the Ogoglio project, “In the context of online worlds, people care about personal representation, spatial representation, synchronous communication, and end-user-focused design tools, all of which can be accomplished in the Web browser.” For an indication of the democratization of 3-D content creation, check out Altadyn 3DXplorer, the open source C3DL project, Google Sketchup, Transmutable Tomorrow Space, and View22 SceneCaster — and even the WYSIWYG object creation tools in Second Life, which some residents find easy enough to use.
- **You’ll be able to use the same avatar in multiple virtual environments.** On Web 2.0 social networking sites today, people upload digital photos to represent who we are. A similar concept will be true for avatars. People will create avatars using easy-to-use 3-D content creation tools — some perhaps designed specifically for this purpose — and will upload these avatars to the various Web3D sites and virtual worlds we frequent. IBM, Linden Lab, and other vendors, as well as computer engineers in universities around the world, are working on avatar portability, which is the ability to use the same avatar in multiple virtual worlds.¹¹
- **People will develop rich work environments.** Some of us will have fairly traditional-looking virtual offices. Others will be really out there: underwater, out in space, in tree houses or ice caves. We will be able to easily customize our virtual workspaces to reflect who we are — much the way we customize our real-world, physical workplaces with plants, pictures, books, awards,

and toys. Web3D will take personalized digital work environments — wallpaper, screensavers, signature fonts, email templates, and so on — to a whole new level.

INTERACTIVITY + IMMERSION = ENGAGEMENT

Web3D will become a foundational technology for organizations that are trying to create pervasive innovation environments — work cultures in which the entire workforce is permitted, in fact, encouraged, to be creative, and one where people are recognized and rewarded for innovating. Web3D also has the potential to increase people's engagement with their work. Why? Because the virtual world is just like the real world in some very important ways. For example:

- **Research shows that virtual interactions seem similar to physical interactions.** Stanford University professor Byron Reeves and co-author Clifford Nass have found that interactions with computers, television, and new communication technologies are pretty much identical to real social relationships and to the navigation of real physical spaces.¹² And Reeves found in other work that the human body's physiological response to a person's avatar being touched by another avatar is the same as if the interaction took place in the real world.¹³
- **Learning activities in the virtual world have the same efficacy as the physical world.** Medical education researchers Parvati Dev, Patricia Youngblood, and W. LeRoy Heinrichs at the Stanford University School of Medicine found in their research that there is no noticeable difference in medical students' proficiency gains in managing basic trauma cases using a virtual world versus a human patient simulator learning environment (with a mannequin the student interacts with as though it were a real person).¹⁴

Learn, Teach, And Practice In A Way That "Feels Real"

Immersive learning simulations are video games developed to address a particular education- or learning-related business problem. These simulations can provide a motivational learning/working ecosystem that allows practice, experimentation, and observation, and that can be used by individuals or groups. In Web3D, immersive learning simulations will:

- **Be common training mechanisms.** Many examples exist that illustrate the power of Web3D for training. IT company Rite-Solutions built a 3-D simulator for truck drivers to learn how to parallel park a big rig. Proton Media created a virtual world in which car insurance adjusters can practice examining damaged vehicles by manipulating damaged virtual cars; they can look inside and underneath, try to open the doors, and get a close-up of particular damage spots. The variety of cars with different types of damage provides rich learning experiences that are hard to duplicate cost-effectively in real life. Or in a hotel management training game developed by Virtual Heroes and introduced by the Hilton Garden Inn hotel chain, new employees learn how to service customers at the reception desk and other locations throughout a realistic virtual hotel lobby.

- **Aid in business process rehearsal.** Energy giant BP, a company doing lots of experimentation with 3-D immersive environments, thinks that one of the killer apps for 3-D immersive work environments is business process rehearsal — essentially practicing the management of events that can't easily be practiced in real life, according to BP's Chief Technology Office for digital technology. This covers a wide range of activities from practicing hands-on personal skills in standalone learning environments to practicing group interactive teaming skills in unstructured scenarios. Crisis management exercises in the oil industry are extremely difficult, if not impossible, to conduct in the real world. Another indicator of a trend toward business process rehearsal: IBM has launched an interactive, 3-D business simulator called IBM INNOV8, which is designed to teach the fundamentals of business process management to grad students and, ultimately, customers.

Discover New Ways To Collaborate, Network, And Interact

We have already gone through massive changes in the ways we interact in the business context: face-to-face and snail mail; then by telephone and then voicemail; then email; and now IM and social networking sites and video. Web3D will usher in the next major shift in the way people interact, enabling us to:

- **Hold meetings in virtual workspaces.** Christian Renaud, chief architect of Networked Virtual Environments for the Cisco Technology Center, has been holding weekly one-on-one internal meetings in Second Life for more than a year. He says that virtual environments add a level of fun, which positively influences productivity. The Institute of Advanced Study at Princeton University has set up two organizations and holds meetings in Qwaq Forums for the Meta-Institute for Computational Astrophysics and Ways of Knowing, which is a broadly interdisciplinary initiative that compares the scientific approach to knowledge with other approaches such as those of art, spirituality, philosophy, and everyday life.
- **Meet, talk with, and learn from others at virtual conferences and trade shows.** People already attend conferences at virtual universities, virtual hotel venues, and the private and publicly accessible Second Life islands of experts in various fields. The opportunity to meet virtually with experts, pundits, and an intelligent crowd of participants enhances knowledge acquisition, productivity, and potential partnerships. Some sessions will be mixed-reality meetings, in which some participants are gathered in a physical meeting room and others are gathered in a virtual meeting space. The National Oceanic and Atmospheric Administration (NOAA), as an example, set up an island in Second Life that features a virtual conference hall that is hooked up with real-world conference rooms for mixed-reality events.¹⁵ And in April 2008, the US House of Representatives Energy and Commerce Committee conducted a hearing about virtual worlds in Second Life that combined attendees from both the physical and virtual worlds.¹⁶

- **Travel together throughout the virtual enterprise — or the virtual universe.** The main difference between Web3D and today's Web 2.0 social networking will be that together, embodied through their avatars, people will be able to travel throughout the Web3D enterprise or the broader universe, much as we can travel through the real world of cities and businesses and through virtual worlds with our friends today. We will attend events together, develop and refine 3-D objects and models together, make plans, solve problems, shop, play games, and just hang out and socialize together.
- **Service and support customers in highly interactive ways.** Cisco, for example, set up a 3-D partner site called Cisco Partner Space using Unisfair's technology. This environment is accessible to Cisco's more than 20,000 partners via the Cisco.com Web site. There, the company's partners can set up booths where they can network with each other and customers, put on virtual conference events, and train customers on products. And Intel runs tech training sessions in Second Life that are well-attended, according to Peter Phillips, technical director at virtual worlds agency Millions Of Us. Phillips reports that these sessions offer great experiences, often better than many in-person training classes — interaction is easier, and you never have difficulty hearing during Q&A sessions.
- **Visit common areas and the workspaces and displays of others to see what they are up to.** Virtual environments can increase those serendipitous interactions that are all but lost when the workforce is distributed.¹⁷ This is important because serendipitous interactions can lead to new ideas and innovation. According to Peter Phillips of Millions Of Us, "[The ability to increase serendipitous interactions] always sounded to me like a hollow argument for business uses of virtual worlds and would always make me roll my eyes. Once I experienced it myself, I really got it. It's a great way to get to know folks in other parts of the business, even when you're in the same physical building. When I worked at Linden Lab, I found that every few days when I had 5 to 10 minutes to take a break I'd fly around the private office area and look for similarly idle people and introduce myself."

View, Analyze, Present, And Interact With Complex Data And Information

Business presentations will morph radically during the Web3D evolution. And in Web3D, we will be able to not just view data presented visually but share it with others and have multiple people interact with it. We will not just deliver presentations but deliver tours through space and through information. In Web3D people will:

- **Build or import and share digital 3-D models.** These will include models of physical or theoretical objects (e.g., a 3-D rendering of a molecular model or a model of an office building under construction). People will be able to interact with these models — for example shrinking them, modifying them, and walking their avatars through and around them. Boeing, for example, designed the Boeing 787 Dreamliner and the manufacturing process using a 3-D

virtual environment that was tied into its computer-aided design (CAD) and product life-cycle management systems. Sears created a 3-D space in Second Life that customers could use to design a new kitchen. And a group of architects (the building kind of architect, not IT architects) called Studio Wikitecture used Second Life to collaboratively participate in a competition to design a health care facility in Nepal (see Figure 1).¹⁸

- **Represent and communicate information in new ways.** As noted by Charles O'Connell, IT professional and Second Life estate manager, in today's business environment this often happens when someone gets really creative with Excel graphs or PowerPoint graphics and transitions. But in Web3D, people will create avatars and build objects and worlds that inform, persuade, explain, and represent important concepts in highly visual and interactive ways. According to Ben Lindquist, CEO of Green Phosphor, people develop mental models of multidimensional systems by playing — and hence the rapid advance of immersive learning simulations. Lindquist says that movement within a space helps comprehension, as do interactivity and expression. By drilling down on large complex data sets in context and next to other large data sets, people can gain understanding into the truth that data is telling them.
- **Turn presentations into tours.** Brian Regan, president of Semper International, a placement firm in the graphic arts, printing, and interactive media industries, asserts: "The theatrical experience of a 3-D presentation will hold peoples' attention. Allowing a presenter to take control of your view of the virtual environment, for example, and weave it through their presentation, will have a much higher impact than simply watching the speaker . . . A presentation could literally take the audience through a tour of a facility with various visual and audible enhancements along the way." For a great example, check out the Palomar Pomerado Health Hospital of the Future build in Second Life.¹⁹ Rather than sit and watch a presentation or even a video about the hospital, visiting avatars are given "RFID" bracelets when they arrive at the virtual hospital. They are checked in for their virtual gall bladder surgery and taken on a guided tour of the virtual hospital of the future — to their personal single-bed room, through the procedure room, and up to the eco-friendly roof — a park where patients can get a bit of fresh air to aid in their recovery.
- **Visualize data in new ways.** Think about Web3D displays of business intelligence for stock traders. A single 3-D graph might use elements like color, height, width, and physical location in space to indicate a stock's price, change in price over the last day, trading volume, and more.²⁰ Or scientists and others engaged in drug discovery at a pharmaceutical company might use a 3-D interactive model to work together on an interactive cheminformatic assisted-image array in which many pieces of information about chemicals and drugs can be visualized at the same time, and each piece can be annotated via a link to a wiki.²¹ This kind of experience would be especially useful for right-brained people who are visual and have trouble poring over spreadsheets, and in cases where multiple people need to interact with the complex data.²²

- **Get insights into projects more quickly.** For example, Studio Wikitecture created a 3-D interactive wiki in the form of a tree; people posted design ideas for the building under design on the “wiki tree” in the form of “leaf balls.” Ideas and designs that got lots of positive votes turned bright green, while those that languished or got negative votes turned red and eventually faded away (see Figure 2). And consider this idea from Dave Elchoness of virtual worlds consultancy VRWorkplace: a project plan depicted for participants in a 3-D format of some kind, say a perfect sphere. As the project proceeds, the sphere begins to take shape. If something is out of order, the object doesn’t “look” right. It’s lopsided or parts of it are missing. If a new team member joins the project, by looking at the 3-D representation of the data, he or she will know what tasks need to be done and where to report.

Figure 1 Collaborative Architectural Design Using Second Life



Source: Studio Wikitecture's photos on Flickr

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Source: Forrester Research, Inc.

Figure 2 The Studio Wikitexture Wiki Tree



Source: Flickr, Claudia Linden

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Source: Forrester Research, Inc.

Manage Complex Real-World Systems And Operate Equipment Remotely

IBM announced in March 2008 that Swiss construction giant Implenla used a new IBM virtual data center solution, built on OpenSim, to extend its existing virtual facility management operations center. This 3-D environment represents a virtual replica of servers, racks, networking, power, and cooling equipment. Administrators can gain insight into heat and energy flow, heating/ventilation/air conditioning systems, and security systems. Organizations can use this system not only to manage distributed operations centers but also to perform simulations, or “what-if” scenarios, around physical space, power and cooling planning, training, and disaster recovery. Three of Implenla’s buildings can now have their access, lighting, elevators, power, air conditioning, climate control, and fire safety systems controlled and monitored remotely via a secure control room in Second Life. Preliminary findings indicate that this can reduce building management costs by 20% to 27% in areas like service-level agreements, building automation, and education and training.²³

DURING THE NEXT FIVE TO SEVEN YEARS, WEB3D WILL EVOLVE QUICKLY

Web3D will evolve during the next five to seven years from an immature emerging market to a standards-based, interoperable global environment — assuming that gating factors are addressed (see Figure 3). For example, according to Patrick O'Shaughnessey, VP of software at The Electric Sheep Company, "Much of the adoption for business is going to require more adoption by consumers. We see it as similar to email and IM, which were once frowned upon in the workplace but have become invaluable business tools. Web3D will be in a similar boat until people find it to be a useful and ubiquitous collaboration technology in their personal lives." The Internet is evolving from the pre-Web, text-based Internet through the graphical and now interactive experience with Web 1.0 and Web 2.0, to the three-dimensional, immersive experience of Web3D (see Figure 4).

What's next after that? We think of it as Web "x-dimensional," or WebXD — a hybrid physical/virtual world. Early examples include Implemia's activities with IBM, mentioned earlier. Other examples include Proton Media and Duke University's implementation of a hybrid virtual world/video telepresence system, and Icarus Studios working on projects to try to blur the lines between the Web, virtual worlds, and the physical world through real-time motion-capture streaming over the Internet.²⁴ And don't forget augmented reality: Imagine tagged environments in the physical environment (say, a factory floor) that new hires could follow, using a newfangled hardware interface to learn their jobs.

Figure 3 Evolution Of Web3D During The Next Five To Seven Years

Time frame	Technology maturity	Adoption	Gating factors
Today (2008)	<ul style="list-style-type: none"> • Dozens of technology vendors offer software for creating virtual environments or worlds for business use. • Few virtual worlds used for work are open to the public (the most well-known example is Second Life). • Lack of standards in most areas • A few virtual worlds support standard 3-D content creation tools. • Dearth of extremely easy-to-use 3-D content creation tools for nondevelopers • Little integration with business software applications 	<ul style="list-style-type: none"> • Serious games in use for training in hazardous environments, medical scenarios and some other kinds of jobs • Early-stage experimentation in businesses for team collaboration, meetings, conferences, recruiting 	<ul style="list-style-type: none"> • Ease of content creation • Troublesome interfaces and poor avatar control mechanisms • Inability to use content in whatever virtual environment you want • Embedded intellectual property (IP) protection for copy, transfer, and modify • Many businesspeople don't have computers at work (or at home) that have powerful enough video cards or processors to have a good experience in virtual environments — but their kids do! And Microsoft Windows Vista's support for 3-D may help push along adoption of higher-end computers inside businesses. • Corporate IT security policies may restrict access to Web3D until implications are better understood.

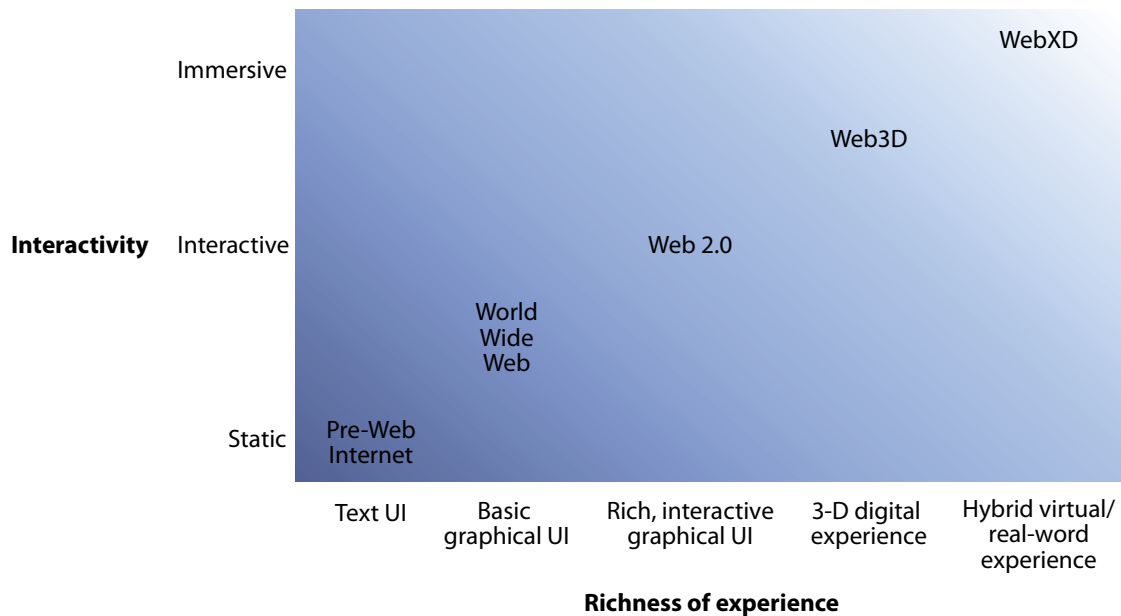
Figure 3 Evolution Of Web3D During The Next Five To Seven Years (Cont.)

Time frame	Technology maturity	Adoption	Gating factors
In three to four years (2011-2012)	<ul style="list-style-type: none"> Hundreds or thousands of technology vendors selling Web3D server products, Web3D hosting services and SaaS, 3-D content creation tools, and engagers (next-generation browsers or viewers designed to support the 3-D experience) Lots of open source projects focusing on various technical components (e.g., servers, engagers, content creation tools) 	<ul style="list-style-type: none"> Intensive experimentation Examples emerge of enterprises that have rolled out virtual work environments to huge workforces of tens of thousands of people. Innovative control devices and interfaces drive adoption of new applications beyond just the tech-literate. A shift in the perception, perhaps best evidenced by references in the media, about immersive workspaces, serious games, and virtual worlds 	<ul style="list-style-type: none"> Lack of widely adopted standards for avatars, 3-D content creation, and identity, resulting in continued lack of interoperability New and improved interface components and control metaphors still not in place Fuzziness about IP rights for objects people create Inability to prevent violations of IP rules through technical means Security: theft of objects and currency, unauthorized access to sites, espionage, viruses
In five to seven years (2013-2015)	<ul style="list-style-type: none"> The market has thinned out, and a handful of technology vendors (probably platform vendors that have built up large ecosystems) can be identified as leaders. Standards are widely adopted, which leads to an interoperable Web3D. People can access multiple 3-D sites, virtual worlds, serious games, and other applications with a single avatar. 	<ul style="list-style-type: none"> Web3D sites and applications are commonplace, even among technology laggards. Innovative organizations will achieve breakthrough competitive advantage by exploiting Web3D. Control metaphor enables seamless usage of Web3D as it becomes a vital business tool. 	<ul style="list-style-type: none"> Identity: impersonation, identity theft Governance: Who rules and polices a virtual world? How do taxes work in a global virtual world? How about employment law and dispute resolution?

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Source: Forrester Research, Inc.

Figure 4 Evolution Of The Multidimensional Web



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Source: Forrester Research, Inc.

TO COME TO FRUITION, WEB3D REQUIRES SIGNIFICANT TECHNOLOGY ADVANCEMENTS

A number of technology barriers must be overcome for Forrester's vision of Web3D to come to fruition:

- **Interface devices have to improve.** In part, the advance toward Web3D depends on how quickly and easily people can navigate around the sites they're visiting and access the sites/worlds they want to visit from various devices. If the controls for interfacing with Web3D are as easy as the controls for interacting with the world in general (e.g., you move your body to move around, you turn your head to see what's around you), people will get involved quickly and begin to get value out of Web3D. If the controls are as complex as they are in the video game *Call of Duty*, forget about it.
- **The speed with which standards emerge will determine interoperability.** Today there are no widely adopted standards for Web3D servers, clients, avatars and avatar profiles, inventories of items, animation scripts, or individual identity. Efforts are underway in some of these areas. We believe that it's the open source community — especially if it gets help from influential vendors like IBM and Sun — that will lead the way.
- **Identity issues — a major sticking point — must be addressed.** In the physical world, we can't even get consensus in the US that a national ID card is a good thing — never mind an

international, universal ID card. So how are we going to accomplish this in the virtual world? We are seeing early efforts in the OpenID Foundation, an organization with Google, IBM, Microsoft, Verisign, and Yahoo!, on its board, which is focused on a free and easy way for people to have a single digital identity on the Internet. And Linden Lab has an opt-in Identity Verification system for Second Life.

Core Requirement For An Interoperable Web3D: Standards-Based Server Technology

Affordable Web3D servers, which could run in the data center behind companies' firewalls, in hosting providers' data centers, or in the cloud via a software-as-a-service (SaaS) model, will serve up simulations, rich textures, animations, and avatars, and will handle the "physics" of 3-D interactive environments (e.g., gravity, acceleration, collisions, lighting, and earth rotation).²⁵ With standards-based server technology, Web3D sites could be configured to appear in search results just like other Web content or data source. Today, standards don't exist for these servers, which is what has led to the current walled-garden environment of myriad disconnected virtual environments.

The most likely source of interoperability among virtual world servers won't be large software companies that push their own technology into use as de facto standards. More likely, the open source community and a Web 2.0 "we can do it ourselves" mentality will drive this. Individual developers and virtual world inhabitants with a passion for Web3D will lead the way toward interoperability. Web3D will likely follow in the footsteps of successful open source movements like Linux, now widely adopted inside enterprises. Keep an eye on projects like COLLADA, Croquet, the Ogoglio project, OpenSim, the OpenSource Metaverse Project realXtend, and Sun Microsystems' open source Project Wonderland.

Necessary For Mass Adoption: Vastly Improved Interface Mechanisms

Depending on how rich any given Web3D world, site, or application is, the movements necessary to interact with it and other people may be very complex. New mechanisms will emerge that put keyboard and mouse to shame. Using these new tools, people will immerse themselves in virtual worlds in a seamless, natural-feeling way — in many cases, without wearing obtrusive devices. Next-generation interfaces and devices for Web3D will include:

- **An "engager" — a next-generation browser or viewer.** We like the term "engager" because it's active, not passive like "browser" and "viewer." Engagers will be the client-side technology (it could be thin or thick and run on a desktop or laptop computer or even a mobile device) that allows you to immerse yourself in interactive 3-D experiences. The main difference from the typical Web browser of today is that the engager will enable people to interact with constantly changing rich textures, animations, communication, and avatars. Some efforts are already underway, such as Altadyn's 3DXplorer, Electric Sheep's OnRez viewer, and View22 SceneCaster.²⁶

- **Motion capture devices to create more natural actions and interactions.** Before too long, to interact with virtual worlds from our PCs, we will be able to simply turn our head or smile to make our avatar turn its head or smile, without wearing any weird-looking headgear. A startup called Seeing Machines has already built a head tracking and expression recognition system called faceLAB.²⁷ FaceLAB requires no specialized hardware at all — only a laptop and built-in Web camera. By tying technologies like this with an avatar, a person could begin to experience a virtual world and communicate with others in it in a very natural way.

Here's where Technology Populism comes into play: Let's use the Apple iPhone as an example. Apple came out with a device that made interacting with email, the Web, voicemail, photos, mapping tools, YouTube, stock tickers, and music on a handheld device easier than it had ever been before — and information workers immediately began to clamor at the doors of their corporate IT departments to get corporate email on their iPhones. When a technology provider comes to market with an interface mechanism that makes interacting with Web3D as natural as interacting with a person in the cubicle next door, that is the tipping point.

- **Haptic devices will intensify the feeling of really “being there.”** Haptic devices give the user a sense of touch by applying forces, vibrations, or motions. Think about the way the Microsoft Xbox 360 or Nintendo Wii game controllers vibrate when players take certain actions (e.g., shoot a gun in Halo 3 or earn “star power” in Guitar Hero III). Game producers like EA, Nintendo, and Sony have many years of experience designing ways to navigate complex 3-D environments and map functions to (admittedly far too complex for business use) controllers.

The video game companies are the current masters of (affordable) motion control, multiplayer, real-time transaction services (often powered by industry-strength eCommerce solutions from the likes of IBM), and they are starting to get more into digital streaming and content distribution. Expect to see some of these companies produce versions of these technologies for immersive-learning simulations and workspaces. Other companies doing interesting things in this area include 3Dconnexion, Emotiv Systems, Hillcrest Labs, and Logitech.²⁸

- **Mobile phone device with engagers built in.** We may one day use our mobile devices as virtual world engagers. Imagine holding up your mobile phone outside a medical office building and seeing in your engager, overlaid on the image of the building, the names of the practitioners who occupy each floor. Or viewing a person standing near you through the engager and having their Web3D avatar's profile pop into view. We are seeing just the earliest signs of this possibility today. In February 2008, mobile technology vendor Comverse demoed Second Life running on an iPhone at the Mobile World Congress 2008 conference; you can also get a Second Life search application for your iPhone from Magrathean Technologies.²⁹ And in April 2008, at the CTIA-The Wireless Association 2008 trade show, Alcatel-Lucent and Georgia Tech demonstrated a prototype of mobile augmented reality, which overlays images of the physical world with computer-generated images to let people in the real world collaborate with others in the virtual world.³⁰

RECOMMENDATIONS

I&KM PROS: UPGRADE TECHNOLOGY AND BEGIN TO EXPERIMENT

Information and knowledge management professionals have an opportunity to help bring their organizations into the future by:

- **Applying Web3D concepts to innovation strategies.** We are seeing more and more organizations pursuing strategies of pervasive innovation. If your organization is one of them, think of Web3D, with all its possibilities, as a foundational technology. Look for a champion in the business who is focused on innovation. Put out feelers for people who have an affinity toward Web3D and together explore using it for innovation projects. Virtual environments can be used for collaboratively building 3-D models of products or abstract concepts, increasing the rate of serendipitous interactions among people, and allowing people who are geographically distributed to meet and collaborate easily and in a more immersive way than simple conference calls and Web conferences.
- **Experimenting with Web3D in areas like training and simulation or collaboration.** With Web3D we'll go through similar phases of maturation to those we went through with the Web, in terms of navigability and sophistication and ease of use. But just because we are in the infancy stage of Web3D doesn't mean it's too early to experiment. Look for opportunities to use virtual environments in areas like training and simulation, collaboration among distributed workers, and changing how some repetitive jobs get done (e.g., customer service and support, analyzing and processing data). Training and next-generation learning is a natural fit with virtual worlds and will be the first beachhead for virtual world projects in many organizations.
- **Conducting Web3D workshops and seminars.** Bring together stakeholders in innovation, collaboration, emerging technologies, and other areas to inform them about the Web3D trend and how the organization might capitalize on it. Be prepared to face resistance early on until people become comfortable with the idea of work being fun, and until they see how a video-game-like experience can be valuable for work. The best ways to counter objections are: 1) to allow people to experience it for themselves, and 2) to provide examples of how other companies are using immersive workspaces, immersive learning simulations, and virtual worlds to get real work done.
- **Including Web3D in revised Web 2.0 policies.** I&KM pros working on policies for blogging, wiki use, social networking, and other Web 2.0 technologies should keep in mind that 3-D immersive virtual work environments are right around the corner — if they're not already in use somewhere in your organization. Feel free to crib from others who've already done this. Linden Lab, for example, has published a set of community standards for Second Life, and IBM has created its own internal virtual environment policy.³¹

- **Developing Information Workplace strategies that include Web3D concepts.** The seven tenets of the Information Workplace are: seamless, contextual, individualized, visual, multimodal, social, and quick to create and modify. The most common Information Workplaces today are delivered via portals, Microsoft Office, and rich Internet apps.³² But expect to see 3-D virtual environments enter the scene this year as another Information Workplace scenario. If you're working on an Information Workplace strategy, include Web3D in your thinking.
- **Working with infrastructure and operations to upgrade hardware and networks.** Today many desktop and laptop computers in the hands of businesspeople don't have adequate video cards; some don't have adequate processors or displays. And some people don't have adequate network bandwidth to be able to experience immersive 3-D environments without significant lag. Work with desktop and network infrastructure and operations teams to upgrade hardware and the network as needed for people in roles that could benefit from or require using interactive 3-D applications, workspaces, and worlds.
- **Talking now with security and risk professionals to understand their concerns.** While experimentation is one thing, don't go too far with a production system without consulting security and risk management pros. By understanding their concerns around privacy, access control, authentication, and viruses upfront, you can work together with them to put plans in place to mitigate risk.
- **Grilling the vendors on their interoperability strategy.** Take a good look at technology vendors like BreakAway, Forterra Systems, Icarus Studios, Linden Lab, Proton Media, Qwaq, Sun Microsystems, Unisfair, and Virtual Heroes. Before making significant investments in a virtual environment, look into your shortlisted vendors' interoperability strategies. What are their plans for allowing their environments to integrate with those built using other vendors' technology? What do they think of avatar portability? If they tell you that all this stuff is not technically possible, or the political hurdles are too great to ever allow it to come to pass, think twice before signing the purchase order.³³
- **Joining industry consortia to network and learn more.** The Association of Virtual Worlds is a new industry association "where virtual worlds, the people who share the vision, and those who wish to experiment and explore virtual worlds technology, come together." Virtual Worlds Connect, run by the organization that publishes VirtualWorldsNews.com and runs virtual worlds conferences, is another community for professionals involved in the virtual worlds industry.³⁴

WHAT IT MEANS

WEB3D IS INEVITABLE — THE ONLY QUESTION IS WHEN

Our take: It's easy to poke fun at Second Life and pooh-pooh the whole idea. But ignore it at your peril. Web3D has major implications for innovation — especially pervasive innovation. Don't get caught asleep at the wheel: Look for ways to bring Web3D into your organization to prove its value. Immersive learning simulations may be the first place to look.

ALTERNATIVE VIEW

STANDARDS DON'T EMERGE, LEAVING US WITH A UNIVERSE OF WALLED GARDENS

The next most-likely scenario is that the open source community has trouble coalescing or loses interest, leaving interoperability to the myriad — and growing number of — small vendors with offerings in this area. This drags out interoperability, leading to an explosion of virtual world walled gardens, worse than the state we are in with IM and social networking today. With IM and the large social networks, a few large walled gardens survive, each technology provider with not much motivation to take down its walls. However, the walls are breached by a variety of third-party tools, providing varying levels of interoperability. None of them provide a seamless fully functional experience, but enterprise IM survives. In this Web3D alternative-view scenario, people must use a different engager for each virtual environment they use, which will significantly slow adoption. In this scenario, Web3D takes a decade to arrive, forced into existence by a generation raised on Webkinz and the Nintendo Wii.

SUPPLEMENTAL MATERIAL

Companies Interviewed For This Document

2b3d	Qwaq
Altadyn	Rivers Run Red
BP	ROCKETON
Cisco Systems	Semper International
Forterra Systems	Stanford University
Green Phosphor	Sun Microsystems
IBM	The Electric Sheep Company
Linden Lab	Transmutable
Microsoft	Virtual Heroes
Millions of Us	VRWorkplace
Proton Media	

ENDNOTES

- ¹ When Forrester first described the Information Workplace in 2005, we positioned it as the next-generation platform that delivered collaboration, content, portals and office productivity — plus a plethora of new capabilities bursting on the scene, such as unified communications and expertise location. But the Information Workplace has never been about the piece parts. Instead, what makes the Information Workplace transformational is how the piece parts are built into a seamless whole that supports people in the way they want to work. See the November 26, 2007 “[The Seven Tenets of the Information Workplace](#)” report.
- ² Venture capital, technology and media firms invested more than \$1 billion in 35 virtual world companies from October 2006 to October 2007, and venture capital and media firms invested more than \$425 million in 15 virtual world companies during the fourth quarter of 2007. Sources: “\$425 Million Invested In 15 Virtual Worlds Companies In 4th Quarter 2007,” Virtual Worlds Management press release, January 23, 2008 (<http://www.virtualworldsmanagement.com/2007/q4.html>), and “\$1 Billion Invested In 35 Virtual Worlds Companies In The Past 12 Months,” Virtual Worlds Management press release, October 3, 2007 (<http://www.virtualworlds2007.com/media/10-03-2007.html>).
- ³ For deeper insights into the requirement to innovate, see Gary Hamel’s *The Future of Management*; John Kao’s *Innovation Nation: How America Is Losing Its Innovation Edge, Why It Matters, and What We Can Do to Get It Back*; and Henry Chesbrough’s *Open Business Models: How to Thrive in the New Innovation Landscape*.
- ⁴ Forrester defines Technology Populism as an adoption trend led by a technology-native workforce that self-provisions collaborative tools, information sources, and human networks — requiring minimal or no ongoing support from a central IT organization. See the February 22, 2008, “[Embrace The Risks And Rewards of Technology Populism](#)” report.

- ⁵ Managers must understand the work style differences among the members of the multigenerational workforce and develop collaborative work environments that give Millennials the information they need — just in time and integrated with the job. See the September 30, 2005, “Get Ready: The Millennials Are Coming!” report.
- ⁶ The original press release announcing the funding is in Chinese: <http://games.qq.com/a/20080320/000245.htm>. For an English translation of the press release: <http://www.google.com/translate?u=http%3A%2F%2Fgames.qq.com%2Fa%2F20080320%2F000245.htm&langpair=zh%7Cen&hl=en&ie=UTF8>.
- ⁷ IBM said that it would partner with others to take the best of virtual worlds and gaming environments to build a seamless, standards-based 3-D Internet — the next platform for global commerce and day-to-day business operations. Source: November 14, 2006, “IBM Invests \$100 Million In Collaborative Innovation Ideas,” IBM press release (<http://www-03.ibm.com/press/us/en/pressrelease/20605.wss>). Just days prior to IBM’s announcement, Reuters reported that IBM would be ramping up its push into virtual worlds with an investment of roughly US\$10 million over the following year, including an expanded presence within Second Life and the development of its own 3-D intranet. Source: November 9, 2006, “IBM accelerates push into 3D virtual worlds,” Reuters (<http://secondlife.reuters.com/stories/2006/11/09/ibm-accelerates-push-into-3d-virtual-worlds/>).
- ⁸ Rhodin’s other predictions were that IM and other real-time collaboration tools will surpass email, companies will integrate unified communications into business processes, interoperability and open standards will prevail, and new meeting models will emerge. Source: March 19, 2008, “IBM Predicts Future Trends That Will Drive Unified Communications,” IBM press release (<http://www-03.ibm.com/press/us/en/pressrelease/23716.wss>).
- ⁹ Also part of the announcement: Linden Lab and IBM are exploring the development of enterprise solutions for security-rich, custom virtual world creation and collaboration on the Second Life Grid platform. Source: April 3, 2008, “IBM and Linden Lab to Explore Enterprise-Class Solution for Virtual World Creation and Collaboration,” IBM press release (<http://www-03.ibm.com/press/us/en/pressrelease/23800.wss>).
- ¹⁰ The Ogoglio Project aims to use ordinary browsers to deliver 3D experiences (<http://www.ogoglio.com/>). The OpenSimulator Project is a BSD-licensed virtual world server that can be used for creating and deploying 3-D virtual environments (http://opensimulator.org/wiki/Main_Page). The OpenSource Metaverse Project provides an open source metaverse engine along the lines of the commercial engines Second Life, There and Active Worlds (<http://metaverse.sourceforge.net/>). RealXtend is a partnership of two Finnish companies, ADMINO technologies and LudoCraft, both pioneers in virtual world development and interactive experience design (<http://www.realxtend.org/>). Sun Microsystems’ Project Wonderland is a tool kit for creating collaborative 3-D virtual worlds (<https://lg3d-wonderland.dev.java.net/>).
- ¹¹ In October 2007, IBM and Linden Lab put out a press release announcing their intent to develop new technologies and methodologies based on open standards that will help advance the future of 3-D virtual worlds. They plan to work on universal avatars, secure transactions, platform stability, and integration with existing Web content and business processes. Source: “IBM and Linden Lab Launch Collaboration to Further Advance the 3D Internet,” IBM press release, October 10, 2007 (<http://www-03.ibm.com/press/us/en/pressrelease/22428.wss>)

- ¹² Byron Reeves and Clifford Nass, *The Media Equation: How People Treat Computers, Television, And New Media Like Real People And Places*, University of Chicago Press, 2005.
- ¹³ Byron Reeves discussed this on a panel at the MetaverseU conference at Stanford University in February 2008. Source: February 16, 2008, "Virtual Worlds: The World Describes, The Web Predicts" (http://blogs.forrester.com/information_management/2008/02/virtual-worlds.html).
- ¹⁴ This study focused on skills interacting with other participants in the trauma simulation. Source: Parvati Dev, Patricia Youngblood, W. LeRoy Heinrichs, and Laura Kusumoto, "Virtual Worlds and Team Training," *Anesthesiology Clinics*, 2007, Volume 25, Issue 2, pp. 321-336.
- ¹⁵ Mixed-reality meetings are those in which some participants are gathered together in a physical meeting room. Good practices for successful mixed-reality meetings include high-end audio and video streaming from the physical room into the virtual room, the right physical meeting room, and ground rules for chat in the virtual room. Source: February 17, 2008, "Good Practices For Mixed-Reality Meetings" (http://blogs.forrester.com/information_management/2008/02/good-practices.html).
- ¹⁶ For more details on the hearing in Second life, see Dana Milbank's "Goofy Characters and Weird People — Sounds Like a Hearing," *The Washington Post*, April 2, 2008 (<http://www.washingtonpost.com/wp-dyn/content/article/2008/04/01/AR2008040102372.html>).
- ¹⁷ Virtual work environments can help people develop relationships with people with whom they otherwise wouldn't. Source: February 4, 2008, "Virtual Offices For All: Return of the Serendipitous Interaction" (http://blogs.forrester.com/information_management/2008/02/virtual-offices.html).
- ¹⁸ Studio Wikitecture is a Second Life group composed of a diverse spectrum of individuals interested in exploring the potential of applying an Open Source paradigm to the design and production of both real and virtual architecture and urban planning. For more information, see <http://studiowikitecture.wordpress.com/>.
- ¹⁹ A video tour of the hospital is available on YouTube (<http://www.youtube.com/watch?v=KMtMWdlX9Z8>). For more information on Palomar Pomerado Health, see this link: <http://www.pph.org/>. If you want to take the tour but have not visited Second Life before, see this link: <http://virtualpalomarwest.org/>.
- ²⁰ We heard some great examples of work going on in data visualization during the panel "Data Visualization In Second Life" at the CMP Life 2.0 Summit on March 17, 2008. More information on 3-D stock histograms can be found on the MS Futures Group Web site. MS Futures has built a 3-D stock histogram viewable in Second Life. (<http://sldataviz.pbwiki.com/>).
- ²¹ For information on the potential uses of 3-D data visualization for drug discovery, check out the work of Assistant Professor Gus Rosania in the College of Pharmacy at the University of Michigan (http://sitemaker.umich.edu/pharmaceuticalsciences/pharmsci/gus_rosania).
- ²² For a great book about right-brained people at work, check out Daniel H. Pink's *A Whole New Mind: Moving from the Information Age to the Conceptual Age*, Riverhead Trade, 2006 (<http://www.danpink.com/>).

- ²³ “Soon real buildings will be monitored and taken care of remotely through cyber replicas on the net — and their inhabitants too.” Source: Duncan Graham-Rowe, “Our house in cyberspace,” *The Guardian*, February 26, 2008 (<http://www.guardian.co.uk/technology/2008/feb/26/internet.buildings>).
- ²⁴ For more details about Implenian’s efforts and the Icarus Studios example, see the January 7, 2008, “Getting Real Work Done In Virtual Worlds” report.
- ²⁵ Physics engines like Havoc Engine, Crytek Engine, and Unreal Engine have varying degrees of ability to power virtual environments that can animate turning gears, power wind, and simulate fluid dynamics.
- ²⁶ Altadyn’s 3DXplorer is a Java applet that runs in a Web browser and provides a real-time 3-D engine, 3-D data model description, visualization and rendering, and character animation. The Electric Sheep Company’s OnRez Viewer is a user interface for Second Life that resembles a Web browser. View22 SceneCaster is based on a new technology called SceneWeaver, for creating in-browser 3-D scenes (rooms, areas, etc.) on the Web.
- ²⁷ Seeing Machines designs vision-based human machine . We saw this device demo’ed at MetaverseU, a conference on virtual worlds at Stanford University on February 16 and 17, 2008. Source: February 18, 2008, “Virtual Worlds For Collaboration: When You Remove Constraints, You Change The Possibilities” (http://blogs.forrester.com/information_management/2008/02/virtual-world-1.html).
- ²⁸ Logitech will soon be shipping 3-D mouse support for Second Life. Logitech claims that Second Life residents will be able to gently move the 3-D mouse controller cap to pan, zoom, and rotate simultaneously. For more information: <http://www.3dconnexion.com/solutions/secondlife.php>.
- ²⁹ A video is available on YouTube showing Comverse’s support for Second Life on the iPhone (<http://www.youtube.com/watch?v=bJF3LBREabk>). Magrathean Technologies offers an iPhone application called Second Life Search (<http://www.apple.com/webapps/searchtools/secondlifearch.html>).
- ³⁰ The prototype is the first development resulting from the Alcatel-Lucent 4G Center of Excellence established in 2007 at Georgia Tech. Source: March 31, 2008, “Alcatel-Lucent and Georgia Tech Develop First Prototype of a Mobile Augmented Reality Interface for 3D Virtual Collaboration Environments,” PR Newswire (http://www.foxbusiness.com/markets/industries/telecom/article/alcatellucent-georgia-tech-develop-prototype-mobile-augmented-reality_540132_13.html).
- ³¹ Second Life community standards cover topics such as intolerance, harassment, assault, disclosure, indecency, and disturbing the peace. Source: Second Life (<http://secondlife.com/corporate/cs.php>). And IBM’s virtual world guidelines include guidelines like “engage,” use your good judgment,” and “protect your — and IBM’s — good name.” Source: IBM (http://domino.research.ibm.com/comm/research_projects.nsf/pages/virtualworlds.IBMVirtualWorldGuidelines.html).
- ³² Until recently, the primary options for delivering on the vision of Information Workplaces were enterprise portals or Microsoft Office. While those options remain suitable for many scenarios, rich Internet applications are emerging as vehicles to enable the next generation of Information Workplaces that are best suited for decision-makers and task-oriented workers who engage in complex, multistep processes — people who need seamless, individualized, and highly visual user experiences. See the November 26, 2007, “RIAs Bring People-Centered Design To Information Workplaces” report.

³³ The open source players are all about open standards, but other vendors are showing signs of digging in their heels. Source: April 4, 2008, “Open Source Community Will Drive Virtual World Standards And Interoperability” (http://blogs.forrester.com/information_management/2008/04/open-source-com.html).

³⁴ Industry networking sites can be a great way to meet people who have experience with Web3D and learn about best practices. Examples: Association of Virtual Worlds (<http://associationofvirtualworlds.ning.com/>), Virtual Worlds Connect (<http://www.virtualworldsconnect.com/>).

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