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# Using 3D Immersive Technologies for Organizational Development and Collaboration

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Working Paper #11-02

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**Abstract**

Over the course of the Spring 2011 semester, a team of three student researchers, led by Dr. Ana Reyes of the University of Pennsylvania set out to explore the 3D immersive technologies currently in use by corporations, non-profit, government and academic organizations for organizational development and collaboration. During this first phase of the project, our team endeavored to identify organizations who are leading the way in the use of these technologies. Our hope was to tour the identified immersive workspaces, observe individuals or groups as they use these spaces and to interview key stakeholders such as the participants, the immersive project champions and organizational leaders and the vendors providing the solutions in order to identify best practices and key learnings from these early adopters. Our key objectives were as follows:

- Identify corporate, academic, non-profit and government workplaces that are presently utilizing 3D immersive environments to meet organization development needs;
- Understand why immersive technologies were chosen and how these organizations are using the 3D environments to accomplish their goals, and
- Derive lessons and insights from this research for the purposes of designing 3D Learning Conferences and a potential 3D Organizational Dynamics Laboratory at Penn.

This paper provides a high-level business and technology summary of each platform reviewed, along with team observations about their capabilities and the challenges that we faced in our own use of each one. Later, it describes in varying detail several organizational use cases provided by vendors and key stakeholders, the benefits they realized from using 3D tools and the key learnings they acquired through their use of the immersive workspaces for organizational development and collaboration purposes. The conclusion highlights several best practices gathered from our research with both user organizations and technology vendors and proposes additional areas for further exploration.

**Comments**

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Stephanie Carmichael, MSOD Candidate

Organizational Dynamics Graduate Studies

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# Business and Technical Overview of 3D Technologies

Our project team reviewed and conducted our own class meetings using several different technologies in an effort to become familiar with the opportunities and challenges facing organizations using 3D immersive spaces. These technologies ranged from consumer-driven, entertainment-based platforms, to commercialized product offerings squarely aimed at the business community, and were available in either vendor-hosted or enterprise-hosted models.

## Second Life

Our team began our class meetings on the University of Pennsylvania campus in Second Life. Founded in 1999 by Philip Rosedale, Linden Lab created Second Life, the most well-known commercial 3D virtual world claiming over 750,000 unique users from around the globe who have spent more than 105 million hours exploring and experiencing this vast "metaverse" since its inception. (Linden Lab, 2011)

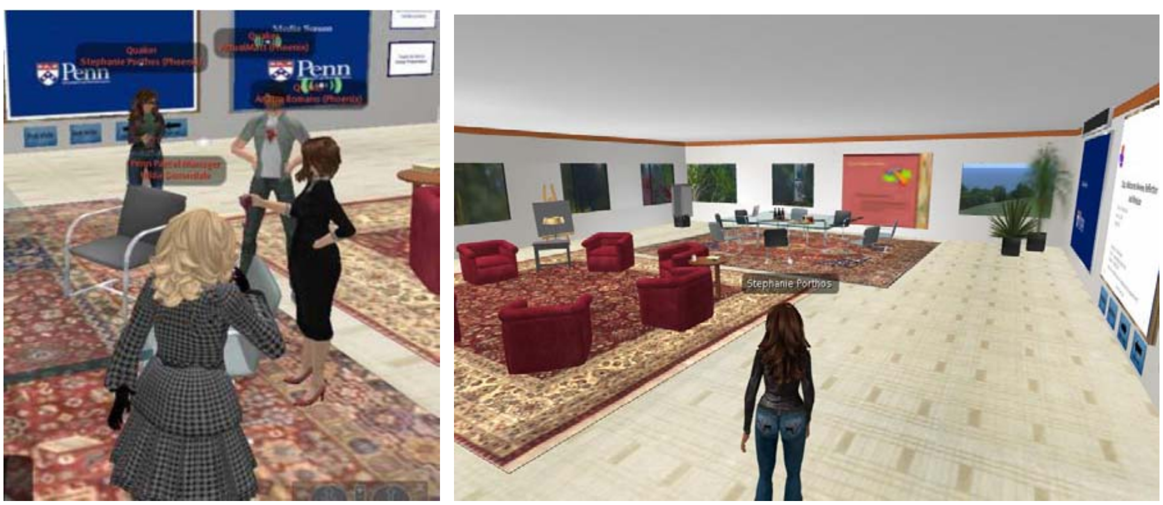


**Figure 1: Virtual Collaboration Lab Team Members Meeting in Penn Classroom in Second Life**

### Overview

In Second Life, users may simply explore the metaverse (most spaces have unrestricted access) or lease space in the environment and build upon it as they wish. Users may also control access rights to the parcel, also control whether other users can build on their parcel. As with most of these technologies, a user must first create a personal avatar in order to participate. An avatar is a movable three-dimensional image used to represent an individual in a virtual world environment. Second Life offers one of the most robust and flexible platforms for both the creation of personal avatars as well as for the meeting space itself. In fact, every aspect of the Second Life experience is user-created and mostly user-controlled. This allows for complete freedom of the user to create a space limited only by one's own imagination. The Penn campus itself has been created by Penn staff in cooperation with some outside assistance from experts in Second Life development.

**Figure 2: Virtual Van Pelt Library on the Penn Campus in Second Life**

The Penn Campus in Second Life offers a realistic microcosm of the real life Penn Campus, featuring classrooms as well as other buildings along with important campus landmarks and even a skating rink. Our team met in the Organizational Dynamics classroom in the virtual VanPelt building. One of our first classes was actually an introductory session with a non-Penn staffer who has assisted in the building of the campus. Our "instructor" gave us a brief introduction to the platform as well as tips on navigating and finding resources for customizing avatars and building simple objects.


**Figure 3: Campus Map of Penn Campus in Second Life**

## Technology Challenges

The challenges we faced as a team attempting to do real collaborative work in Second Life were significant. In order of priority, these were:

### *Platform Instability*

Our team experienced numerous failures ranging from an inability to communicate effectively using to the embedded Voice Over IP (VOIP) functionality to complete failure of the platform. The VOIP failures were most frequent and involved garbling of the voice or significant time elapsed from the time someone spoke until the others in the environment heard them. Platform failures encountered involved the software (either server or client) "freezing" or "crashing" on team members' computers, resulting in the user being disconnected from the environment and sometimes even having to reboot their PC entirely. It is unclear whether this may have been due to the instability of the server platform and software, the client software We even hypothesized in one of our final meetings in Second Life that the manner in which the Penn Campus has been designed and built may have also played a role in the technology instability, when our issues seemed to "disappear" when on another Second Life "island" that had been developed by another organization, only to reappear upon returning to the Penn Island.

### *Sharing and Collaborating on "Real World" Assets*

Second Life is a graphics-intensive environment, using polygons to "build" assets in-world and then layering these polygons with textures and images. Because Second Life was originally designed as an entertainment-oriented immersive platform, there is limited ability to share and collaborate in real-time using common business technology such as desktop and application-sharing and simultaneous viewing of web sites in real time. Direct sharing of media such as Microsoft applications is not supported. Users must first prepare the material they wish to share and then convert it to a series of images, which can then be shared, one by one, on a viewer built for that purpose. While this is not terribly difficult, even for a fairly inexperienced user, it does require advance planning and does not allow for easy "on-the-fly" sharing that users of common collaborative business technologies such as WebEx™ or Adobe Connect™ have come to expect.

### *User Interface/Usability Challenges*

With its extraordinary level of flexibility and user creation, Second Life requires a much more significant learning curve in order for users to interact seamlessly in world. In some cases, team members, none of whom were advanced users of Second Life or other 3D immersive technologies, were limited in what we could do simply because we could not easily find the way to achieve a desired task in the user interface. Challenges ranged from simple navigation (teleporting), to creating "landmarks" and viewing and navigating on the map.

## VenuGen

VenuGen was the second technology platform our team used for our collaborative class sessions. VenuGen, the company, was founded in 2007 by CEO David Gardner. Gardner describes his impetus to create VenuGen as "a reaction to Second Life's lack of support for the specific needs of the business customer." (HyperGrid Business, 2010) The commercial beta of the VenuGen platform was released in 2010 shortly before our project began.


**Figure 4: VenuGen Classroom (VenuGen Press Images, 2008-2011)**

## Overview

Similar to WebEx and other web-based collaboration tools, VenuGen is a completely hosted technology offering, meaning that businesses must subscribe to the service and pay a monthly subscription based on number of users. While VenuGen's technology is sold as browser-based, it does require a hefty "plugin" software to be installed on the user's computer. No Mac or mobile platforms are supported at this time.

Unlike Second Life, whose roots were in the entertainment marketplace, VenuGen is geared entirely toward business collaboration. They market themselves as a "3D immersive internet meeting platform." The VenuGen "world" is basically a series of 3D meeting rooms, in which human-appearing avatars can be personalized with photo-mapped faces (although this functionality did not work for our team). It has a set of controls which attempt to replicate both the real-world experience of sitting in a meeting room and the unique online experience of sharing onscreen presentations and having private back-channel conversations via chat while watching a public presentation.


Figure 5: VenuGen Meeting Spaces (VenuGen Press Images, 2008-2011)

The user interface of VenuGen is extremely simple and easy to use. Avatar customization has been significantly simplified by limiting choices of body, face, hair and clothing based on human archetypes. Navigation is simply a matter of pointing to a spot on the floor with your mouse and the avatar walks to it. In contrast to Second Life, the avatars automatically start moving their lips when participants talk, and a control panel lets the participants set their avatar "mood," which controls the intensity and frequency of their body language and facial expressions. An additional "Gestures" console allows users to make familiar gestures such as raising their hand, clapping, shrugging and even expressing disagreement or disgust. The system also tracks where each avatar is located in the room and makes sure that when one avatar is pointed at another, the other person can see that your avatar is looking at him or her and paying attention. Positional audio is used to give cues as to where other speakers' avatars are physically located in the meeting space.

VenuGen's meeting environment and flexibility is much more limited, however, by the fact that user creation and modification of the meeting space is not supported. When setting up a meeting, one can choose from numerous venues, which replicate board rooms, training rooms and larger auditoriums, however navigating outside the designated meeting space and between "rooms" is not supported, other than to exit the meeting entirely and enter a new meeting. In most ways the experience replicates that of a physical work place where facilities and tools are designed and controlled by the organization and not the user.

With its roots in the business collaboration market, VenuGen does support features such as application-sharing, distributed document sharing (which purportedly improves performance of a presentation for attendees), markup tools, and text chatting, all similar to the 2D collaboration tools mentioned previously. Virtual screens (movie screens, TVs, and laptops) in the virtual space are used for sharing digital assets.

### Technology Challenges

Our experience with VenuGen was mixed. The client and general 3D environment was more stable than our experience in Second Life; however we did still experience several issues:

#### *VOIP Failures*

First, we had trouble several times with the embedded VOIP service and had to resort to the “backup” option of an audio conferencing line provided by VenuGen. This, in turn, seemed to have some issues as well, when participants who were on the actual VOIP channel had difficulty hearing those on the dial-in to VOIP line and vice versa.

#### *Application Sharing*

Second, we had some intermittent trouble with viewing content that was being shared by a presenter in desktop sharing mode, when the content appeared “tilted” at something of a forty-five degree angle and became difficult for some participants to read. This issue was fixed in a software update during our term.

#### *User Interface*

Finally, while participants using VenuGen can get the full 3D immersive experience of being “in-world” with other avatars viewing whatever was being shared on the screen, a presenter or host sharing their full desktop had to choose between having two browsers open (thus showing a “hall of mirrors” effect to participants on one side of the shared screen) or not fully participating in the immersive experience by having VenuGen minimized while they shared the content or application desired. This could be overcome by a user with dual PC monitors, however this is not common in today’s workplace. Due to limited support during the free trial and limited time on the part of the team to attempt to address these issues, it remained unclear whether these were platform challenges or our own lack of experience that were causing the problem.

## Unity

Unity was founded in 2001 to create a universal development platform for creating Massive Multiplayer Online (MMO) games and other interactive 3D environments such as training simulations and medical and architectural visualizations. Their gaming engine "Unity 1" was launched in 2005 and since then has been used as the core game development platform by well- known companies such as: Cartoon Network, Coca-Cola, Disney, Electronic Arts, LEGO, Microsoft, NASA, the US Army, and Warner Brothers. Lending to its great appeal is the fact that the platform supports development of applications for PC, Mac (and iOS for mobile/wireless devices such the iPhone and iPad) as well as Android and several gaming consoles like the Wii. (Unity Technologies, 2011)

Unity is not a pre-built virtual world, but rather a development platform that it provides users and developers with a set of tools which can be used to create any type of 3D immersive environment desired by the user. The difference between Unity and Second Life is that organizations purchase Unity outright as a development engine and then build upon it. Our class was not able to explore the Unity platform, but became aware of this technology through contact with the Director of the LaDOTD Transportation Training and Education Center (TTEC), Glynn Cavin, who works within a partnership of the University, the Louisiana Department of Transportation and Development (LaDOTD) and the Louisiana Immersive Technologies Enterprise (LITE) and used the Unity engine to develop a training program for road workers in Louisiana. This work will be described below in the section for Selected Case Reviews of Uses of 3D Immersive Technologies. In addition, we learned through our research that some virtual environment developers are also considering leveraging Unity as a platform for future versions of their product.

## ProtoSphere

Protosphere is the 3D immersive technology offering from ProtonMedia. ProtonMedia was founded in 1998 as an e-learning systems provider. Early on, founders recognized that to eLearning left a gap in users' learning experiences around more ad-hoc, unscripted interaction with "experts" about the material being covered. By integrating eLearning solutions with interaction in a 3D immersive environment as well as social networking features, ProtoSphere allows organizations to bridge that gap.

## Overview

The ProtoSphere technology is a client/server application (requiring the installation of a full client on the user's machine in order to access ProtoSphere) and is the only offering built on a Microsoft platform. This tight integration with Microsoft technologies lends itself well to corporate adoption. Its latest release is fully integrated with the Microsoft Lync unified communications platform which integrates Microsoft Instant Messaging, Web Conferencing and high quality VOIP directly into the ProtoSphere interface. It is also fully integrated with Microsoft's SharePoint portal and document management solutions in order to allow controlled access to information repositories from within ProtoSphere. The ProtoSphere application may be hosted by ProtonMedia or by the client, behind its own corporate firewall. This was important to initial ProtonMedia Life Sciences industry clients for regulatory and security reasons.

One of the biggest differences between the ProtoSphere and the VenuGen models is ownership of the virtual space. In ProtoSphere, organizations have the environment, and the data incorporated into it, persist beyond the actual event. This allows teams to keep digital resources such as graphics, flip charts, PowerPoint, and video on presentation panels or in document "carousels" which access secured corporate content repositories, and allow remote team members go to the virtual space to access them at any time. This replicates a real life project team "War Room" experience. Protosphere is a "leased" model, which differs from VenuGen, which does not allow for environments to persist after the participants leave. Having its roots in Life Sciences, most of the ProtoSphere 3D environments are, like VenuGen's, predominantly replicas of the real world conference rooms and auditoriums of their users.

Like VenuGen, ProtonMedia has significantly simplified the ProtoSphere user interface by limiting options in avatar styles and creating a gestures console, but it has kept the means of directing avatar navigation similar to Second Life by using the arrow keys on the user's keyboard, leaving more of the control to the user.

## Challenges and Best Practices

Our team met with Reginald Best, COO of ProtonMedia, and Domenick Naccarato, their VP of Product Management. In our discussions they shared with us some of their existing challenges as well as lessons they have learned over the course of their product's development and usage by their business clients. These challenges are elaborated below and, according to the ProtoSphere team, have been addressed in the current platform or will be addressed in upcoming releases. They also shared with us the opportunities they see for 3D immersive technologies moving into the future.

### Platform Stability and Lightweight Graphics

First and foremost, ProtonMedia has focused on getting their technology stable enough to run seamlessly on the user's end. As they described it, they have focused strongly on building a robust scalable platform that can be run from their servers or their clients' and keeping both the client and server side applications "light" enough to perform well in the bandwidth generally available in enterprise and small business environments of today. Being 3D, the application is quite graphics intensive, with avatars themselves taking up to one third of the system-processing resources. Building both the avatars and environments to be realistic is a balancing act that requires deep knowledge of graphic design and building in these environments in order to ensure that the technology performs adequately while also providing a rich visual experience.

### Bandwidth Requirements

While bandwidth requirements are definitely more intensive than traditional web conferencing, ProtonMedia highlights that they are significantly lower than those required by teleconferencing and telepresence platforms, making the adoption of ProtoSphere more economical in that respect. They have also worked hard to simplify the user experience from a application interface perspective, with very light "console" features which can be viewed or hidden with one click.

### Multi-Platform Client Support and Cloud Computing

As they move into the future, ProtonMedia is addressing two additional issues that are important to their clients: porting the current application client to support the Mac and iOS (mobile/wireless) platforms, and allowing their customers to leverage Cloud computing architectures for hosting and deploying the software.

### Enterprise Integration

ProtonMedia also working on tighter integration of ProtoSphere with Microsoft's enterprise Active Directory networks, Microsoft Outlook email, and other enterprise applications such as Learning Management Systems (LMS) to provide users with Single Sign On capability, so that users can use their network logon and password and seamlessly be passed into the ProtoSphere platform from within their standard desktop environment.

### User Orientation/Training and Ease of Use

Facilitating the user's orientation to the virtual world environment was also noted as critical to smooth adoption. ProtonMedia has worked hard to make initial setup and deployment simpler and easier to manage in a corporate environment. That said, they recommended that participants sign on to ProtoSphere one day prior to events, but also said that even one half hour could help to get users comfortable with the interface. In terms of technology adoption, they found some client reservations regarding technology adoption, specifically fears that users of "a certain age" would not respond to the "game-like" experience. In actual experience, however, they have not found this to be a significant issue, and have in fact gotten very positive feedback on the experience from customers in all age ranges, including doctors, scientists, researchers, professionals and managers.

Our class was able to meet and interact in a demonstration ProtoSphere environment hosted by ProtonMedia and accessible from their website (www.ProtonMedia.com) After downloading and installing the client (which took between two and ten minutes, depending on whether one installed the regular or Microsoft Lync edition), we were able to fairly quickly customize our avatars to our personal tastes and then move about to explore the numerous locations provided in the demo.

## Selected Case Reviews of Uses of 3D Immersive Technologies

Over the course of the semester, our team contacted a number of individuals and organizations whom we identified as advanced users of 3D immersive technologies for organizational development purposes. One such organization is BP, who is a client of ProtonMedia, and was referred to us by ProtoSphere's CEO. We conducted an in-depth telephone interview with Joe Little, from the BP Chief Technology Office, who was a member of the leadership team that selected ProtoSphere as the technology platform for a management training initiative they called their *Global Graduate Challenge*. Joe also provided us with literature that summarized findings from an academic research team that was engaged to evaluate the participant experience in the program as well overall program effectiveness.

We conducted an in-depth interview with Glynn Cavin, Director of the LaDOTD Transportation Training and Education Center (TTEC), who described the use of a virtual environment to provide work-site safety and job skills training train road workers from the LaDOTD. The LaDOTD partnered with the Louisiana State University (LSU) and the Louisiana Immersive Technologies Enterprise (LITE), a state-funded, non-profit technology incubator, in order to conduct a study to evaluate whether it is possible to decrease worksite accidents and fatalities by providing this training in a virtual environment rather than in a blended classroom/on-the-job training model. Glynn shared his experiences in technology selection and implementation as well as his observations of the actual training participants during their training sessions. He also referenced the vast amounts of data collected from test scores, course evaluations, direct participant observation and interviews, and video tapes that captured every training session that was conducted for the 305 study participants.

Our final case review covers a variety of uses of 3D immersive technologies within the pharmaceutical/life sciences industry. In an on-site interview held on April 13, 2001 with Domenick Naccarato, from ProtonMedia, he described in detail several uses of 3D immersive spaces by several of their life sciences clients. During this interview, we were also able to tour these virtual environments that were used for research and development, collaboration, sales enablement, employee onboarding and internal networking.

## BP Uses ProtoSphere to Improve Collaboration and Lower Costs

BP is a global organization employing over 90,000 people and offering products and services in more than 100 countries. BP has leveraged eLearning solutions to address the global nature of their business and reduce training costs since 1999. Their ELearning programs ranged from broadly based "just-in-time" learning on core corporate issues and agendas to specialized learning solutions for specific professional groups. It is safe to say that the BP has a mature and experienced eLearning organization offering third and fourth generations of eLearning to their workforce across the world. In 2009, BP took their organization into new realms by employing 3D virtual worlds and social networking tools to meet the development needs of their new graduate hires at the end of their second year with BP. (Proton Media, Inc., 2011)

The *Global Graduate Challenge* described in detail below, however, is just one example of BP's longer-term intentions for leveraging 3D immersive technologies to drive learning and knowledge transfer across the organization. BP also determined that virtual world and gaming toolsets could be effectively be applied for collaboration, business process rehearsal, consumer education, and brand communications in addition to internal learning.

### From *Global Graduate Forum* to *Global Graduate Challenge*

The *BP Global Graduate Forum* (a real-world event held annually in London) was initiated largely due to a realization by BP's Human Resources and Learning organizations that, as a globally distributed enterprise, they had difficulty providing a smooth transition for recent college graduates into their professional careers and the BP organization and culture. They found that in their first few years of employment, graduates struggled to make connections with peers, interact with executives, and build their professional networks within the company, resulting in a larger than desired number of these new employees leaving the organization after just a few years; taking with them to their new employers all of the investments BP had made in their training and development.

The *Global Graduate Forum* marked the culmination of BP's *Graduate Induction Program*. The mission of this three day conference was to address the issues mentioned above by 400 recent globally distributed graduates the opportunity to meet one another, company subject matter experts and senior leaders within BP. It also immersed them in BP's leadership culture and values. The conference sought to: a) Expose the graduates to critical business issues and activities outside of their current roles and specializations; b) Allow them to network globally with peers and executives to broaden opportunities, and c) Develop capabilities in leadership, project management, problem solving and teamwork. By 2008, this program was costing over $5 million annually and only about one third of all graduates who were qualified to participate actually attended, due to budget and travel constraints. Worse yet, attendees characterized the event as "a PowerPoint festival" and demanded more interaction and engagement. In short, the event was not providing value to the organization commensurate with its cost.

BP set out to reinvent this initiative using the new 3D collaboration technologies available and innovative instructional techniques for more impactful knowledge and skill building. The new solution needed to provide the same or better ability to indoctrinate participants in the BP organizational culture and values, qualifying them to become the managers of the future, connect these future leaders with the current BP senior leadership, and create global networks that allowed BP to share best practices across geographies. Additional key success metrics included developing a scalable approach that was more inclusive (allowing anyone who qualified to participate, regardless of their country organizations' travel and budget restrictions) and reducing costs as economic pressure to contain expenses was strong. Finally, the solution also needed to meet BP's technical requirements, including compatibility across global networks, secure global access, fast and reliable performance, and ability to share documents in real-time. (Proton Media, Inc., 2011) (van Dam, 2011)

### *The Global Graduate Challenge Participant Experience*

**Figure 6: BP Global Graduate Challenge Meeting Room (Proton Media, Inc., 2011)**

The *Global Graduate Challenge* was designed as a team-based simulation that would divide the graduates into 15 teams of 10-12 graduates from more than 70 offices worldwide, who would participate over the course of one month. For the simulation, the teams took on the roles of the BP executive team of the year 2025. They were tasked with determining whether or not to explore and develop a fictitious territory for drilling and oil extraction. This required evaluating the current business, social and political environments, considering a variety of business strategies, and making recommendations on a path forward. (van Dam, 2011)

Over the four-week simulation time frame, the teams participated for a period each day using the ProtoSphere 3D platform to build their knowledge of business processes, policies and procedures by attending live virtual sessions with Subject Matter Experts or SME's (BP executives, VP's and directors from a variety of internal disciplines) and accessing supporting learning materials such as wikis describing in detail the fictitious territory, and bots or videos providing competitive intelligence and market opinions. They also used the social networking tools in the platform, including online profiles containing participants' photos, experience, and interests, as well as application sharing, messaging, and embedded VOIP to collaborate on their assignment.

In terms of maintaining participant engagement, BP's Human Resources, eLearning, and CTO teams took their strategy from the Serious Games world and focused heavily on providing a detailed and realistic scenario as well as "just-in-time" learning, information, and opinions, and building the scenario over time. For example, exploration experts covered access and geography of the fictitious region, health and safety executives covered safety, external affairs people covered how to work with government, and managers covered project management and executive and public communications. In addition, simulated news videos covered the "issues of the day." Multiple "interventions" were staged, where bots representing the views of interested parties around the globe made their case. In one case, bots keen on opening up the land for exploration presented, followed by bots so opposed to the possibility that they threatened legal action. Another intervention had bots from oil and other national companies presenting their exploration strategy. These were driven by actual competitive intelligence data, and gave the graduates a realistic view of how competitors might play off anything BP does. (Proton Media, Inc., 2011) As Joe Little, from the BP Chief Technology Office described it, the graduates couldn't just make a "cold" decision based on a discrete set of facts and figures, they had to return to the Global Graduate Village in order to see what would happen next and what "curve balls" might be thrown in. This kept the simulation interesting and challenging.

Each daily session was designed to present approximately 15 minutes of educational material from the designated SME(s) and then 45 minutes of question and answer time for the participants. Sessions were held twice daily in order to provide a suitable time for participants across global time zones to attend.

Teams were configured so that no team had members more than 3 times zones apart in order to facilitate live team participation and collaboration. As the Challenge ramped up, the initial few days took a bit longer, but a rhythm soon emerged and the teams met through the rest of the four-week period for an average of about an hour each day.

By the end of the four-week simulation, each team needed to create a 15-minute final presentation summarizing their opinions and recommendations. The presentations were judged at the end and the winning team won an "Ultimate Field Trip," in this case, a week-long trip to Egypt.

In terms of participant hours, the *Global Graduate Challenge* guidelines recommended that graduates spend a maximum of 4 to 5 hours per week on this initiative (that is, 16 to 20 hours in total over the 4 weeks). The MIT Sloan team, who was engaged to evaluate the program's effectiveness, interviewed 19 graduates and reviewed system logs and found that individuals averaged 14 hours total time in world over the course of the event. The minimum time in world spent was 1.4 hours, and the maximum time was 66 hours). The average total time in world for all the 160 participants was 11 hours in the Global Graduate Village (with the minimum time being 2 minutes, and the maximum time being 66 hours. These findings proved that the initiatives objectives of successfully engaging a majority of participants in the learning, while not placing an undue burden in terms of time, cost and lost productivity were successfully attainted. (Orlikowski & Evans, 2009).

### *The Global Graduate Village*

BP designed the futuristic *Global Graduate Village* as a venue for the *Global Graduate Challenge* team-based simulation. The campus is comprised of 51 rooms, including briefing rooms, conference rooms, and 35 team rooms. Briefing rooms held 24 people and featured a flat screen TV to view videos created for the challenge, a schedule of Subject Matter Experts (SME) sessions, and an intelligent bot to play back audio for the students. Some also featured audio conferencing. All supported VOIP, chat, and whiteboard capabilities.

**Figure 7: BP Global Graduate Challenge - Team Breakout Room (Proton Media, Inc., 2011)**

## *Rolling out the Technology*

Prior to starting the project, connectivity from all 70 offices was tested and verified. Key sources of issues that needed to be resolved during this stage were firewall settings and local legal constraints on the use of VOIP. To help prepare and guide participants through the Challenge, BP created a “Pathfinder” role from within BP’s IT staff, each of whom was responsible for 10 participants. The Pathfinders assisted graduates in installing the needed software, testing access, ensuring the graduates had headsets for communications and providing ongoing support. In addition, some Pathfinders assisted in setting up the team profiles and facilitating the first team meeting.

Additional tools used to market the event and onboard the participants were videos, live events, and an orientation packet. The orientation packet explained the rationale behind using the virtual world for the event, provided contacts in the event of technical issues, and also included essential information on using the virtual world. An introductory video provided learning objectives, an overview of the virtual environment technology, and the expected business outcomes. All of this was deployed to participants four months in advance of the simulation. (van Dam, 2011)

## *The Outcomes*

As a whole, the Global Graduate Challenge delivered on the business goals set for it, in that it provided a new and compelling way to engage the graduates in learning while helping them develop new knowledge of BP business strategies, policies and processes, and leadership and leadership and project management skills. It also served to promote virtual collaboration and cultivate new networks while reducing both direct (program) costs as well as lost productivity and travel expenses.

A quantitative study of the Global Graduate Challenge was conducted by a consortium of 3 universities, led by Duke University. A qualitative study was conducted by MIT Sloan School of Business. Below are two quotes from participants, one a graduate and one an executive, pulled from these research teams:

*The Challenge itself and the team work were absolutely amazing. I [became] aware of many important businesses in which I was not involved before. [I gained] great experience and a new valuable knowledge in different fields that I can certainly apply throughout my life at BP.* [Graduate] (van Dam, 2011)

*"Well, I thought it was very appropriate, given the economic climate, that we had found a way to try and connect graduates, and provide them with insight about BP, but not end up having them, you know, flying them around the world to get together. I thought it was a great innovation."* [Executive] (Orlikowski & Evans, 2009)

According to the quantitative study performed by the Duke University team, the graduates felt that the *Global Graduate Challenge* expanded their understanding of and exposure to BP's broader business issues and also provided the opportunity to discuss business issues and opinions with senior BP leaders. They also believed that it developed their leadership, project management and problem solving skills and allowed them to build new global networks. The graduates felt strongly that the scenario used for the learning challenge was relevant to BP's business, was engaging, and that the project provided them with a significant learning experience and enhanced their team-work and virtual-teaming capabilities. They also found the SME/Leader sessions and project information resources were useful and valuable.

On the technology front, participants found that the ProtoSphere platform was easy to install and use, however when asked if they preferred the virtual environment to a traditional face-to-face approach for learning, the graduates disagreed. This was, in fact, the lowest scoring question in the quantitative study, receiving only a 2.49 on a scale of 0 to 7, with 0 representing Strongly Disagree and 7 representing Strongly Agree. It was clear that the "real world" experience would have been preferred by this population over participating virtually. However, in comparison to more traditional web-conferencing technologies, the graduates did slightly prefer the virtual environment and indicated in their surveys a preference for an integrated environment such as ProtoSphere over standalone collaboration tools such as web conferencing and audio conferencing. (O'Driscoll, Montoya, & Massey, 2009).

### *Key Learnings and Recommendations*

The quantitative post-event evaluation of the program conducted by the Duke team focused on measuring the impact of this new way of conducting the event in terms of the program, the project and the technology. In terms of the overall *Global Graduate Challenge* program, the Duke team concluded that the scenario-based virtual approach was quite valuable and should be considered for future events. They also recommended broadening the participation to accommodate larger groups of graduates. However, based on negative responses to their survey question, "My opportunities have been broadened as a result of the program," the Duke team suggested that a more focused or formal introduction to the program should be conducted that would emphasize how the *Global Graduate Challenge* can provide broader opportunities for participants.

The team challenge approach was generally recognized as adding to the experience of the program as well as teaching virtual teaming in a new collaborative environment. As the scenario-based project itself was considered quite effective as a learning tool by the participants, it was recommended that this remain a part of the project, but BP was cautioned to revisit the scenario for future events to ensure that it remains relevant to BP business issues over time. In addition, the Duke team recommended that the Senior Leader/SME sessions remain a strong component of the program as they were identified as highest value, however opportunities for improvement were noted based on participant ranking of the "Top 3" SME sessions. This ranking gave BP insights into which topics and speakers were most valued and which could be examined for improvement in future sessions. (O'Driscoll, Montoya, & Massey, 2009)

In terms of the technology, participants were also asked to identify areas for improvement based on their experiences. The table below summarizes these findings:

| Improvements | Frequency |
|---|---|
| Voice over IP (VoIP) | 60 |
| Application sharing | 59 |
| Avatar design (e.g., Using Photos, Dress Code) | 47 |
| Voting buttons pane | 36 |
| Conference call in meeting rooms | 35 |
| Whiteboard | 35 |
| Multiple groups of users at any given time | 29 |
| Social networking | 26 |
| Larger number of avatars per room | 23 |
| Navigation | 10 |
| Meeting room booking facility | 8 |
| None, quite satisfied with current environment | 2 |

(O'Driscoll, Montoya, & Massey, 2009)

It is interesting to note that the top two improvement areas identified by the participants in this event correlated directly with our own class participants' challenges in using all of the various 3D immersive technologies we tested during our semester. This further reinforced our own team's conclusions that the technology is still quite immature and requires significant planning, testing, and support in order to be utilized effectively at this point in its evolution. It also supports the Sloan recommendation (discussed further below) that support both from technology teams as well as the "Pathfinders" who assisted the graduates in installing the software and providing mentoring and best practices on the use of the platform were critical components to the success of the initiative.

In its qualitative assessment of the Global Graduate Challenge, the Sloan team organized their findings into four areas: experiences with the virtual world; trajectories of engagement with the virtual world; norms of engaging with the virtual world; and assessments of the virtual world for future use.

## Experiences in the Virtual World

Initial expectations of the *Global Graduate Challenge* ranged from disappointment to excitement. Some participants reported being disappointed that the "in-person" event had been cancelled and replaced with a virtual one. Others were excited about the prospect of experiencing a virtual world. Several also reported initial skepticism about the usefulness of the 3D immersive technology. After the event, participants reported being generally impressed by the seriousness of the environment and favorably surprised by the range of features provided by the virtual world and its potential to support distributed interaction and remote teamwork. The Sloan team reinforced the Duke team's finding that the SME sessions were highly valued by the participants and added that one participant even reported being "less inhibited to raise questions with the "avatar" version of the executive than she would have been with the "real" person." (Orlikowski & Evans, 2009)

According to Joe Little from BP's CTO, this was a surprise finding for BP's Human Resources team, as they considered the graduate population to be generally unreserved and entrepreneurial, and as such would not have expected them to be uncomfortable interacting with members of senior leadership. Little also noted that BP was also surprised to find that this population of twenty- and thirty-somethings turned out statistically to have the same distribution of users who liked or disliked the technology (generally 85%/15%) as every other age group that has been polled. A preconception entering the program was that a younger audience would embrace this type of technology more readily.

BP's executives who participated as SMEs also found the 3D immersive environment to provide benefits not realized in a "real world" event. The illustrative quote below was from one executive describing his experience during his SME session:

*"Well, I suppose that I listened very, very hard to what people said. … And so, in a way, that was good, because I was engaged in probably a completely different way than I would have been if I'd been in the room with the people. I was probably far more receptive, actually, to what they had to say. … When you're in a room with people, do you listen in the same way when you're talking to someone when you have them in front of you, as when you just have them over the phone? I don't think so, so I recognize that that was a benefit. And the other benefit, of course, was that I was able to interact without the chore of traveling anywhere… which isn't insignificant."* (Orlikowski & Evans, 2009)

The Sloan team did recognize some difficulties in the experience of participants using the virtual world. These could be generally described as technological challenges or organizational challenges. The technological challenges uncovered by the Sloan team correlated with the findings of the Duke team. These were network connectivity, audio communication (headsets and VOIP), and application sharing. On the organizational side, the participants reported feeling overwhelmed by the work required to complete their project as they were not generally released from their day-to-day tasks during the Challenge. One recommendation from participants was that the initiative timeframe be shorter but more intense, like a week, and that they be able to focus exclusively on it, while remaining in their home offices. Other organizational difficulties reported by the graduates were language (for non-English speakers and those participating on teams where the rest of the team spoke another language and would revert to using it) and location (managing collaboration over time zones and teams where the majority of the team was collocated with only one or two remote participants).

Both the technological and organizational challenges can be addressed in a fairly straightforward manner. On the technology side, while it was understood from the program's inception that the supporting technology would require significant planning, testing and support, the experience of some participants was still impacted by technology failures. Through this initial experience, BP has been able to identify in more detail the potential technology pitfalls and can be better prepared for future initiatives to avoid them as well as to have support for resolving the unavoidable issues more easily available.

In understanding the organizational challenges faced by this first group of participants, BP can modify its program approach in two ways. Acknowledging the difficulty of balancing existing workloads with participation in the program, they could modify the duration or format of the program. Another alternative would be to reset expectations within the participants' home offices by requiring their direct supervisors to formally relieve them of some of their day-to-day responsibilities for the duration of the program. Finally, including these initial participants in the development of behavioral and interaction “norms” and best-practices for use within the virtual environment (and distributed teams in general), which could be shared as part of the orientation to the program would improve the experience for future teams.

## Trajectories of Engagement with the Virtual World

Over the period of the *Global Graduate Challenge*, most participants’ engagement with the virtual world shifted, taking either a positive or a negative trajectory. These trajectories appeared to be most influenced by two related processes: individual sense-making and team dynamics.

Individual sense-making of this new technology was generally based on how the participants anchored it in comparison to communication mediums they were more familiar with: phone/video-conferencing, in-person meeting, or online games. Those participants who viewed the new 3D immersive medium as a replacement for telephone or video-conferencing interactions tended to have a more positive reaction to the virtual environment and were excited and intrigued by the prospect of using this new collaborative technology. Those participants who viewed it as a replacement for in-person interactions tended to have more negative or skeptical initial reactions to the technology. Those few participants who anchored their understanding of the ProtoSphere platform in terms of online games all formed positive opinions of this new platform, but also expressed higher expectations than the other participants about the possibilities of virtual worlds and in some cases, expressed disappointment that the richness of the environment and the avatar choices were more restricted in ProtoSphere than those in the other immersive environments they were more familiar with (e.g., Second Life, World of Warcraft). (Orlikowski & Evans, 2009)

While individual sense-making influenced participants’ initial reactions to and expectations of the virtual world, team dynamics had a considerable influence in shaping the participants experiences and assessment of the *Global Graduate Challenge*. Two primary team dynamics were identified by the Sloan team within the Challenge: (i) inactive team dynamics, including teams that encountered persistent technical or organizational difficulties; and (ii) active team dynamics, including teams that managed to coordinate their teamwork efficiently through the virtual world.

Inactive team dynamics were found in teams who were largely collocated (and thus did not find much use in interacting in the virtual world), or who experienced technological or organizational difficulties such as workload, schedule difficulties (including religious/national holidays and time zone challenges) and language barriers. Active teams seemed to have overcome many of their technical and organizational issues, and often made good use of their Pathfinders and Team Leaders. They also tended to have fewer language difficulties. Because such teams made considerable use of the platform for their teamwork, they developed more extensive experience with the technology, produced more effective group and coordination norms for participating in the Challenge, and generated a richer understanding of and interest in the virtual world's possibilities. Such active team dynamics had a positive influence on participants' interests in, experiences of, and attitudes towards the *Global Graduate Challenge*. In general, whether a participant was positive or skeptical about the technology from the outset, teams and participants who experienced inactive team dynamics either remained or increased in their level of skepticism and negative attitudes toward the technology over the course of the challenge and those who experienced active team dynamics either remained positive or moved from positive to negative attitudes and opinions of the usefulness of the technology. (Orlikowski & Evans, 2009)

## Norms of Engaging with the Virtual World

All teamwork requires the development of norms of interaction, and this is no different in virtual worlds. That said, the nature of interactions and novelty of the technology makes the development of team norms particularly valuable in virtual world. In virtual worlds, it is difficult to determine from an avatar's stance or expression whether an individual is participating actively and this makes interacting in lager groups more challenging. Furthermore, technical or organizational difficulties can also have a potentially disruptive effect. These challenges make the development of team norms even more important for efficient and effective teamwork.

Participants who reported positive experiences using the virtual world (including those from the three finalist teams) often reported that they made more extensive use of the gestures provided by the platform for avatars. The types of gestures used by these participants was divided into two levels in the Sloan report: instrumental level of gestures and experimental level of gestures.

Instrumental gestures were basically used to enhance or facilitate communication. These gestures were fairly limited in scope and were agreed upon by team members as to their meanings. They included such actions as raising a hand to speak or to vote and nodding heads to indicate approval or disapproval. Teams who reported using only instrumental gestures tended to apply no meaning to any other gestures avatars displayed such as scratching a chin or shrugging.

The experimental level of gesture use went beyond using gestures for their direct instrumental purposes and generally evolved in some teams toward the end of the Challenge. They were often used to enhance the richness and playfulness of the virtual interactions and served as an icebreaker or to relieve tension. One participant described the process in the quote below:

*"It was interesting the way that you could use the avatars to mimic expressions, and I guess more or less as we got through the project, we picked up on that more and more. At the beginning, team members felt it was wasted aspects of the technology … it was something that was just redundant. It was just something that was there that we thought, "Oh, what value does it add?" And by the end, I think we were using it more and more, and it became useful. … I think we just started playing around with it, and changing the avatars to something more, kind of childish. I think I turned myself into an old man at one stage, just because we'd been working for 12 hours, and we were still talking about our presentations. But it's just another aspect of fun [that we did] by the end."* (Orlikowski & Evans, 2009)

Participants who used both instrumental as well as experimental levels of gesture expressed more satisfaction with and engagement in the virtual world.

According to the Sloan study, a number of teams (including two of the finalist teams) described the value of developing interaction norms within the virtual world. Some of the norms reported included having team members transcribe the discussion in the chat window for those participants who were experiencing audio difficulties, or team members nodding periodically during discussions to signal their presence, attention, and agreement.

### Assessments of the Virtual World

According to the Sloan study, most participants reacted positively to the virtual world and were excited about the prospects of using a virtual world for future collaboration and virtual teaming. Several specific recommendations for improvement included managing workloads more effectively by disconnecting this form of virtual participation from the regular workday, allowing for more choices in avatar appearance, and providing additional, informal networking and social opportunities for participants. Options suggested for more casual interaction and social networking included: a place for informal meeting and interaction (other than the library), such as a virtual café; a cyber-competition with more game-like features such as a quest; and in-world informal networking events. (Orlikowski & Evans, 2009)

## Post-*Global Graduate Challenge* Uses of ProtoSphere at BP

Having created the demand for the virtual environment through the *Global Graduate Challenge*, BP has recognized that it needs to open up the platform across the organization to allow other teams to benefit from their initial investments. According to an interview we conducted with Joe Little on May 4, 2011, BP continues to use the ProtoSphere platform for virtual collaboration in several ways. This was further corroborated by Domenick Naccarato from ProtonMedia. In our interview with Naccarato, he told us that BP has consistently shown the highest and most consistent ongoing usage of the platform from their server logs.

Joe Little described several of the other uses they have found for the virtual collaboration platform: They have conducted various executive briefings and trainings, held sessions to review and refine processes for their SAP implementation, and used it for company orientation. For each of these initiatives, they have provided minimal additional upfront investment, generally in training and orienting participants to the new technology.

Another way BP has gone on to use the ProtoSphere environment that Little described was for orientation and networking purposes. After sponsoring a ship that would head to Antarctica for a study on climate change, they used the virtual campus to conduct onboarding sessions for the 50 participants who would board the boat together for the three week journey. Several weeks before the trip, the team began meeting in the virtual world to attend orientation sessions, pre-event networking events, and educational sessions presented by environmental experts on climate change. According to Little, this on-boarding and training was also very well received and considered quite successful. In addition to the learning, the participants had the opportunity to meet and interact with their fellow passengers well before the trip, which facilitated a smooth transition to working together once on board. It also made the initial days of the journey far more comfortable and relaxed for all participants.

In describing the benefits they continue to reap from their initial investment, Little also described a safety training session facilitated by his boss in ProtoSphere. Having conducted this training in person in the past, they knew that it generally took about three hours to complete the training in the "real world" for a class of 40 students. When the class was conducted in ProtoSphere, they were able to complete the initial presentation part of the curriculum in 20 minutes. Following the initial presentation, teams moved immediately into 10 breakout sessions of 4 participants each to discuss the case study and come back to the larger group to present their learnings. As a result of the ability to move participants immediately into their small group sessions and get them focused on the case study review, they were able to complete the training in the virtual world in one hour." According to Little's boss, the training group appeared fully engaged during the one hour session and neither the students nor the trainers felt that they were "cutting corners" at all. As Little described it, "It was a very carefully planned exercise that was executed thoughtfully and expeditiously."

Little echoed the best-practice advice we had learned from our ProtonMedia contacts in saying that careful planning and having a well-defined purpose for the use of the platform is key to its successful use. According to Joe, "If you just show up and try to get organized in real-time, you will quickly lose participant interest." Another key learning Joe mentioned was the contradiction of a preconception many at BP held before the *Global Graduate Challenge* initiative, and that was that they had anticipated that people would use the virtual environment more casually, as a social space for remote teams to meet and interact socially. In reality, this has not been the case. This was somewhat surprising, particularly given some of the feedback from the *Global Graduate Challenge* teams that was mentioned above. This was a fascinating description.

# Using a Virtual World to Train Marginalized Populations – The Louisiana Department of Transportation and Development

There are approximately 800 deaths in highway work zones each year. The Louisiana Department of Transportation and Development (LaDOTD) partnered with the Louisiana State University (LSU) and the Louisiana Immersive Technologies Enterprise (LITE), a state-funded, non-profit technology incubator (http://www.lite3d.com/), to determine whether it is possible to move the initial work-site safety and job skills training from a minimally interactive classroom training to a virtual environment in order to improve participant engagement and retention of the training concepts and reduce the number of post-training accidents and fatalities. The project was designed to test the use of an Immersive Virtual Learning Environment (IVLE) simulating real-world highway work zones to achieve these goals. In a telephone interview, Glynn Cavin, one of the team leaders for this initiative, provided the history and outcomes which are described below.

## History and Team

The LaDOTD began its partnership with LSU back in the 1960s for conducting materials and other research related to highway development, long before they realized they needed a training solution for these endeavors as well. For this initiative, the team also engaged LITE The LITE staff included members who had worked for Pixar and Disney and were able to bring significant experience to the project in terms of designing 3D spaces.

### Technology and Costs

This training environment was built on the Unity engine. Glynn reported during our interview that the software licensing cost was about $5,000 for the server license and game controllers were $17 each. LSU already had a PC lab and they were able to leverage the standard lab PC configuration for the training as

PC computing and processing requirements were not terribly high-end. Glynn also noted that LITE, who did the initial design and development, donated their time for the first phase, as they are state-funded incubator. In future phases, however, they will be paid.

## Project Overview

As Glynn described it, this solution was developed to serve a group of workers who are considered a marginalized population when it comes to technology. They are generally blue collar, low-skilled workers, most of whom have, at best, a high school education or equivalency. In speaking with many of the students, the team confirmed their suspicions that many do not like to sit in a classroom, because the traditional classroom "failed them as teenagers," so they have bad memories; they don't want to be embarrassed. The team reasoned that in an immersive environment, these students would feel "safer," as the learning is achieved more privately and personally, between the learner and the computer. In essence, their emotional safety would not be threatened as it is in a classroom environment. In addition, the physical environment of their work does not lend itself well to experiential learning on the job site. It is too dangerous. Yet in most cases, these workers get only a very cursory course in both the job skills and safety, which is why so many get injured or killed. There was significant focus within the team on the efficacy of this solution for low skilled workers, because of the importance of willing suspension of disbelief inherent in the immersive environment. Their goal was to make complex concepts easier to learn in a true knowledge transfer form. It also served as an opportunity to realize the potential of immersive learning.

Their initial study group was comprised of 305 students and used a mixed methodology, combining classroom training with the immersive environment training. Their Control group did the traditional classroom training and their Experimental group did the classroom training plus the immersive environment. The immersive environment used a "single player" rather than a "multi-player" model. The study approach included participant observation (via video-taping of all training sessions), post-training participant interviews, and telemetry built into the virtual world that gathered avatar data every 1/10 of a second. This resulted in robust measurements of how well students were able to maneuver the avatar.

At the outset of the project, Cavin reported that there was significant skepticism relative to the interest and ability of this population to learn in a high-tech, computer-based environment. The team knew it was important to approach this training and this population correctly. To begin, they started with a study of immersive learning concepts from the book "Learning in 3D" (Kapp & O'Driscoll, 2010) as well as studies and literature on immersive learning from David J. Clarke IV, and others. While following the basic design principals from the literature, they also kept in mind that their final product needed to be student-centric and geared toward their specific population.

## Outcomes and Key Learnings

Learning was measured using a pre- and post-training written test that was administered to all study participants. This was, in the team's opinion, not what they would have wanted from a design perspective, but they needed to do it to justify the project and taking people out of their work environment. Cavin's opinion was that the test, based on and developed for classroom training, was poorly-designed for the purpose of evaluating immersive learning results, but they needed equivalency with existing methods in order to secure initial funding and continue forward. From Cavin's perspective, testing would ideally take place within the immersive environment, and subtly, so that students are minimally, if ever, aware that they are even being tested. For them, the results indicated that the students did, indeed learn the key concepts being presented, but the tests were not what they would have liked and he felt that using other testing methods would have demonstrated that the Experimental group of subjects were learning, and retaining, even more than the Control group.

One key learning Cavin shared in our interview was their approach to designing the actual immersive learning environment. The team studied research and articles published some years ago by the Air Force, which suggested that a balance must be struck between providing enough realistic detail to facilitate the "willing suspension of disbelief" within the immersive environment while at the same time not overwhelming the learner with too much detail, which could wind up being distracting or overwhelming. Following these principals, the team designed the elements of the central scene (the road, the cones, the signs/flags) with much detail and realism, but the view out into the field beyond it was relatively simple.

As a result of the robust telemetry data gathered by the learning system, the study team was able to gather over 40,000 pieces of data on every student. One of their key objectives was to determine how well this group of students would perform in this environment and how quickly and efficiently they were able to become fluent in the use of the virtual environment. When the students initially started in the environment, Cavin described their actions as a "butterfly effect." Their avatars moved fairly indirectly, but the end the avatar movement was described as a "beeline effect;" very smooth and directed movement. The team concluded that not only were the students easily able to familiarize themselves with the technology, but also move past that and most importantly grasp the abstract concepts being presented.

One of the key decisions credited for the success of the training was the use of game controllers as opposed to a keyboard and mouse. The game controller chosen by the team was simple, having only a small joystick and three buttons. From the video-taped sessions of the initial classes, it appear that this reduced tension immensely, as students' posture and body language changed from detached, leaning back, as far away from the computer screen as possible, to leaning forward and fully engaged in the simulation. Cavin also noted that a large percentage of the students had an Xbox or Nintendo system at home and that 95% of them students had a phone on their belt; many of them smart phones. Some, who had little to no gaming experience prior to the training, did have some difficulty at first with game controller, however, the instructors gave them some additional help and used the metaphor of driving heavy equipment (something many of them HAD done) and found this to be successful. Students were given some time at the beginning to get used to moving the avatar around. They concluded that marginalized populations can, in fact, work quite successfully in the immersive environment, when care is taken to create an environment that is familiar and with a controller that is simple and straightforward.

In terms of students' attitudes toward the immersive training, the team questioned them in the post-training interviews about their feelings while in the environment. Most felt overwhelmingly positive about the experience. None described their experience as "Just OK." As a result of the study, the team believes that the immersive learning experience is able to overcome some of the resistance or aversion this type of student feels toward learning a in traditional classroom.

## Future Plans

The first release of the road worker training was developed as an experimental prototype, however plans are to continue into a second phase and a grant submission is currently underway to fund it. The intention is to continue with this low-skilled population but broaden the scope to include more participants and also to broaden the study to evaluate the results of using immersive environments for training based on cognitive load theory, under the belief that immersive environments can lessen the extraneous cognitive load (processing information based on previous experience, which are stored as sort of "schemas" in your brain) and allow the student to focus on intrinsic and germane cognitive load, facilitating better knowledge transfer.

As they go forward with the next phase of the study, they are considering things like eye movement and pupil metrics to look at cognitive load. The team wants to get a deeper understanding of whether the immersive environment adds to or reduces cognitive load to see why students are learning better. They also plan to follow up with original students to measure how well they have retained the concepts learned.

They would also like, in the next phase, to measure fatigue. The existing classroom and classroom plus immersive training took about four hours. In future studies, the team will focus on learning whether that amount of time is optimal or whether it would be better split up, due to student fatigue and loss of concentration.

## Life Sciences Uses of Virtual Worlds

ProtonMedia is the only vendor with whom we were able to have in-depth discussions regarding additional customers and uses of the technology that we were not able to witness directly. The information below is from our respective interviews with Reginald Best, President and COO and Domenick Naccarato, VP of Product Management. ProtonMedia's core client base is within the Life Sciences industry, specifically pharmaceutical and biotechnology companies. They broke down the different uses of their ProtoSphere platform into Inter-enterprise (internally facing) and extra-enterprise (externally facing) uses.

### Inter-enterprise Uses of Virtual Worlds within Life Sciences

Pharmaceutical clients of ProtonMedia have leveraged the ProtoSphere platform internally for a variety of uses ranging from research and development collaboration and sales enablement to employee onboarding and internal networking. In the R&D collaboration environment, scientists can bring 3D models of their content into a virtual environment for discussion and elaboration. This can range from 3D models of molecules to 3D displays of data. ProtonMedia was able to show us several of these cases, including a model of protein-folding within a molecule which "floated" and moved in the same manner the actual molecule would. As Reginald Best described to us in our March 25, 2011 telephone interview, scientists have found great benefit not only in the ability to physically represent the object or the data, to rotate it and point to it or apply filters to it, but also the ability to interact socially around the data while at the same time allowing colleagues to view it from different vantage points. At the same time, they can also bring in 2D content such as documents and presentations, to add additional context and further their discussions.

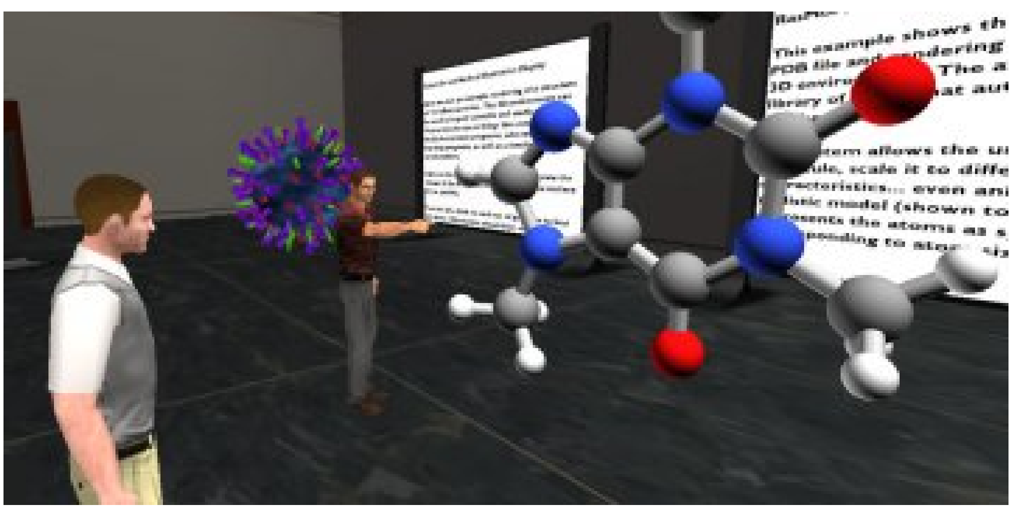

**Figure 8: Modeling Molecules in ProtoSphere (Collaborative Work-product and Decision-Making, 1998-2011)**

In terms of sales enablement, the virtual platform has been used to conduct training for globally distributed sales forces, allowing for improved knowledge transfer and communications. Often, these initiatives are combined with other eLearning technologies to provide a robust training program that allows for self-guided learning via the eLearning component, and then group discussions and role-playing exercises done in the virtual world.

A final use of the virtual world for internal-facing training and collaboration was a traditional pharmaceutical “poster session.” A traditional poster session in a pharmaceutical company is a presentation of research information by an individual or representatives of research teams at an internal or external research-oriented conference. The work is usually peer reviewed. Typically a separate room or area of a tradeshow floor is reserved for the poster session where researchers accompany a paper poster, illustrating their research methods and outcomes. Each research project is usually presented on a conference schedule for a period ranging from 10 minutes to several hours. The scientists presenting the research affix the research poster to a portable wall and then are in attendance at the scheduled time to answer questions posed by passing colleagues. The poster itself is generally 5’ x 4’ in dimension.

One pharmaceutical client of ProtonMedia used the ProtoSphere virtual world to hold the industry’s first virtual poster session within their organization. For this company, direct and indirect costs associated with this type of event typically topped six figures and the company had to coordinate the timing with attendees work schedules and absorb the loss of normal productivity to accommodate the time to travel to and attend the event.

In order to host the event in a virtual world, the company required that the environment be built to simulate two large conference halls where the posters could be presented and the ability for attendees to be able to approach and listen to a presenter speak and answer questions on their topic while attendees reviewed the poster, as well as ongoing access to all of the research content available before, during, and after the event. In addition, they also required an area where attendees could chat without interrupting the presenters and areas where attendees could meet and speak privately.

**Figure 9: Pharma Poster Session in ProtoSphere (Proton Media, Inc.)**

The company launched a three-hour poster session in ProtoSphere that included twenty posters, eight presenters, and was attended by forty-six participants logged in from various company locations via their standard desktop PC. The conference space simulated the look and feel of the actual symposium exterior and interior and the posters simulated the large 5' x 4' posters used in the traditional event. Attendees could zoom in to view and study them in more detail and could even download a copy to share or for future reference.

According to a survey conducted after the event, attendees provided the following feedback:

- *83 percent said the virtual event in ProtoSphere was the same or better than meeting in the real world.*
- *83 percent said access to the virtual posters' information in ProtoSphere was the same or better than seeing them in the real world.*
- *88 percent said the time they spent at the virtual poster session in ProtoSphere was valuable.*
- *94 percent said the information provided by presenters in ProtoSphere was valuable.*
- *59 percent said the virtual symposium in ProtoSphere was more valuable than the in-person symposium.*
- *100 percent said they would attend another virtual event in ProtoSphere.* (Proton Media, Inc.)

Additional feedback gathered anecdotally from participants also highlighted other benefits. One aspect of the feedback that the company leadership found surprising was that many attendees reported they were more comfortable striking up conversations with senior scientists in ProtoSphere than they were in the real world. In fact, several reported they would not have engaged senior scientists with questions were the event held in the real world. Furthermore, most attendees said the ProtoSphere environment kept them more engaged and attentive than a webinar or Web conference, thanks to its use of interactive avatars that provide context to communication with visual cues and gestures.

As a result of this "beta" event, the company's IT team determined that a ProtoSphere environment could allow them to hold technology symposiums more frequently and for less cost. The ProtoSphere world was shown to be as effective as the real-world event in its fundamental purpose: accelerating knowledge transfer. Furthermore, unlike in real life, the environment does not need to be taken down after the event. They are able to persist the data and later users can come to see that content in context, including discussions, which were all captured and available because it can persist in the virtual space indefinitely.

In terms of benefits realized, the company was able to host the event entirely behind their corporate firewall, ensuring secure access to this highly-proprietary corporate information, eliminated travel time and costs associated with this annual event and reported that they were able to realize a five-figure reduction in production costs. (Proton Media, Inc.)

### Extra-enterprise Uses of Virtual Worlds within Life Sciences

In addition to internally-focused events and training, life sciences organizations are finding ways to use virtual world platforms such as ProtoSphere for improving engagement with customers, suppliers and parties outside of the organization. For example, product teams are seeking to improve engagement with key opinion leaders (well-known doctors, scientists, and members of the FDA and other regulatory bodies) by hosting Key Opinion Leader discussions in the virtual environment. These meetings allow people who are using or developing devices or pharmaceuticals to conduct focus-group-like sessions where they can explore new uses for a particular treatment or device. Other uses are in continuing medical education, which is a huge cost area for life sciences organizations. These types of initiatives are typically done via third party organizations or partners, and some organizations are now using 3D immersive environments to deliver this education to very busy doctors who, as Reginald Best described it, "have time constraints, and who frankly have only their own time to "sell" as it were. It is far easier to get them to participate when they don't have to spend time travelling."

One such initiative currently underway is a partnership between a pharmaceutical company and a third-party medical training and conference provider. They have developed a virtual Diabetes University. This is planned to be a three-year continuing medical education program for doctors and other healthcare professionals where they can earn CME credits and a certification in diabetes management. Part of the content is eLearning based and part is conducted in ProtoSphere. The 3D immersive portion of the course, which will involve several Subject Matter Expert (SME) sessions held in the virtual world, is at this point, an option which healthcare professionals can choose to augment their learning experience. As Domenick Naccarato described it, the virtual component is providing "augmenting eLearning." In many cases, people have come to realize that moving from in person learning to eLearning, has resulted in the loss of some "tribal knowledge," or the ability to train and interact with other trainees as well as content experts.

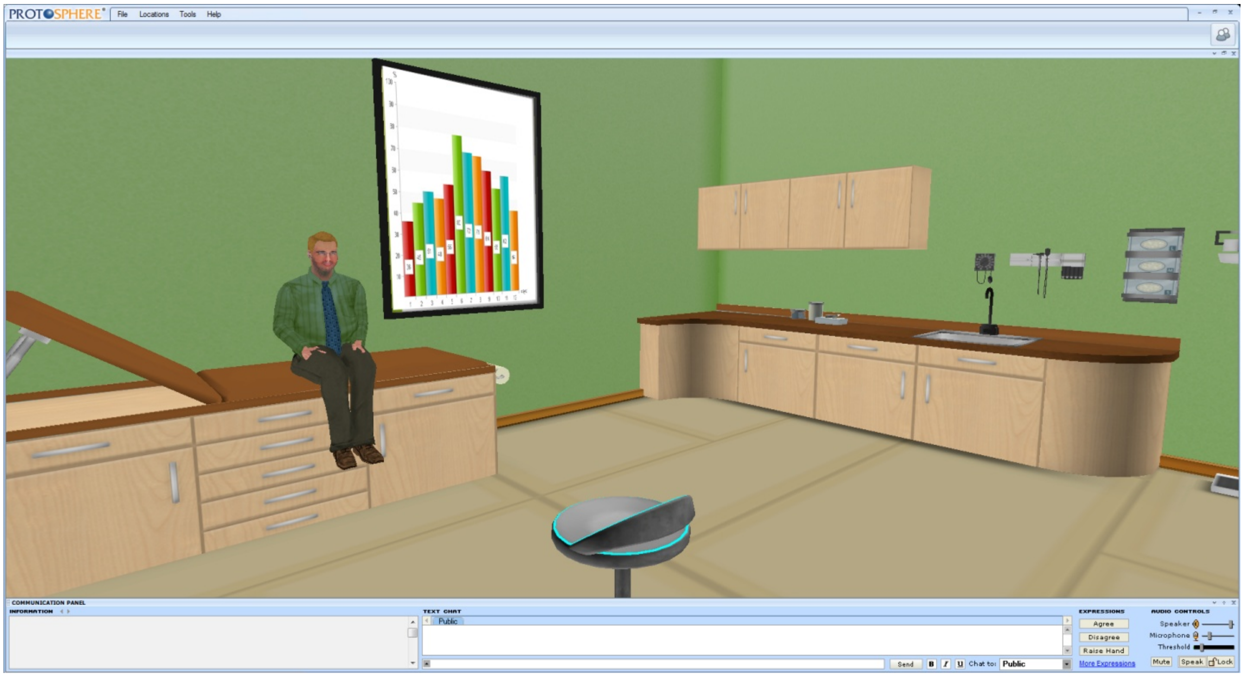


**Figure 10 Training for Medical Practitioners in ProtoSphere**

## Conclusion

In summary, our team found that despite the challenges of a still-immature technology, there are organizations that are effectively leveraging 3D immersive workspaces to further organizational development initiatives and improve collaboration for globally distributed teams. Across the different usage scenarios we explored, several key themes emerged in terms of best practices that should be considered when attempting to implement this type of technology-assisted learning, development and collaboration.

The broadest theme that we encountered through every successful virtual world implementation was having a clear purpose for using a 3D immersive environment. Many times, this involved using the abilities of the 3D platform to emulate physical spaces that present challenges in the real world relative to their value, such as significant cost (i.e.; the BP *Global Graduate Forum* or the Pharmaceutical Poster Session) or significant risk (such as training road workers in the LaDOTD). It was also recognized by several of those we interviewed that the most successful uses of 3D virtual worlds thus far often have a learning component. Whether it is the "augmented eLearning" of the Virtual Diabetes University, the classroom safety training augmented by the virtual roadwork simulation conducted by the LaDOTD, or the blended eLearning, SME presentations and team collaboration of the BP Global Graduate Challenge, organizations found that the 3D immersive environment, when used for a clear purpose, was able to keep participants better engaged and facilitate learning and collaboration better than other collaborative technologies more regularly in use today, such as web, telephone or video conferencing and application sharing.

Along with having a clear purpose for developing their initiative in the 3D space, the key stakeholders we interviewed also recognized the importance of establishing key metrics to measure the success of the initiative once completed. When the initiative is undertaken to replace in-person training or meetings, as was described for BP and Life Sciences uses of the ProtoSphere platform, the cost savings might be immediately recognized in terms of cost avoidance for travel and lost productivity, which can be measured by comparing the cost of developing the 3D environment against the costs normally associated with previous events of its type. However, many organizations also realized longer-term benefits in the ability to reuse the platform for future events as well as the ability to keep the original environment intact so that others who were not able to be present at the time of the event can explore the space and even review the interactions at a later time. In other cases, organizations such as the LaDOTD will be able to measure retention of the key concepts presented in their virtual world training over time in comparison to the control group, who received only the classroom training. These metrics are critical to maintaining funding for and increasing the use of 3D technologies within their respective organizations.

Careful planning and user orientation was also recognized as a critical success factor in the successful implementation of virtual world technology. In each case we reviewed, the teams were keenly focused on ensuring that the environment provided a seamless user experience for the purpose for which it was intended. It was important that users be properly oriented to the new environment, and organizations used several methods to ensure that any challenges encountered could be overcome as quickly and efficiently as possible. The best example of this practice was the use within BP of "Pathfinders" and team leaders who were available to their graduate teams throughout the duration of the *Global Graduate Challenge*. These individuals spent a significant amount of time using the platform in advance of the Challenge and became "super users" who could assist teams who were struggling with the technology or offer suggestions for better ways to interact in the virtual space. Vendors also echoed the importance of careful planning and have recommended having users new to the technology get the required software components installed and providing brief user training at least one day in advance of the planned event. In the case of VenuGen, the company offers a half-hour training session to the public at least once per week for new users. In all cases, it was clear that overcoming the challenges of inexperience in the platform and avoiding or resolving technical difficulties was critical to the success of each initiative.

As these technologies continue to evolve at a rapid pace, it will be important to continue to track their growth in terms of the features and functionality they can provide. Vendors such as ProtonMedia are planning to provide more control to end users in designing their virtual workspaces as well as improvements in avatar gestures and ease of use in using these types of advanced functionality that further “personalize” the user experience. As their usage continues to expand in support of organizational development and collaboration within globally distributed teams, further research is warranted to explore in more depth the best practices of successful teams, more specifically in the areas of effective use of the virtual spaces and observation of participant interaction in high-performing virtual teams.

## Bibliography

*Collaborative Work-product and Decision-Making*. (1998-2011). Retrieved May 16, 2011, from www.protonmedia.com: http://protonmedia.com/the-product/collaborative-work-product-and-decision-making/

*VenuGen Press Images*. (2008-2011). Retrieved May 16, 2011, from www.venugen.com: http://www.venugen.com/?q=press_images

HyperGrid Business. (2010, June 14). *VenueGen Offers Free Migration For Second Life Business Users.* Retrieved May 2, 2011, from http://www.hypergridbusiness.com: http://www.hypergridbusiness.com/2010/06/venuegen-offers-free-migration-solution-for-second-life-business-customers/

Kapp, K. M., & O'Driscoll, T. (2010). *Learning in 3D.* San Francisco, CA: John Wiley & Sons.

Linden Lab. (2011, May 2). *http://lindenlab.com/about.* Retrieved May 2, 2011, from www.lindenlab.com: www.lindenlab.com

O'Driscoll, T., Montoya, M., & Massey, A. (2009). *BP Global Graduate Challenge.* Durham, NC: Fuqua School of Business, Duke University.

Orlikowski, W., & Evans, J. (2009). *Study of Virtual Worlds: The Global Graduate Village.* Cambridge, MA: Center for Information Systems Research, MIT Sloan School of Management.

ProtonMedia, Inc. (2011). *BP Improves Online Collaboration, Reduces Costs with ProtoSphere*. Retrieved May 2, 2011, from www.protonmedia.com: http://protonmedia.com/the-product/case-studies-literature/

ProtonMedia, Inc. (n.d.). *Top Five Global Pharmaceutical Company Conducts Industry's First Virtual Poster Session in ProtoSphere.* Retrieved May 14, 2011, from www.protonmedia.com: http://protonmedia.com/the-product/case-studies-literature/

Unity Technologies. (2011, May 2). *http://unity3d.com/company/fast-facts.* Retrieved May 2, 2011, from www.unity3d.com: www.unity3D.com

van Dam, N. (2011). *Next Learning, Unwrapped.* Unknown: Lulu Publishers.