

# The Generation of Team Resources in a Virtual World: Practices, Culture and Workspace

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## **Abstract**

Communication technologies allow organizations to increasingly rely on distributed work arrangements and are changing the nature of workspaces and practices within them. It is thus imperative to understand interactions among team practices and virtual workspaces. We draw on Orlikowski's (2000) practice lens for studying technology and Feldman's (2004) conceptualization of resourcing to investigate interactions among the everyday activities of an emerging, distributed team, their virtual workspace and team resources, including assets and qualities of relationships. We report findings of our analysis of a unique, longitudinal dataset, which documents the activities encompassing the formation, organization, and work of a distributed team that was developing an open-source software toolkit for building virtual worlds. Our analysis shows that the team generated collaboration resources through articulation and the development of digital physical markers that drew on assets from other cultures to which they belonged. We discuss the vital role the virtual workspace served in generating potential and utilized collaboration resources.

## **Introduction**

Information and communications technologies (ICT) allow organizations to increasingly rely on distributed work arrangements (Watson Manheim, Chudoba, & Crowston, 2012) and are changing the nature of workspaces and practices within them (Bailey, Leonardi, & Barley, 2012). It is thus imperative to understand interactions among team practices and virtual workspaces. Although virtual work arrangements and the technologies that support them have been a focus of research for some time (Gibson & Gibbs, 2006; Olson & Olson, 2000) scholars have noted the need to investigate and revisit the fundamental conclusions of research when emerging technologies may influence practices and outcomes (Bjorn et al., 2014; Watson Manheim et al., 2012).

Virtual worlds—computer-generated, three-dimensional spaces that can be experienced by many users simultaneously through virtual representations, or avatars (Castronova, 2005)—allow users to create virtual workspaces which support synchronous, tightly-coupled collaboration to a greater degree than do more traditional ICTs. Virtual worlds permit interaction with a computing environment and the work of other users, while creating “a psychological state in which the individual perceives himself or herself as existing within the virtual environment”

(Blascovich, 2002: 129). Virtual worlds provide a sense of immersion, the ability to co-construct a virtual environment, tools for data manipulation and multiplex communication capabilities, which provide opportunities for communication not available with more traditional ICT. Past research found that tightly coupled work is difficult to accomplish in distributed arrangements (Olson & Olson, 2000). Recent studies focused on engineering and software development, however, suggest that emerging technologies are increasingly supporting distributed but closely coupled work and argue that this type of work should be further investigated (Bjørn, Esbensen, Jensen, & Matthiesen, 2014; Espinosa, Slaughter, Kraut, & Herbsleb, 2007).

Virtual worlds and the virtual workspaces they can create have the potential “to change work’s historically tight coupling to physical objects” (Bailey et al., 2012). Research, however, has not yet focused on the processes and implications of operating not simply with representations, but within them (Bailey et al., 2012, p. 1489). This study begins to address this gap by investigating interactions among the everyday activities of an emerging, distributed team, their virtual workspace and the potential and utilized collaboration resources they generated through a grounded analysis (Corbin & Strauss, 2008; Locke, 2001) of a qualitative dataset encompassing almost 4 years of participant observation of a distributed team that organized and performed its work in a virtual world. The data provide unique, real-time insight into the activities of a distributed team in a virtual workspace.

We draw on a practice perspective (Feldman & Orlikowski, 2011; Orlikowski, 2000) and Feldman’s (2004) conceptualization of resourcing to investigate interactions among the everyday activities of an emerging, distributed team, their virtual workspace and team collaboration resources. Our study advances understanding of the role of virtual workspaces in distributed team collaboration. Additionally, this study builds upon work that conceptualizes resources as mutable and generated through practice (Feldman, 2004; Howard-Grenville, 2007) by exploring these processes in a virtual setting. Finally, we integrate resourcing theory with conceptualizations of culture as a set of resources to explore how newly emerging teams generate cultural “toolkits” (Swidler, 1986).

## **Theoretical Background**

Resources are vital to teams and organizations, however, organizational theories generally focus on the effects of resources (or lack thereof) on organizations’ structures, decisions, and outcomes, leaving much about resources themselves under-explored (Feldman, 2004). In most organizational research, the existence of resources is taken as given and unproblematic; resources are viewed as relatively static entities, available for the taking (Baker & Nelson, 2005; Feldman, 2004). Several authors have recently put forth a more nuanced view of resources, arguing that resources can be created or transformed (Baker & Nelson, 2005; Feldman, 2004). This practice perspective on resources suggests that things are resources only when used as such. The term *resourcing* refers to the process through which resources are created in practice (Feldman, 2004; Howard-Grenville, 2007).

Feldman (2004) described the resourcing cycle as a recursive relationship between actions, resources, and frameworks, where frameworks and resources are viewed as elements of structure. Frameworks are rules, frames or schemas. Actions potentially create resources as they energize frameworks for further action. Action “[spills] over to produce resources, resources poring out to enact one or more frameworks, and frameworks enabling further actions” such that actions “contribute energy to frameworks in the form of resources” (Feldman and Quick, 2009 p.

141) The resourcing cycle described above suggests that resources are anything that can be used to enact frameworks (Feldman, 2004). We focus in this study on the generation of cultural resources to support team collaboration.

Culture can be viewed as set of resources that individuals draw on to enable everyday actions (Leonardi, 2011). This view of culture, stemming from Swidler's (1986, p. 280) notion of a cultural toolkit suggests that "culture provides the materials from which individuals and groups construct strategies of actions." Congruent with a resourcing perspective, culture is activated in action when cultural resources such as skills, goals, attitudes and theories are combined and employed. In this study, we extend knowledge of cultural toolkits by exploring how teams generate cultural resources drawing on studies of resourcing. We extend this work

Research has shown that cultural resources influence the performance of distributed teams (Sivunen & Valo, 2006; Zakaria, Amelinckx, & Wilemon, 2004) and has identified a lack of a shared cultural resources as a barrier to distributed teams' success (Cramton, 2001; Monk, 2008). To engage in teamwork, individuals must build upon each other's ideas and actions through iterations of communication, which requires individuals to make assumptions about what others know and how others will act on that knowledge in order to know how to interact with them (Enfield, 2000). The shared assumptions about what is mutually known is usually referred as common ground. Common ground includes cultural resources such as the knowledge, beliefs, and assumptions individuals infer they share, either through participation in a common community, shared experience, or personal exchanges (Clark, 1996; Cramton, 2001; Monk, 2008). Research has shown that common ground is a vital team resource. Our focus on resourcing and teamwork in a virtual world allowed us to extend knowledge of how distributed teams' generate common to include the virtual workspace.

## **Research Approach**

We conducted a grounded, naturalistic field study (Corbin & Strauss, 2008) as participant observers of a distributed team collaborating in a virtual world. We drew on a practice lens and assumptions congruent with this approach. We assumed that situated, everyday actions are consequential in producing social life, that agents and structures are a duality, not independent sets of phenomena and that relations are mutually constitutive (Feldman & Orlikowski, 2011).

### **Study setting**

The team that is the focus of this study originated as a business-sponsored effort to develop an open-source software toolkit for building virtual worlds. While the software was still in development, the sponsoring business (hereafter 'firm) was acquired and support for the project terminated. The tool kit's developers self-organized into an independent open-source community, established a foundation and governing board, and acquired rights to continue development of the software. Community members began meeting regularly in the virtual world to organize, and a subset formed a team that met weekly in the virtual world to develop code to advance the software toolkit.

The overall community included the team that met in weekly in-world meetings to develop the software, additional participants who attended less frequent community organizing meetings and meetings to test the software, and finally a broader group that offered input to the software through the community forum. There were seven regular team members and twelve semi-regular team participants. The core team members included entrepreneurs working in

software development and business consulting, a computer science graduate student and a faculty member conducting research on virtual worlds for education, an aerospace engineer tasked with implementing virtual worlds in his organization, and computer programmers. Participants volunteered their time to the project to develop the software toolkit. Group members belonged to various, overlapping group cultures. Many members came to the group with interest and experience in Java programming. Programming was a predominant cultural sub-group such that members often described themselves as either a programmer or not a programmer. Of the core group approximately two-thirds described or introduced themselves as Java programmers; the remainder (with the exception of one of the authors) described themselves as technical, but “not a programmer.” Of the programmers, two further described themselves as knowledgeable of Agile programming techniques. Four group members described themselves as researchers, this included academics and others who had conducted research in industry lab settings. Two members described themselves as members of the original firm team. About half of the core team members came from the U.S., one was from Canada and the others were from Europe. Semi-regular members and visitors generally fell into these groups with most describing themselves as programmers or researchers.

### Data and approach to analysis

We collected data primarily through participant observation, attending community and developer meetings and participating when asked in, for example, testing new elements of the software. We recorded meetings in digital video files and had the files transcribed, took detailed notes, and collected texts used by the group for communication in and out of the virtual world. In addition, we collected recorded presentations by community members posted on the Internet and conducted 10 interviews with regular participants lasting from 30 to 60 minutes. The data encompass almost 4 years of weekly meetings, typically lasting from 1 to 2 hours, but extending in several instances to 4 hours, and in one instance to 8 hours as summarized in Table 1.

We initially prepared a timeline of events, and identified the introduction of new tools. We sought to understand how the team communicated and used tools and features of the software. This drew our attention to research examining interactions between artifacts, culture and behavior (Boivin, 2008). We thus, then focused on the images in our data set. We prepared a pictorial, annotated timeline of screenshots and examined the screenshots across time to identify the introduction of visible features. We coded the meeting transcripts, our notes and interview transcripts to understand how participants interacted with and used visible features. For each artifact, we asked, Why is this here? What is its purpose? How is it used? How do individuals interact with it?

**Table 1: Summary of Projects and Meetings**

Event	Description	Span	Duration
Subsnap	First in a series of collaborative development projects, created a tool for copying a portion of a virtual world	9 mos.	Weekly, for 90 to 120 min.
EZ Move	Second project, created a tool to move objects in the world	6 mos.	Weekly, for 90 to 120 min.
Telepoint	Third project, created a virtual pointer to point to objects within the world	2 mos.	Weekly, for 90 to 120 min.
Postcard	New meeting format, created a “camera” to take an “in-world photo” and send as a postcard out of the world	2 mos.	One 8-hr. and two 3-hr. sessions
Community	Initially regularly, then between as needed to organize work	4 yrs.	About monthly, 90 to 120 min.
Testing	Initially held as needed to test new code, then regularly prior to the release of new versions	4 yrs.	About bi-monthly
Board	Conducted virtually or at a conference	4 yrs.	Annually

We focused theorizing on the problem and solution patterns shown in Table 2 and developed a model explaining the process and mechanisms of the emergence of cultural norms in a team working in a virtual world.

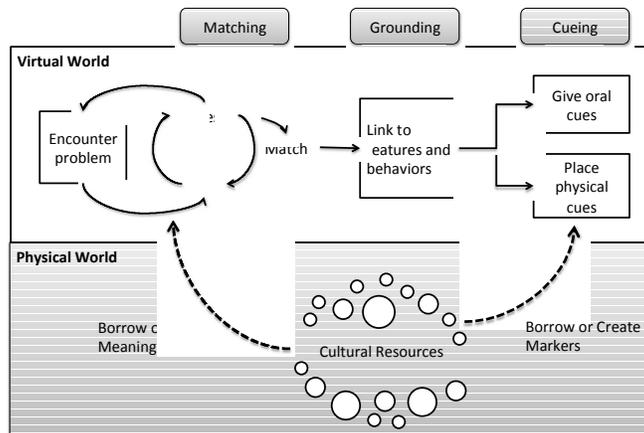
**Table 2: Problem and Solution Patterns**

Problem	Group Norm	Source	Visual Artifact	Cue
How to create shared mental representation	Articulate characteristics of setting known to the individual, “I am seeing Jake spin, is that what you see?” or “Is it dark?”	New to virtual setting	None	Explained to new members
How to interject and contribute to the conversation	Stay on mute, use push to talk to interject, use chat for side conversations or notifying of action without disrupting flow use of tools assumed known, norm of mute explained to new members	Push to talk action borrowed from radio, chat like writing notes in meetings,	Brackets and colored name, then chat box, push to talk button	Visual markers mimic markers common to computer software (i.e. drop down menus and windows)—newcomers are told when how to use mute, chatting is assumed to be known and not explained
Initiating work, blending social and work time	Chat then “shall we move to the Dev zone,” everyone teleport to work location, stand together and begin work	Programmer culture, professional culture	Dev Zone, teleport, sign left at entrance	Visual markers (portal, placemark, welcome sign) signal shift is space Rug cues positions
How to view work of others without moving around and disrupting work	Stay put, use best view to adjust view	New to group	None	Explained to new members

### Analysis and Findings: The Generation of Cultural Resources

We found that the team generated potential and utilized resources through three processes: *matching* problems with solutions, *grounding* patterns in team common ground and *cueing* group behavior. After coming to a shared goal, team members sought to act in unison toward a goal, sometimes encountering barriers, which were often exacerbated by the nature of the virtual environment. In some cases a particular problem was explicitly recognized by the group or an individual, in others, a solution appeared, absent a problem and was later matched to a problem. A problem initiated, but did not always result in, the emergence of a new practice. Team members sourced possible meanings and markers from existing cultural resources known to one or multiple group members or created new actions and markers unique to their team environment. This process is depicted in Figure 1 and discussed below.

**Figure 1: The Emergence of Culture in the Virtual World**



The first barrier encountered by the team following the termination of the firm's support was how to organize and maintain a community in the virtual environment. The team had access to existing resources including a virtual space and electronic forum and participants' understandings of how to use these and other digital tools such as blogs, wiki spaces and email, which had been used to support the firm sponsored effort. Although the firm's blog, wiki spaces and email addresses were no longer available, participants shared a common understanding of how to use these tools and knowledge that each other had the same shared knowledge. In other words, knowledge of these communication patterns and tools was part of this group's initial common ground. Participants drew on these resources to organize the first community meeting, which presented the first barrier, how to organize the virtual community.

### **Matching the problem and solution**

When the team initially began to meet, there was a desire to see the software continue but no clear avenue forward as described in this blog post:

The good news is that those of us who have worked so hard to bring this project to life still wholeheartedly believe in it. A core group of the WW<sup>1</sup> team intends to keep the project going. We will be pursuing both for-profit and not-for-profit options that will allow us to become a self-sustaining organization...Any concrete help you can give us would, of course, be welcome, but what we are asking for now is your moral support and your continued participation in our thriving community. Let's stand together in our determination to keep this project moving forward.

Following this post, one community member who was not part of the firm team, invited others to attend a meeting. The group required a community, but faced the problem of how to create one. After several community meetings the idea of a "developer session" emerged as explained in the blog post below, titled "Impromptu [WW] Developer Meeting."

If you follow the Open Wonderland Forum, you know that...has been organizing bi-weekly community meetings. These meetings mainly focus on how community members can help move the project forward. In today's meeting, one of the suggestions was to begin to hold regular in-world developer-focused sessions. Everyone was so excited about the idea, that they wanted to get started right away. So if you're a developer and interested in the topic, please feel free to join in tomorrow.

These sessions became regular Wednesday meetings as reported in the blog, "After two successful developer-focused sessions, the group has decided to settle on a regular meeting time on Wednesdays due to the much larger turnout on that day." The developer sessions were called WW as described in this post, "[WWs] are weekly, developer-focused sessions that take place in the [WW] community virtual world" and were held weekly for almost 4 years.

The meetings came to be accepted as a means of creating community as explained by one participant:

I think the biggest milestone was the one, the kind of formation of the [WWs], I think that gives a central place for you know, people to meet, and everyone kind of knows, its at this time on this day, and you know, and that's kind of, the sense that I get, is that's how you get in contact with developers, through the forum and through the [WW] meetings and if you have a question, that is really the best time to kind of ask those questions.

Team members later explicitly linked the problem and solution in presentations and discussions as shown in the blog post below:

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<sup>1</sup> Names have been removed or changed throughout this paper.

Since its inception in March, [WWs] have provided developers in the...community with the opportunity to meet live with other developers to both learn about Open Wonderland and get to know each other. On Wednesday, June 23<sup>rd</sup>...developers were given the opportunity to showcase their work to the rest of the community for the first time.

By explicitly linking the WWs as a solution to the problem or need for community, the team imbued WW with the meaning of a solution to a problem, initiating the process of becoming a group norm.

## **Grounding**

Matched problem-solution-meaning sets become norms when they became part of a group's common ground. Common ground includes the knowledge, beliefs, and assumptions individuals infer they share, either through participation in a common community (e.g. we are academics), shared experience (e.g., we attend academic conferences together), or personal exchanges (e.g. you tell what happened in your last session). Grounding is the collective process that occurs through conversation by which conversants try to reach a particular instance of mutual belief that they have achieved understanding sufficient for their current purposes (Clark & Brennan, 1991: 223).

In our study, repeated, matched problem-solution-meaning sets came to be assumed to be shared knowledge among participants through conversation, as described in the literature on grounding. In the virtual world, absent body language and known shared visual cues, participants also grounded problem-solution-meaning and also through linking them to digital representations of tangible or physical features in the virtual world and also to additional behaviors forming more complex patterns.

## **Creating a tangible workspace in an intangible world**

After the dissolution of the firm sponsored effort, the self-organized community moved the virtual world space created by the firm to a different server host. At the first group meetings, the space was unchanged and presentation slides and demos from the final firm sponsored meeting remained in the space. After several meetings, these items were removed, and the group met in an open area containing only the tools they were using for a particular meeting. The visual features of the world that were stable in the space included the sky, mountains, and brick. Tools represented by windows included the chat window showing ongoing chats and the user monitor listing who was present in the world. Tools that were added for the session to support brainstorming included a brainstorm pad, configured to resemble gazebo and the sticky notes. If participants stand on the pad and add a sticky note with their ideas, all of the sticky notes are automatically grouped together for easy viewing. The brackets around avatars' names shown in these photos indicate that those individuals are muted. When the group began developing code in-world, a NetBeans window used for collaboratively writing software code was added in the open space on the grass.

After the initiation of the developer-focused meetings (later named WW meetings), the group constructed a separate developer space, eventually termed the Dev Zone. The NetBeans window was moved to the Dev Zone. The Dev Zone incorporated a view out of an open window-like area and the tools required for the development work including the NetBeans window for developing the code. A cardwall used for keeping track of issues or bugs in the code was added and became a semi-permanent visual feature of the space. And, later, tables and chairs and a rug were added to the Dev Zone. Participants discussed the Dev Zone in a presentation:

...this is a developer zone that was designed in Google Sketch up that was designed by a developer, obviously. It's extremely functional. There's now a table, there's now a rug so you can see the table better, and you can see the chairs. [Nancy speaking] Because Nancy couldn't stand it. [Jake speaking]: Yeah, Nancy asked for a rug.

The physical space and features of the DevZone, as discussed below, became linked with WW meetings and patterns of behavior.

### **Linking behaviors, physical features and meaning.**

Over-time, a pattern of behavior incorporating the use of the physical spaces developed. The DevZone and the behaviors were linked to WW meetings. WW participants would meet in the community space and chit chat before the meetings and then move together to the Dev Zone to begin development work. The beginning of this pattern is described in the following excerpt from one researcher's notes after her first trip to the Dev Zone:

Everyone waits in open area at the entry then moves over into the code area [DevZone].  
Talk about fact that no background noise is very disconcerting people expect a certain level of background so that you know that people are still connected.  
General chitchat—people could hear the construction noise outside.  
Jonathan rebuilt the server so it is all new code.  
Someone asks how to you view the screen?  
Jonathan says that it is best to open in hud. He has worked on a program to jump to the best view without getting in anyone's way.

This pattern is further shown in the following two exchanges. The first exchange occurred during the early meetings, the group is discussing the fate of a former open-source project that remained under the acquiring firm's control after the acquisition. The second exchange occurred later, after the pattern became a norm.

**Person 4:** Yeah, they've been killing their [community but the] main developers didn't run away anyway.

**Person 5:** Yeah, but I mean --

**Person 6:** Just like the Open Indiana project, when open Solaris's went away. And what the other one? The Jenkins project went away. Like how many different communities do you think Oracle can most alienate?

**Person 3:** Exactly.

**Person 5:** Yeah. It's, I mean, yeah, if people are running away there has to be a reason. Because yeah, it's funny. Let's see what happens.

**Person 3:** Well what do you guys say we go ahead and jump to the DevZone and take a look at it?

**Person 5:** ure, sounds good.

**Person 4:** Sounds good.

[Group moves to DevZone]

**Person 3:** Hey, new furniture.

**Person 4:** There's everybody.

**Person 3:** Have we all made it in?

After time, this pattern became linked to problem-solution-meaning set encompassed by WWs and became a norm. WW participants waited for others to arrive before moving to the DevZone, even if there was no chitchat. It was expected that everyone would wait until all expected members had arrived. It would have been possible to move the avatars to the DevZone prior to everyone's arrival (all of the physical bodies were seated in front of their computers) or

conceivable to leave the avatars in the open space and view the NetBeans window without manipulating the avatars by using the best view feature mentioned above.

- Person 1:** Oh, that is how you pick the color?  
**Person 2:** Yes, except that I didn't like my color so Chris changed it for me. I had clout.  
**Person 1:** I think letting people choose their own color is maybe better.  
**Person 3:** Okay.  
**Person 1:** So you just get assigned a color and then you can—.  
**Person 2:** You can change it, yes.  
**Person 1:** Yes.  
**Person 3:** Yes. Okay, so I think—.  
**Person 2:** Here comes Bob.  
**Person 3:** **Okay, we will wait for Bob to come in but I think that we should probably jump over to the DevZone as soon as he is in and take it from there.**  
**Person 1:** All right. Bob?  
**Person 3:** Oh, there he is. Hi Bob.  
**Person 1:** I see him but he is on mute.  
**Person 6:** Hi there.  
**Person 2:** You are just in time to jump over to the **DevZone.**  
**Person 6:** I had my keyboarding in a Canadian multi-lingual mode so the square bracket didn't work very well.  
**Person 3:** Oh, got it.  
**Person 2:** **Okay, we are going to DevZone.**  
**Person 3:** **DevZone.**

The DevZone became the primary workspace for writing code, while other activities such as brainstorming and community organizing took place in the open entry area. Thus, the DevZone became linked with developer work, the distinguishing activity of WW meetings. Brainstorming, testing and community discussions usually happened in the open entry separating general tasks from coding, as illustrated in two exchanges below. In the first, the group has been brainstorming and testing, but a server error must be fixed before the testing can continue. The group discusses moving to coding work while waiting for the technology fix. In the second, the group has completed testing and move to the DevZone to work on developing additional code.

- Person 1:** Should we start working on telepoint [the current developer project] while Jake is figuring out—.  
**Person 3:** Okay, I have got my stack. I can come back to it later. I will quit and come back.  
**Person 2:** Okay.  
**Person 3:** I will be right back.  
**Person 1:** I kind of forget where we left off. I remember we fixed one thing but—.  
**Person 3:** The Z buffer.  
**Person 1:** Yes.  
**Person 3:** We were trying to maybe change the Z buffer algorithm to get that thing to always show up on top.  
**Person 1:** Yes.  
**Person 3:** I will be right back.  
**Person 2:** Okay.  
**Person 1:** **So I guess we will head to the Dev Zone, or should we wait for Jake?**  
**Person 2:** No, let's go ahead and get things set up.  
**Person 1:** Okay.  
**Person 2:** **Alright, to the DevZone. Alright.**

[group moves to the DevZone and begins development work]

- Person 1:** All here?  
**Person 2:** I think so. Oh, there is Jose. He is hanging back. He must be sleepy.

**Person 1:** I continuously forget where we put that Z buffer stuff.

**Person 2:** Can't search for it? Here comes Jake.

**Second exchange:**

**Person 2:** That worked. Huh. Well, it is corrupt on the server.

**Person 1:** I don't think I have ever seen that avatar before, so—.

**Person 2:** Yes, this was one I was making during testing. Okay. All right, well we will have to get some examples and see if we can reproduce the problem.

**Person 1:** Alright.

**Person 2:** Okay.

**Person 1:** Telepoint?

**Person 2:** Yes, you want to go back to telepoint?

**Person 1:** Yes.

**Person 2:** The one thing that I remember from last time and we can look at this when we get over to the DevZone is that they weren't working properly on 2-D apps, which is something that we thought was working.

**Person 4:** That is right.

**Person 2:** Maybe they weren't—the transparency wasn't right. So let's jump over to the DevZone?

**Person 1:** Okay.

This division was particular apparent in later code-a-thon meetings. After initially greeting in the open area, participants moved to the DevZone. Then, the work was further divided. Those working on development stayed in the DevZone and those working on brainstorming and the visual design of the interface for the tool the group was developing returned to the entry area.

The meaning of WW meetings as a solution to the problem of how to form a community become linked to the visual representation of a DevZone, a resource borrowed from developer culture in the physical world, in the virtual world. The pattern of waiting in the entry area, moving together the DevZone, developing code in the DevZone and conducting other work in the entry area was linked with the meaning of WW and the meaning and behaviors were assumed known by all participants—participants did not ask, “Why should we go to the DevZone?” or suggest that development work be conducted in the entry area.

## **Cueing**

New norms were cued with oral and physical signs. For example, the phrase “Shall we go to the Dev Zone” cued the separation of development work from other tasks and the end of chit-chat. Additionally, a welcome note was placed in the open area directing participants to the DevZone through two avenues. Participants were instructed via the sign to use a drop down menu or walk through a portal “behind you and to the right.” These physical cues referred to resources, developer areas and tools, known by many participants and newcomers familiar with programmer culture, thus cueing the WW cultural norm of conducting development work in the DevZone.

Some problem-solution sets that became norms seemed to have no equivalent in the physical world. For example, the best view tool, which was referenced in an earlier example in one researcher's notes, solved the problem of having to maneuver an avatar to see well and then blocking other's view. Because cues the might allow one to sense the presence of others are absent in the virtual world, and because the view or camera angle from an avatar does not always match the view of a person, viewing work windows by attempting to arrange the avatars was difficult and cumbersome. One participant developed a “best view” tool, which allows a user to click on an object that was enabled with the feature to make it zoom and rotate to allow a best

view. This could be done without moving the avatar. This feature quickly became viewed as a necessity and it became expected that participants would largely stay put, not obstructing others, and use their “best view” to view the windows. This increased the quality of viewing and also negated the need for everyone to wait while avatars were moved about. There was apparently no readily accessible physical marker available in the cultural resources available to the group. The norm was cued orally. For example new members were told, “Go to best view,” and existing members frequently articulated their own use as in, “Just a minute, let me get to best view.”

## Conclusion

In this study, we reported our analysis of a longitudinal dataset encompassing the formation, organization, and work of a distributed, virtual community working in a virtual world. Our analysis shows how the virtual community matched problem-solution-meaning sets and then grounded the sets by linking them to tangible or physical features in the virtual world and to patterns of behavior. Potential resources including behaviors, meanings and physical markers were borrowed from existing resources and additional resources were generated through the day-to-day activities of the team. Participants cued the repetition of norms, absent face-to-face cues normally found in the physical world by giving oral cues or placing physical cues in the virtual world. Participants used the physical world as a metaphor for to develop virtual artifacts, which cued the new norms. Thus, in an intangible virtual environment, participants created artifacts to make cultural rules visible.

This study is limited by reliance on one team working synchronously in a specific technological environment, a virtual world but makes several contributions. This study advances understanding of the role of virtual workspaces in distributed team collaboration, investigating an emerging technology that enables different practices (synchronous, tightly coupled distributed collaboration). This study builds upon research on resourcing (Feldman, 2004; Feldman & Quick, 2009; Howard-Grenville, 2007) by exploring resourcing in a virtual setting. Finally, we contribute to research on cultural toolkits by showing how a team generated cultural resources.

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