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ABSTRACT

Second Life ® (SL) as the exemplar of virtual worlds has become a new platform for simulating real-life experiences and interactions. Businesses, universities, hospitals, governmental organizations, and individuals participate in SL for a variety of activities and experiences. Increasing participation in range of activities has made SL a suitable environment for creativity and innovation in the web-based delivery of services. However, there is little knowledge about the process of creating systems/presence in this new environment. This paper explores the unique aspects of systems development for educational purposes in SL using a case study approach. Multiple cases have been analyzed to investigate the process of systems development in SL projects and contrasted with existing information system development approaches. Contributions to education and research are discussed.

INTRODUCTION

Virtual worlds (VWs) have pushed the boundaries of virtual experience by creating a cyber version of the real world in which participants "live" in the virtual world through their avatars. Their avatars take part in a wide range of activities, such as attending discussions or social events, participating in educational classes and seminars, collaborating, doing business, making objects, and building. Three dimensional environment of VW brings social connection and production close to real-life experiences, adds a dimension of anonymity by making it possible to keep the avatar's identity separate from the person's real identity, and provides a potential platform for the Web 2.0/3.0 evolution. One of the most advanced VWs is Second Life® (SL), which has become a prominent example of the VW experience. In 2008, SL had more than 14 million registered users and a $75 million (real U.S. dollar) GDP (Bonsu and Darmondy, 2008). Educational institutes around the world have started to experiment and establish their presence in SL—for example, Ball State University, Harvard University, Princeton University, University of Delaware, University of Idaho, University of Hamburg, University of Sunderland, and University of Wisconsin –Milwaukee.

Building an educational or university presence in SL requires creating the environment that includes simulated physical structures, including the classrooms, auditorium and development centers, objects such as signs, chairs, podiums, and multimedia functionalities. Building a presence in SL is tantamount to creating a system. Although there are numerous such systems (or presence) in existence in VWs, there has been little systematic investigation of how to create such presence (systems). To our knowledge, there is no published research study exploring the differences, if any, between the process of system development in VWs (specifically in SL) and that of the existing information system development methodologies, such as systems development life cycle or rapid prototyping. This paper attempts to address this gap. Hence, the research questions addressed in this exploratory study are: What is the process of developing an educational presence in VWs (with focus on SL as the exemplar)? And, what are, if any, unique aspects of developing a presence in such environments?

A significant amount of research is required to understand the design and architecture of 3D virtual worlds and how they differ from other environments (Davis et al., 2009). In their discussions of foundations of research in metaverses, Davis et al.(2009) argue that "interviews or focus groups with existing metaverse users could provide an understanding of the aspects of each area of 3D VWs that are yet unknown" such as design features, avatar communication and interaction, and interplay of features between in-world and application outside the world. In this research we carried out case studies of seven educational institutes that had large scale presence in SL from around the world (Austria, Germany, South Korea, USA, and UK) and conducted in-depth interviews with the project owner/stakeholder of these SL educational institutes to answer our research questions.

Our initial results show that the development process in SL has many unique features. This work makes a number of contributions to research and practice. Our work provides a glimpse into the *how, when, who* aspects of an emerging process, and the chaotic creative process that accompanies it (i.e. presence development in SL). We learn how project leaders and champions of creativity deal with the uncertainty of resources and outcomes in such environments. This work also contributes to practice by identifying the unique aspects of VWs development process, which could enhance future undertakings by educational institutes.

In what follows, we provide a brief review of VWs and SL. We then discuss the process of data collection, analysis, and results. The paper ends with conclusions and future directions of research.

VIRTUAL WORLDS AND SECOND LIFE

VWs are "sophisticated pieces of software that enable their users to project an identity into a generated three dimensional reality through the use of advanced computer graphics and –through the eyes of this digital persona or avatar –interact with other players and wander though this computer generated reality"(Mayer-Schoenberger and Crowley, 2006, pp. 1781). VWs can be classified based on target users and the level of fantasy, extent of simulation, and social interaction supported. Most of the VWs target teens and have themes like Barbie Girls, Barbie Worlds, Disney, sports, movies and games. Such VWs are geared towards social interactions and fun activities and do not enable the building of customized virtual environments by their patrons. In recent years, VWs have been gradually making their mark in commerce, education, military, and medical consultation using the second type of VWs, called "mirror worlds." These types of VWs allow users to create, own and trade objects such as furniture, buildings, offices, furniture, landscaping, etc. to create museums, universities, and cities similar to real world objects with few constraints. One can buy land or whole islands in VWs by spending real dollar. The most popular and well-developed VWs in this category are Active Worlds®, Second Life ® (SL), and There.Com®, of which SL is currently the most popular (TechCrunch, 2007). SL has a powerful platform in terms of collaborative and communication tools, advanced 3D technologies, customizable avatars, and active population. There are numerous potential innovative application opportunities in SL for educational activities such as providing a meeting place, offering classes and seminars, and collaborating with students in novel ways (Eschenbrenner et al., 2008).

RESEARCH METHODOLOGY

This study explores the steps required in building a system in SL, how these steps are structured, and why the process of developing systems in SL may be different from the traditional systems development process. The methodology used is multiple case studies. Many definitions of case study exist in literature. "A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organizations)" (Benbasat et al. 1987, p. 370). According to Yin (2003), "A case study is an empirical inquiry that investigates a contemporary phenomenon within real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2003, p. 13).

Systems development life cycle (SDLC) has a similar set of fundamental phases—planning, analysis, design, and implementation—that appear in various system development approaches, irrespective of their underlying methodology (Dennis et al., 2005). Software development methodologies adopt SDLC phases in distinct manners based on order and focus they place on each SDLC phase, such as linear and pre-panned sequence in traditional waterfall model, iterative use of structured techniques and prototyping as in RAD, iterative and adaptive development as in agile methods and spiral and concurrent in other hybrid technologies (McConnell, 1996; Boehm and Turner, 2004). Thus, as a starting point of this research, we used these phases as a partial structure for conducting data collection and data analysis. In this research, case studies were conducted by interviewing owners/stakeholders of the existing large scale University systems (presence) in SL. The interviews were semi-structured and were formulated based on the potentially important SDLC variables that could play a role in creating such systems.

Data Collection

Case studies were conducted through avatar-to-avatar interviews inside SL on the interviewee site. The interviewees were the major stakeholders, including owners/project-managers/developers of the system. Interviews lasted between 1.5 to 2 hours. An interview instrument was prepared for starting questions. However, based on the nature of the answers, the questions were altered and additional questions were asked. The medium of interviews was the SL's private chat. The interview replies were captured (chat window) and analyzed. Table 1 provides a profile of cases and interviewees.

Data Analysis

The method of analysis was the grounded theory. The analysis of interview texts led to distinct categories. Although interviews were conducted using the interview instrument as a guide, the categorization of results emerged based on the principle of constant comparison and categorization.

Case #	Interviewee's Role in Project	Description
#1.	Project Manager	One of the oldest public universities in Western US.
#2.	Project Manager	One of largest public university in Austria.
#3.	Head of all Second Life Activity	One of the well known public universities in UK.
#4.	Second Life Project Manager and Coordinator	A public university located in Midwest US.
#5.	Project Developer and Owner	A large college based in South Korea.
#6.	Organizer and Executive Director	A large public university based in Midwest US.
#7.	Coordinator of Virtual World Activities	A large public university based in Germany.

Table 1- Case Information

Vision

The first category related to who had the idea and what was the original vision. The data shows that the project idea normally starts with one person (or a very a small group) serving as champion or thought leader, who pursue the idea persistently. For example, one large University has futuristic and elaborate structures and landscapes with offices built on tree trunks that look like sophisticated tree houses. The project manager/owner of this university describes how the project started.
Just me. It was a solo act for a long time (#5).

Another interviewee described the nature of the vision as being creative and thinking outside-the-box.
So my vision is to improve the learning process and achieve a better motivation for students and lecturers, especially the awareness that there is more than powerpoint and boring homeworks (#7).

Project leaders often had a vision for their SL project but often lacked a clear idea of how the vision would be achieved. For example, the interviewee in Case #1 offers a far-reaching vision of an SL system that can reach "*remote students*" and "*allow them to further their education with us*" with extensive involvement of other stakeholders "*academic and non-academic unit can interact with students, alumni, parents and granting units*" thus offering a sweeping vision of how SL could revolutionize the delivery of education and interactions with stakeholders. However, once pressed for more specifics, the answer was "*LOL, good question!*"

As we observed in other cases, the vision of project initiator was revised, refined and became feasible only after they gained some experience in not only designing and building in SL and but also using it with their audience. The interviewee in Case #2 was forthcoming about the evolving nature of the vision, stating that they are in the process of experimentation of both building and using, noting that "*Right now it's rather a project to experiment, explore and learn.*"

What emerged in the study of the project initiators/champion and the vision was that initial ideas had single champions with a vision. The initial vision and scope of project changed as the implementation started. Hence, the system vision was a starting point for experimentation that involved iterative cycles of vision-design-implementation-use. These cycles were used for the creative process of discovering novel approaches and their acceptability to the internal and external stakeholders.

Stakeholders and Target Audience

The evolving nature of vision was also present in stakeholders. They too changed as the SL project progressed. A stark example of this evolution was observed in the case of a large university with an impressive SL project (Case #6). This university has a number of large structures and an impressive emulation of the real campus with details such as political

banners, a water tank, a gas station, and detailed landing area. The owners of this project were originally a husband and wife but later evolved to the college of business and the university. This change of stakeholders echoed in other cases when asked who the stakeholders were:
Me initially, then it has expanded to [a well-established center within the university] (#2).

A common theme among all cases was the emphasis on "word-of-mouth" to reach the target audience and stakeholders. Internet social networks formed another venue for word-of-mouth to promote the SL project.
The word is spread by the students as they tell others how much they like it (#7).
We are going to be mounting an advertising campaign to increase awareness which will include machinimas, wikis, and other Web 2.0 technologies as well as presentations to major health care conferences (#4).

As the SL project was promoted and the internal stakeholders changed so did the target audience. For example, some of the universities with a global presence initially wanted to reach only international students through SL. Later they changed the target audience to include their existing students. In another case, the target audience changed from attracting new students to serving existing students.
Well, at first it was/is NEW students, but we are now actually developing in-world course materials and projects (#3).
Currently the users are students who experiment with the media and lecturers trying to have their lectures in Second Life. Target audience (anticipated in the next year) are also companies and secondary schools (#7).

Hence, the internal and external stakeholders changed. Initial owners promoted their SL projects to involve a large set of internal stakeholders. As they went through the iterative loops of vision-design-implementation-use cycles, they also promoted their SL projects to external stakeholders through social networks in an attempt to broaden the appeal of their SL projects to a larger audience. These loops provided a gradual growth as the knowledge and experience of builders and users increased and novel applications were discovered.

Objectives

Owners of SL projects recognized the evolutionary and growing nature of their projects as they offered different sets of objectives for the short term and long term. The theme of building first and discovering later was present in all cases.
My coworkers and I just want to see what works (#5).
Short term was getting it built, big project, then generating traffic and visibility (#6).

In most cases, there was an understanding that objectives of SL projects would change and evolve into something beneficial for stakeholders. This evolution was dependent on the expansion of stakeholders and available resources, as seen in cases below.
Long term to establish a viable platform that adds value for students as well as teachers (#2).
The objectives are fluid at the moment based on our current activities and the future of SL (#3).

Hence, in the short term objectives in most cases were to implement and operationalize SL systems and put them in use. The long-term objective was the expected organic growth of SL systems. As builders and users together learned and discovered new possibilities, they transferred their insights into the growth of the system.

Project Management: Funding, Scheduling

SL projects lacked a well-structured project management process. Most owners of SL projects in universities were intensely involved in all phases of their projects (as seen in Case #6 statement that *"This is very time consuming and intense.")*. SL projects were based on an individual's (thought leader) heavy involvement with small ad-hoc teams. Cases of two or three member teams were prevalent and the involvement of the original champion in all phases was evident, as seen in the following:
I did some of the detail work myself. I did all of the island management and terraforming (#6).
For the terraforming and building of the overall environment, we hired a terraformer that had experience building other sim areas. For other buildings, I did the work myself (#4).

Funding for university SL projects also lacked budgeting. Funds were in small scales, strung together by champions from their own sources, for example, *"my wallet," (#5)*, or *"My consulting company loaned funds to get things started" (#6),* all evolving incrementally "*There was not really a master budget plan but it rather evolved incrementally (2).*

The lack of structure could be attributed to the lack of experience with SL and the use of volunteer builders.

The project is ongoing...with no scheduled ending period as of this time (#4).
I just sort of winged it…Had to, because I had no idea how much time things would take (#5).
The project took much longer than planned, due to volunteer labor (#6).

The quote from an interviewee sums up the time frames of SL projects as follows.
We didn't have a specific time frame for this project as such. It grew—organically" (#3).
In sum, SL projects had an evolving management structure, funding, and scheduling, which changed, took form, and grew as SL projects were implemented and used.

Feasibility and Requirement Analysis

None of the interviewees reported any methodical feasibility study done before project initiation. They built and resolved the issues as they were encountered, which included issues related to security, privacy, intellectual property rights, hardware, and lag time. Security issues included the problem of unwanted intruders and *"griefers"* and the display of sexually explicit behaviors, such as avatars walking in the nude, sexually explicit public interactions, or sexual harassment of avatars. Some reported that security guards were needed to monitor, warn, or eject offenders. Boundaries and guidelines were needed in order to define socially acceptable behavior or limit access by public.

Privacy was another issue, which included the question whether real identities should be separated from virtual identities in SL. While this might not be an issue for public events, it could be a major problem when real identities were needed for the delivery of educational services or evaluation. One university described its gradual convergence to a possible guideline:
Privacy of the students was an issue where I stressed the importance of helping protect them inworld. The faculty members initially wanted them to use their whole name as their avatar first name along with the Linden last name. I highly discouraged this practice and suggested them using their RL firstname/first initial of last name as their SL first name…..and then a similar last name for all students for easier tracking for faculty. We started with that for the first group...but now only have adopted the first part. (firstname/firstletter of last name) and any SL last name they wish for the students (#4).

Issues related to hardware and connectivity also were present as systems were used. Students had different hardware and connection capabilities, resulting in some being unable to take full advantage of the SL features incorporated in the project. These problems could cause screen freeze and create time lag in interaction, which destroy the immersive experience of SL.
Varying technology capabilities and computer hardware issues became a source of frustration that we had to take the time to work through with individual students. We learned much from the process and have now developed a better training ground for new students (#4).

Interviewees were upfront about the lack of requirements analysis, stating that they followed an "informal" approach for requirement gathering. They reported that it was hard for them to do requirements analysis since they did not have enough experience to analyze what is doable compared to what users wanted.
Requirement gathering: "was really informal". Requirement elicited from users/stakeholders: discussing with the core team which features make sense and what is doable even though many aspects where hard to plan in advance because of no prior experiences (#2).
We learned much from the process (#4).

Here, too, we observed the organic growth of discovery of what was feasible, what problems existed, and what requirements the SL project could handle. Many of these discoveries were made at the time of system implementation and use in step with the growth of stakeholders and their knowledge.

Designing and Building

Design process in SL projects evolved as stakeholders gained more experience and knowledge about the SL environment. The expressions "trial and error" and "it evolved" were consistently used by interviewees when explaining their design process. One interviewee explained the creative design process in SL as a back–and-forth process between her and the builder involving multiple trials and errors before realization of her vision.
It evolved over time. As we went along, I just asked students what worked and what didn't. So there was never any formal plan. I've been making it up as I go along, in other words (#5).

Yet, another interviewee with a widespread university SL presence (including multiple offices for faculty and physicians, a multi-story library, open auditorium, picnic areas, welcome center) explained that as more stakeholders got involved with the

project, they had to iteratively revise their overall theme and change various structures accordingly to fit with the evolving theme, a notion that was supported in another case.

The project committee held many discussions to talk about various elements of the environment. Wisconsin, Bahamas, European,.... also the learning spaces... open air or closed classrooms? Should places have doors? We are going to be changing the student center building soon...to have it fit the overall theme that is being developed for this sim (#4).

Everything here is developing much more organically than that, we're learning as we go and shifting with demand from our staff/students (#3).

In most cases, design for SL projects started with the core idea of replicating the real structures and set up. As the design progressed and, in some cases, was implemented, the design was changed to make the system more compatible with the environment of SL, for example, incorporating flying capabilities for avatars in design rather than having elevators for them as in real world.

A lot of the experience design was based on trial and error I would say. Experimenting with what works and then adapt what has not worked. The core is the university building but we changed that in the second phase created a more open auditorium got rid of the elevator, make flying space many adaptations and it really grew organically (#2).

I did brainstorming, spoke with interested parties, we went through 4-5 versions of the design plan and 2D sketch. (#6).

In sum, design in SL was an iterative process that could involve loops as far back as to the vision and forward loops as far as to the actual use. In addition to the technical and functional aspects, design involved strong artistic, aesthetic, and "feeling" components. Although design started with a vision, both changed as the system was built. External builder partnered with project owners in both the creative process and technical specifications in redefining the original vision and theme to fit with special features of the SL experience.

Testing

As the loop of design and building was repeated, the testing phase merged into these iterations. Interviewees reported lack of methodical approach to testing. Building was part of testing and constant tweaking was part of the system growth. Here too "trial and error" was part of the response. Users (faculty and students) provided feedback on implemented system for further redesign and changes in the system.

We still have a lag problem, this is incremental design, I am always tweaking (#6).

We used our faculty members as the test subjects for things developed here...and utilized their feedback to make changes (#4).

We also used a freshman/sophomore class to visiting the space and try it (#1).

In sum, testing the system was part of the organic growth of the system. It was in the form of feedback from users after the system was built and implemented.

Success Metrics

Interviewees mentioned several success metrics based on their target audience, objectives, and vision. A number of metrics mentioned included acceptability, reaction, adoption, traffic, and learning outcomes by their students and faculty.

The success or failure was based upon the actual event - i.e. a class, a presentation a fashion show. The results have been great (#1).

Interviewees observed that there was a need to have value added services, such as events, classes, presentations, to sustain audience interest and traffic. Interviewees uniformly reported that as they pushed the boundaries in their SL projects, they were still experimenting—even with success metrics. As one interviewee stated, "*We are still experimenting. Judging by student reaction, it's a big success!" (#5).*

In sum, the metrics of success also evolved with the iterative loops in which stakeholders corrected and expanded the vision and requirements, changed the management structure of the project, and altered the design, building, testing, and implementation. The organic growth brought about the metrics for its success in different stages of experimenting and learning.

DISCUSSION, CONCLUSIONS, LIMITATIONS, AND FUTURE DIRECTIONS

This exploratory study focused on issues related to system development in SL starting from initiation of the project to designing, testing, implementation, and measurement of success. A sample consisting of seven educational institutes with large scale initiatives in SL was used in the analysis. The constant comparison and categorization of results led to structuring results in multiple dimensions, including vision and stakeholders, objectives, project management, feasibility and requirements analyses, design and building, testing, and success metrics.

The common theme in every stage was significant experimentation and iterative process. Insights and knowledge gained in each iteration was used to alter the project in some cases, many stages up the stream. Internal stakeholders changed and expanded, as did external customers and users. With new stakeholders came changes in vision and requirements. Project management, funding, and scheduling were in a state of flux, changing as the system was built, tweaked, and rebuilt. Design changed and improved as the system was being built or used. Testing mostly consisted of feedback from users of the implemented system. Metrics for system success changed as new potentials were discovered. Also, little to no structured testing approaches was found to exist. The measurement of success was found to be quite difficult. SL systems had the fluidity of a growing organism, changing and expanding as humans involved in these projects, such as owners, builders and users alike, grew in experience and knowledge.

The system development in SL shares some common features with existing information system development approaches such as waterfall model (traditional), rapid prototyping, and agile software development. However, it shows a set of distinct characteristics that are unique to SL projects such as emphasis on creativity, art, aesthetics and flow on the development and design stage. Compared to the traditional systems life cycle approach, the system development in SL had many iterative loops from vision to implementation and adoption that could completely change the system and its purpose, leading to the emergence of a system with new stakeholders, visions, and use. Learning was a major theme in the SL system development process. It shares the learning feature with the rapid prototyping approach (Maurer and Martel, 2002). However, prototyping is normally used for requirement elicitation and design, whereas the organic nature of the SL system development consisted of iterations from vision definition to full implementation, with strong partnership of external and internal stakeholders. Similarly the SL development process shares the iterative and incremental development approach of agile software development (Boehm and Turner, 2004). However, the SL development process exhibited a holistic and organic process that allowed the system to evolve and engage its stakeholders. Systems grew and emerged alongside the growth of their human players with emphasis on creativity and novelty at each stage, reflecting some of the unique human dimensions such as elements of creativity, aesthetics, art, and play. Such features are not normally prominent in existing system development approaches. A quote from one of the interviewee's sums up the system development is SL as "*agile methodologies on steroids*".

The findings of this paper have significant implications for educational institutions. First, it offers a potentially rich medium for providing educational services in an efficient and cost effective manner. It also has significant implications in terms of how educational institutions should educate the next generation of students to enable them to operate and compete in the virtual world of the future. Branding universities through SL projects is a valid motivation for universities to build an SL presence. This work identified a number of features as SL projects mature. University champions need to be aware of the nature of SL development and its unique process. They also need to be aware of unique problems associated with security, privacy, intellectual properties, and constraints related to hardware and bandwidth.

This work has limitations as inherent in such case studies. The number of cases was limited to seven. This work should be extended to include more cases and should be tested in multiple domains and technologies and VWs. This work should be integrated with salient theories for exploring the elements that are critical in the design of SL projects. Our ongoing study aims to build on this effort by incorporating cases from business and by developing a theoretical approach to systems development in such environment. In the words of an interviewee, "*the jury is still out*" on the sustainability of these environments—but this is the case for all emerging technologies. We have no choice but to investigate, experiment, evaluate, and use them as they evolve.

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