Communication of Business Process Models via Virtual Environment Simulations

Ross Brown and Florian Cliquet

Games and related virtual environments have been a much-hyped area of the entertainment industry. The classic quote is that games are now approaching the size of Hollywood box office sales [1]. Books are now appearing that talk up the influence of games on business [2], and it is one of the key drivers of present hardware development. Some of this 3D technology is now embedded right down at the operating system level via the Windows Presentation Foundations – hit Windows/Tab on your Vista box to find out...

In addition to this continued growth in the area of games, there are a number of factors that impact its development in the business community. Firstly, the average age of gamers is approaching the mid thirties [3].   Therefore, a number of people who are in management positions in large enterprises are experienced in using 3D entertainment environments. Secondly, due to the pressure of demand for more computational power in both CPU and Graphical Processing Units (GPUs), your average desktop, any decent laptop, can run a game or virtual environment. In fact, the demonstrations at the end of this paper were developed at the Queensland University of Technology (QUT) on a standard Software Operating Environment, with an Intel Dual Core CPU and basic Intel graphics option.

What this means is that the potential exists for the easy uptake of such technology due to

1. a broad range of workers being regularly exposed to 3D virtual environment software via games;
2. present desktop computing power now strong enough to potentially roll out a virtual environment solution across an entire enterprise.

We believe such visual simulation environments can have a great impact in the area of business process modeling. Accordingly, in this article we will outline the communication capabilities of such environments, giving fantastic possibilities for business process modeling applications, where enterprises need to create, manage, and improve their business processes, and then communicate their processes to stakeholders, both process and non-process cognizant. The article then concludes with a demonstration of the work we are doing in this area at QUT.

How can Virtual Environments be used in BPM?

When modeling business processes, typically a set of 2D static diagrams, are generated, and maybe a number of packages are used to indicate the workflow of an organization over time in a simulation, these tools are often noted to be an important factor in the success of process modeling projects [4]. A number of notations are used, and frequently discussed for their relative merits in these and other locations by my colleagues at QUT amongst others [5].

The content of such Business Process Models is, however, very arcane to naive stakeholders. My background is in Games Technology and Information Visualization, and we have attended as many BPM seminars and conferences as possible in order to understand the different culture of my new research domain. The one question we ask people at such seminars is, "How easy is it to get people to understand your process model that you have developed?" The answer is usually, "Difficult," linked with a bemused look on the consultant's face. This problem is exacerbated when dealing with large enterprises that may have thousands of models in a repository.

Compact 2D notations are exceedingly efficient representations for experts, but very difficult to understand for the clients, and other non-process cognizant stakeholders in an organization being modeled. The confusion in the validation process translates to a number of problems for the business process lifecycle:

1. Confusion during the validation stages with clients – How can they communicate back to the modeler that they have captured the subtleties of the process in the diagram, without an understanding of the subtleties of the diagrammatic notation used?
2. Inconsistencies in any final implementation, whether executable or not in nature. Any mistakes are embedded in the process models as conceptual and configuration errors, thus misleading people who access the repository to ascertain how an organization performs its work.
3. Follow on losses from the incorrect modeling of the processes in process improvement stages. Any of the gains from process improvement may be affected due to incorrect modeling of the processes in the first place.

We believe that the value proposition to process modeling community is that any increase in insight and understanding of process models will by default reap savings in the development of any future processes and their optimization thereafter. 3D Virtual World visualizations of business processes offer intuitive simulations that every stakeholder can engage with easily. However, this modeling benefit must be weighed up against the effort involved in performing 3D visualizations of said business processes. The benefit must be seen from a company's bottom line perspective, but we believe there is a strong case from other manufacturing process domains that the use of such 3D simulations can reap savings, as long as modeling costs are kept low. Companies have for some time now routinely use simulation software in order to test the product, to make sure that it meets client specifications [6]. Surely it can be argued that this is the same for developing a complex process model! Clear communication of the structure, both in space and in time of a business process, will lead to fewer misunderstandings, and thus less loss of resources in the process. But to do this we need easy to use 3D process modeling tools.

By analogy, we may look at the history of desktop publishing. Early 80s word processors were hard to use, involving arcane text commands and mark up in order to format a document. Professional publishers needed highly skilled operators to generate professionally formatted books. Now ordinary people can create polished documents using templates that are presentable for the use of communicating their ideas. Virtual environments are at the same stages as these word processors were in their infancy. Tools are powerful, but difficult for the naïve to use, and, as such, require much training to use effectively. Environments such as Second Life [7] have gone a long way to providing modeling and animation toolsets, but they still exhibit a lack of affordability for the task of modeling business processes.

Technology being developed by the games industry offers insight into solving this problem. Games often ship with design tools for users to augment and modify game environments. These tools are typically used by game designers in games studios that will not have a heavy programming background, and will have the design tools developed for them by programmers to build game levels easily [8]. Often these editors allow the integration of models and pre-created animations to create lively interactive environments for the carrying out of game mission. These missions can be seen by analogy as a form of game workflow [9], similar to the concept of workflow as used in Process-aware Information Systems. These similarities are striking. Furthermore, games companies release these game editors to the public to enable people to easily modify their games with these tools; thus, the tools are highly developed and easy to use for non-game development experts.

Present modeling tools in the BPM community may come with components that support discrete simulation methods. A number of products have the ability to simulate the execution of business process models, including ARIS [10], Casewise [11] and others. These tools have sophisticated simulation capacities for the time-based generation of process events to drive a business process simulation.

But what has to be said is that the simulation models are still 2D, and often do not incorporate spatial information or effective representations of the objects in question being used in the process model being developed. While 2D is, of course, very useful, it is missing a vital third dimension that is useful in representing complex representations [12]. This dimension by default

allows the encoding of extra information, and provides the extra interaction possibilities that allow deeper insight into the model by giving the ability to literally manipulate in three and not two dimensions. So why has this not been addressed, and, in particular, why has the whole area of business process visualization not been addressed with real rigor? It should be noted that a search performed on the BPMTrends site using the term "visualiz(s)ation" turns up one reference, that is not about process visualization.

Other work has proposed the use of role-based visualizations for the representation of process models [13] and some have developed 3D visualizations for process modeling [14]. But none have approached this work in a thorough manner, defining a complete approach to such visualizations or a set of novel visualization techniques. We believe there are a number of issues that need to be addressed in order to advance the possibilities of business process modeling and execution within such 3D Virtual Environments, and a lot of this revolves around the nature of the BPM tools being used.

Business Process Modeling User Requirements

What are some of the requirements for the 3D visualization of process via virtual environments? In the large, the idea of using 3D for visualizing processes has not been exploited. Reasons given for not exploring VEs include the difficulty of use, the lack of maturity in business process modeling with regards to 2D models of business processes let alone 3D, the extra effort to model the details, and the lack of research into how one represents a business process in 3D.

Difficulty of use is a misnomer, as games have shown that 3D environments can and are being used by people of many ages to entertain themselves, and soon we believe tools will emerge that will be used for work more and more often, especially in product development collaboration scenarios [15] [16].

Process modeling still has some way to go with regards to formalizing the process (forgive the pun) of modeling business processes. The use of complex visualizations of business processes requires an appropriate layer of technology and expertise to be in place. While BPM tools are obviously well developed, there is a lack of standardization present to fully take up the offerings of 3D virtual environments. Research has indicated that the tools present have an influence on the success of process modeling projects, and thus we can hypothesize that the tools required to develop such 3D visualizations are not present at the moment to create easily such environments.

But, in the end, it can be argued that the major issue is the newness of the field. Virtual reality has for many years required high-end technology to be implemented, costing thousands of dollars. Games technology that now exceeds previous simulation system capacities is now available in consumer form, and, along with high-speed home networking, has brought this technology into home and SME business environments. The research on how to use this technology in the Business Process Management application domain in a broad sense has not been performed. Present research, while addressing in some way the issues of process modeling, has not looked at developing technology to ease the modeling task in any way, let alone rigorously investigated the techniques to visualize a business process in 3D virtual environments.

It must be stated, that in a manner similar to the present 2D diagrammatic representations, business process modeling does not need high fidelity representations in 3D in order to be successful. 3D Business Process Visualizations really only require a number of key components to make the visualization usable:

1. Spatial organization of objects used in the process model – i.e., positioning tasks within a floor plan in a building or on a terrain.
2. 3D representations of objects for use in world. Entire websites are devoted to selling such artifacts, thus such representations can be easily extended to typical physical business system resources (photocopiers, terminals, mobile phones, and people, among other things).

3. Object animations that illustrate the actions that resources perform, either on their own or with another resource.
4. Representations of decision structures involved in the processes. This means the translation of such choice representations from the 2D to a similarly recognizable construct in the 3D virtual world, via either an abstract representation as an artifact or the animation of a human resource involved in the decision process.
5. Representation of the more abstract IT components of a process mode – for instance, the representation of the components of an IT transaction system being used in a bank.

Visual fidelity, while useful, is not essential to improving the understanding of a process. So a business process 3D modeling tool used in a virtual world does not have to be photo realistic, but just good enough to assist the viewer in understanding the processes being illustrated. Visualization is about elegant sufficiency of representation. The use of obfuscating "Chart Junk," as described by Tufte [17], is to be avoided at all costs, as it actually clouds the perception of the information within the representation.

While this does not cover all the nuances involved in the representation of business processes, what it does provide is a basis for the development of process model proofs of concept in 3D, which can be further tested for utility in business process communication.

Second Life Workflow Demonstration

At QUT, we have begun to develop tools to support this process of visualizing business processes in 3D worlds. We have integrated a business process modeling tool we have developed at QUT with the Second Life 3D virtual environment. Much work has been expended on the use of such virtual environments. However, no research has been performed into the actual use of such environments in the specific visualization of process models that have been developed via typical 2D modeling tools, such as ARIS, VISIO, etc. We have chosen this as the first entry point, as the industry has become comfortable with the use of such 2D modeling tools, and they represent a repository of verified and validated process representations that can be used to test the efficacy of 3D in this domain.

At QUT, a workflow tool has been developed called Yet Another Workflow Language (YAWL), which enables the detailed modeling of business processes using a sophisticated executable language [18]. YAWL is amenable to the task of linking to Second Life, due to its service oriented architecture, and encapsulated interfaces to the workflow being executed.

As a first entry point into this endeavor, we developed a custom service module to link the Second Life environment with the workflow interface in YAWL. In effect, this meant that objects associated with workflow tasks within Second Life can animate the traversal of a workflow control network, causing an avatar to change locations and act out the tasks contained within the business process model[1]. The overall system architecture is illustrated in Figure 1.
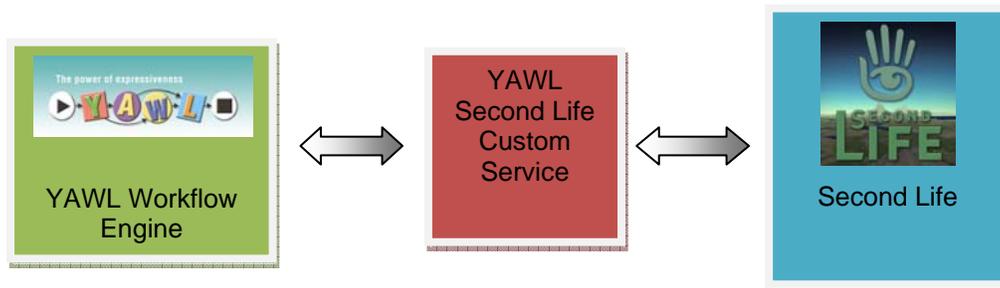

Figure 1. Overall visualization system architecture, showing the software developed as a custom service that enables objects in Second Life to connect with a running business process in YAWL.

[1] A blog post containing a movie of the full process being animated is found at www.bpmve.blogspot.com/2008/07/yawl-and-second-life-linked.html

We decided to implement a working demonstration drawn from a project being run within the research group called YAWL4Film [19]. This is a project seeking to introduce process modeling to the film industry, to facilitate efficient management of the film production process, to assist with multi-site film shoots, and to help the Australian film industry to be competitive via process modeling efficiency gains. The following process diagram in Figure 2 illustrates the process model developed by the YAWL4Film team.
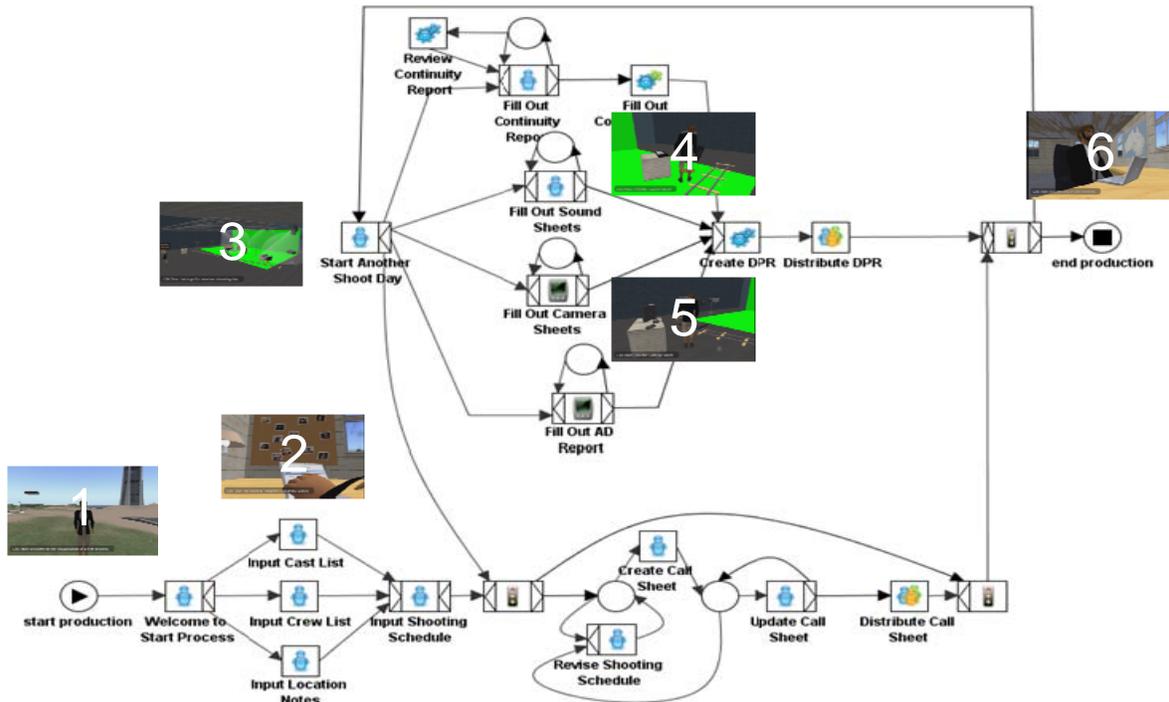
YAWL is amenable software for such an extension, as it is designed from the ground up as a Service Oriented Architecture. Second Life is also capable of accessing web services via its scripting language. So we were easily able to set up objects in the environment to interact with the YAWL server, and animate according to the set of tasks within the workflow. The following figure shows still images from the animation generated by the YAWL/Second Life service. Figure 3 shows a sample of snapshots of tasks being performed by an avatar controlled by the YAWL4Film film process model. Thus, according to the set of five points mentioned previously in the Section Business Process Modelling User Requirements, we have representations of the spatial locations of tasks, the human and non-human resources used, and animations illustrating the execution of the film production process.

1 Starting the film shoot

2 Filling out actor lists

3 Performing the film shoot

4 Filling out sound sheet at sound

5 Filling out film sheet at the camera

6 Conclusion of film production

Conclusions and Future Work

At this moment in time the software is at the level of being able to animate a workflow. It is assumed that the Second Life account has inventory with process resources that contain the appropriate animations to be executed as scripts. So this tool can be used to provide 3D avatar centered visualizations, showing an avatar executing a workflow process in a 3D virtual environment. Thus, a workflow in principle can be designed within a standard 2D tool, such as the YAWL workflow editor, and then be visualized in a 3D environment for communication and validation processes.

The major work to be performed in the future is to generalize the interface to show avatars making choices (programmed as instances of workflows), avatars interfacing with each other (to show the exchange of work between people in process models), and to develop representations of the internal IT infrastructure represented in the visualization (e.g., representations of transaction status). In addition, deeper theoretical questions need to be answered about the data models required for such visualizations, what visualizations are required for different roles within the process development lifecycle, and how these 3D visualizations of process models can be rigorously used in validation and communication processes for the benefit of all process stakeholders.

We welcome any feedback on this work, and the intended direction of our Business Process Visualization research program.

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Author

Ross Brown is a Senior Lecturer within the Faculty of Science and Technology, Queensland University of Technology, Brisbane, where he is the Software Technologies Coordinator for the Bachelor of Games and Interactive Entertainment. He is also a member of the Business Process Management (BPM) Research Cluster at QUT. He can be reached at: r.brown@qut.edu.au