Accounting in Virtual Worlds   **James Grimmelmann**
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Introduction

Hello, and thank you for having me here.

I should warn you, I'm not an accountant. I've never studied any accounting. The closest I come is that my wife's parents are accountants. You'll need to forgive me if I mix up my accounting with my finance or my econometrics. I'm a law professor whose intellectual first love was computer science. I study virtual worlds because they're an endlessly fascinating microcosm for all of Internet law.

So why should accounting scholars care about virtual worlds? Because there's already a great deal of accounting taking place in and around them -- and much of it is profoundly undertheorized. I'll try to punch up some of chestnuts of the virtual world studies literature by drawing out the accounting angles. Perhaps some of you will be able to translate those angles into research projects.

Because accounting is the art of keeping track of the value of things, the basic prerequsite for interesting accounting is that a world contain things of value. Check. Whether based on scarcity, utility, or attractiveness, pretty much every virtual world was either designed with or developed some system of virtual property. ("Virtual property" is a loaded term where I come from, because the legal status of these things is the subject of some dispute, but for your purposes, it's fairly accurate.) Here are some examples of virtual property:
• World-specific virtual currencies, of course, are highly fungible and heavily traded.
• That's a Black Planar Edge Axe from World of Warcraft; it increases your attack power by 42 and your critical strike rating by 20.
• In Ultima Online, high-priced hair dye provided a way for players to flaunt their wealth.
• Second Life has a thriving real estate market; you see here a treehouse, but you could also live in a barn, a skyscraper, a castle, or almost anything you could imagine.
• Even though the "token" was the official currency in Habitat, an early virtual world, avatars' heads could be taken off and swapped, and a barter market in them developed!
• And in LambdaMOO, a text-only virtual world where players could create new items, the disk space used to store the digital codes representing those items becamse a commodity.

I'm going to focus on three particular places in which virtual world designers and players are engaged in some serious accounting.

(1)   Raids

First, let's consider a problem related to the aquisition of virtual items. I'll use World of Warcraft as an example. This is Ragnaros, a firelord elemental who lives deep in the heart of Molten Core.   To kill him, you need to go "raiding" in an attack coordinated with a group of, typically, 40 other players. Should your group succeed, the dying Ragnaros will leave behind . . a pair of pants. Actually, one of about nine different pairs of pants, each with different properties and valuable to different kinds of players. The Legplates of Ten Storms are useful for Shamans, the Netherwind Pants (I'm not making these names up) for Mages, and so on. There's also about a 3% chance that Ragnaros will also drop something called the Eye of Sulfuras that's an essential ingredient in creating a superpowerful weapon called "Sulfuras, Hand of Ragnaros." Other raids generate their own distinctive loot.

The critical point here is that the cooperative project of raiding produces discrete valuable items that need somehow to be apportioned out among the raiders. And not only do those different items have idiosyncratic values to particular players, but keep in mind that different players will have made different contributions to the success of the raid. There's a famous YouTube video of a gentleman named Leeroy Jenkins showing him rashly charging into combat and getting his entire party killed. Presumably, his negative-value contributions should not entitle him to a large share of the loot. To make things even worse, many of these items are so-called "nodrop," which means that the game makes them completely inalienable. Whoever picks up a nodrop item had better really want it, because its resale value is zero.

Ted Castronova and Joshua Fairfield at Indiana University are engaged in a fascinating study of "Dragon Kill Points," a common and quite sophisticated class of player-generate allocation systems. DKP are an artificial local currency; players are awarded them for participation in successful raids, and then "spend" them to lay claims on particular items of loot. Note the enormous substratum of sophisticated accounting required to make such a system work. Let me illustrate, using screenshots from a number of different DKP-tracking tools.

You need to keep track of who particiapted in which raids, and what their roles were. You need to have a system of prices for items that takes into account their usefulness and their scarcity, the latter being a question that can only be answered through observation of the results thousands of raids. And you need to track past allocations so that you can know what players' present DKP account balances are when it comes time for bidding on newly-dropped loot. Needless to say, all of these accounting decisions can be controversial.

(2)   Exploits

Second, here's a story about pathological macroecnomics. Virtual worlds are fundamentally closed economies; the virtual items circulate in a closed system, from which nothing can be exported. This would seemingly mean mean that the details are

stable and precisely controllable, but in fact, quite the opposite is often true. If you had to control every aspect of an economy, you might make a small mistake here and there.

My favorite example comes from Habitat. I've circled the bug. That's a vendroid; it sells things. It turned out that one particular vendroid would sell dolls for 75 Tokens (the local currency), whereas a pawn machine at the other end of town would buy them back for 100. That's an instant arbitrage opportunity with a 33% rate of return for a few minutes of work.

What do you do if you're a player and you discover such an "exploit?" You throw everything you've got at taking advantage of it. In Habitat, the entrepreneurs who found this mistake spent all night shuttling dolls back and forth. You see here a picture of a closet of computers playing Ultima Online 24/7, "gold farming" by repeatedly engaging in repetitive tasks that yield a little profit. Today, gold farming has become a fascinating hush-hush offshored industry.

Detecting exploits often requires some significnat regulatory and forensic accounting. The Habitat game designers only noticed because they discovered that the server's report of the total supply of Tokens had quintupled. Seeing this figure, they assumed that tere was some kind of software bug. Further digging revealed that a few players were now fabulously rich. But there their accounting mechanisms failed them -- despite running the servers, they couldn't figure out what had happened. Ultimately, they asked the players, who explained the source of their wealth.

Something similar happened in Ultima Online. Here's a diagram of the original design for the economy, which followed a strict conservation law: there would be a fixed quantity of "meat" units, for example, that could either exist in the form of rabbits, or as meat in players' inventories. After a while, players started complain that the game was getting boring because all the species were going extinct and resources were becoming incredibly rare. The designers ultimately determined, through careful accounting, that players were hoarding items -- using animal skins as flooring for entire houses, for example -- so that almost nothing was being recycled back into the wild.

The point I'd like to make here is that virtual worlds come with huge mountains of raw transactional data, but that it's much harder to analyze that data in a way that provides a clear snapshot of what's going on in-world and what's off-kilter. Designers have a lot of ad hoc wisdom about what to measure, but they could use help.

(3)   Markets

Third, let's talk a bit about markets. There are all sorts of markets in virtual property. Let me give a few examples:
- Here's the World of Warcraft Auction House . . . it's an actual location in the game world where you go to consign items for auction or to bid on them.
- Here's StationExchange for EverQuest II, which is also linked with the game so that transfers of sold items take place automatically. It's run on the web, however,

so that players buy and sell items using US dollars, with a commission going to Sony, the game's operator.
- Second Life's thriving land market is heavily shaped by the actions of a few huge speculator-developers, especially the Anshe Chung operation, whose land sales web page you see here. Second Life's extensive user-created-content also means that there's lots of room for smaller, in-world entrepreneurial boutiques. Quick -- which two of these stores are run by major real-world corporations, and which two are sex shops?
- And this . . . well, this is the black market at work. It's an unauthorized World of Warcraft gold trading site, one of dozens of businesses that farm gold in World of Warcraft and resell it. I send you $25 via credit card, and then our characters meet up in the world and you hand me the virtual gold. People sell all sorts of stuff this way -- weapons, airplanes, clothing, houses. It's a huge market -- estimated at about US$2 billion annually.

Once again, the work of market-making requires creating a fairly substantial substratum of data about the items being exchanged. Small-scale merchants and occasional customers can keep track of their transactions in a fairly ad-hoc fashion. But as people go full-time and large-scale, they need to keep closer track of their purchases and sales. Thus, you can hardly throw a brick without hitting player-developed accounting tools.
- Here, we're looking at a Warcraft Auction House analyzer, that looks at current acutions and tries to help make profitable opportunities more visible. There are some great stories about attempted Auction House corners and market manipulation.
- Here's EVE-MEEP, a scenario planner from EVE Online, a world I like to call the world's first massively multiplayer Excel spreadhsset, where success pretty much depends on your ability to synthesize a huge volume of financial data.
- Here's Accountant, a much simpler ledger applet for World of Warcraft, but note how it tries to help players have a clearer view of where the money is going. In an example of how there's nothing new under the sun, this player here is deep in the red because of this 25 gold in "unknown" expenses.
- And here, in a format that could have come from a stock-tracking web site, is historical market data from LindeX, the official Second Life exchange for converting Linden $ to US $ and vice-versa.

Yet again, I'd like to emphasize that there's tons of data, that people are already analyzing it in all sorts of ways, and that almost none of the participants are being theoretically sophisticated about it. Sony has published a report analyzing trading patterns in StationExchange, and EVE Online has recently hired a real-world economist to study its economic flows, but these are exceptions rather than the rule. There are few accounting principles in use in virtual value-tracking, let alone ones that are generally accepted.

Conclusion

And that concludes this whirlwind tour. To sum up: Virtual worlds are big. They're full of accounting. Almost no one is thinking systematically about that accounting work. I'm not really competent to perform that theorizing. You are. Happy hunting.