Profiting from Innovative User Communities

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Abstract
Modding – the modification of existing products by consumers – is increasingly exploited by manufacturers to enhance product development and sales. In the computer games industry modding has evolved into a development model in which users act as unpaid "complementors" to manufacturers' product platforms. This article explains how manufacturers can profit from their abilities to organize and facilitate a process of innovation by user communities and capture the value of the innovations produced in such communities. When managed strategically, two distinct, but not mutually exclusive business models appear from the production of user complements: firstly, a manufacturer can let the (free) user complements "drift" in the user communities, where they increase the value to consumers of owning the given platform and thus can be expected to generate increased platform sales, and secondly, a manufacturer can incorporate and commercialize the best complements found in the user communities.

Keywords: innovation, modding, user communities, software platform, business model.

JEL code(s): L21; L23; O31; O32

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Introduction

How can manufacturers establish a process of innovation by users and profit from the outcome? This paper examines how it is possible and attractive for manufacturers to "out-source" product development tasks to innovative user communities by focusing on the phenomenon currently known as "modding". The term originates from "modification" which is the art of applying change to an original. Modding is the act by which users modify an existing hardware or software consumer good to perform a function that is not necessarily authorized (or imagined) by the original manufacturer. Mods - the outcome of modding – range from minor alterations to very extensive variations of the original product. As modding becomes widespread mods are found in many forms such as re-programmed auto engine chips allowing enhanced engine performance, Personal Video Recorders (such as TIVOs) with added functionalities allowing viewers to omit TV advertisements from recordings, and altered Harley Davidson motorbikes. Although many types of software modding were formally criminalized in the US by the Digital Millennium Copyright Act (1998) the phenomenon has flourished most strongly within software development.

Modding is a variety of user innovation. In itself the observation of innovation by users is not new as it has been shown that users are responsible for a large share of novel product concepts (von Hippel 1988). Also, the fact that user innovations often are outcomes of collaborative activities organized and undertaken by users in user communities has recently been recognized (Franke and Shah 2003; Lakhani and von Hippel 2003). However, whereas the phenomenon of user innovation is becoming quite well understood, little is yet known about how firms appropriate value from the distributed innovation processes carried out in product-related user communities.

Some firms are now realizing that modding is an opportunity that can be exploited by (selectively) shifting some innovation-related tasks to product users in the final market. This article investigates the emergence of modding as a business model in which user innovators act as providers of free complements (mods) to a manufacturer's product platform. In other words, manufacturers have managed to hand out complement production to their own users who voluntarily undertake this work. Empirically we focus on the computer games industry. The article shows that under certain conditions mods generate important value. It also illustrates how some manufacturers in the industry have managed to capture important economic benefits resulting from users' innovative activities.

The discussion here suggests that opening up product technologies is a key condition allowing manufacturers to benefit from modding. The establishment of an appropriate "solution space" with additional tools for user innovation (von Hippel 2001) allows manufacturers to selectively open up parts of their product to modification by product users while at the same time maintaining control over revenue generating core assets. Examples from the computer games industry show that the opening up of the products was in fact initiated by users – not manufacturers. The users broke apart the products through hacking, and created their own solution spaces and tools that helped satisfy their specific needs. Only later did manufacturers discover the potential of modding for their business purposes. Upgradeability of the product is now achieved through the creation of a technological product platform (Gawer and Cusumano 2002) with “mix and match compatibility” (Matutes and Regibeau 1988; Sanchez 1999) that lets the final consumer integrate the desired complements selected from a pool of free user-generated complements. In this emergent business model, a product platform models is coupled with an Intellectual Property Rights arrangement that blocks the user innovator from commercializing his complements. This arrangement makes it impossible for the user innovators to appropriate monetary values and benefits manufacturers because it ensures that the mods built for a given product platform remain free to all users and, because it allows manufacturers to pick up the best complements, package them, and commercialize them (or parts of them) as their own proprietary products.

In this paper, the context of the empirical study is established first. Then, the emergence of a platform model in which users act as “complementors” is considered. The evolution of the modding model in computer games is outlined, followed by an exploration of the different business models resulting from these developments. Finally we discuss the findings draw conclusions.

Methods and data used in the empirical context

The ideas outlined above are explored by examining the organization of product design activities involving consumers in cases from the computer games industry. In 2003 this industry sold software worth $18.5 billion worldwide and 7 billion in the US alone (Screendigest.com). The industry has been growing at a rate of 10-15% since the early 1990s (ISDA, 2004).

A tendency towards modding has been seen in the industry especially since the 1990s. Modding is now increasingly being embraced by firms for commercial purposes. Modding is mainly relevant for PC games. PC games account for approximately one-third of the industry sales or around $6 billion US, with the product segments most affected by modding generating an annual turnover of approximately $2 billion US.

The industry was chosen as suitable for the present objective because many firms attempt to involve consumers in the product development process rather than to concentrate solely on in-house created products. In addition, the industry is substantial in size, with numerous examples of firms adopting this type of organization and of products being influenced by users.

Hence, we expected that at least some of the industry’s participants would have invested significant resources in developing efficient methods for involving consumers in the product development process. Data were collected mainly through interviews split equally between experts in the computer games industry and users experienced in modifying computer games products. Industry experts initially selected for interviews were those directly mentioned in the industry press as having adopted methods for consumer involvement in the product development process. The users were identified through the industry experts or simply through their websites or mentions in the popular press on the Web.

To estimate the value of the user complements to manufacturers' products created within the industry data was collected on the popularity (minutes played) of manufacturer created complements and the popularity of user created complements. For this purpose global "server tracking information" was relied on, making up a complete data set on the popularity of game complements in a period of two-and-half years (2002-2004). The data was obtained from csports.net, a specialist in worldwide computer games ranking and the tracking of player behavior in computer games on the Internet. The time frame is appropriate as it covers the period in which modding became a mainstream phenomenon. However, to complete the dataset information on mods prior to this point was also acquired. Data from 1999-2001 were acquired from Gamespy.com, which listed mod statistics during this period, and from the Internet Archive Waybackmachine.com[1].

Platforms with "users as complementors"

The intention with platform models (Gawer and Cusumano, 2002) is to leverage ongoing innovation efforts in the external environment at the application level for product development (Cusumano and Selby 1995). The platform models also describe a situation of business-to-business innovation: platform manufacturers design the platform architectures while external specialist suppliers (referred to in the literature as "complementors") develop complements compatible with the platform. In the platform model many different complements can be added to the same basic platform architecture. The idea is that complements are produced in a decentralized manner by external developers and that the platform manufacturer can increase platform sales when numerous popular complements are available because this enhances the value that users can derive from owning the platform. A platform manufacturer needing complements tries to encourage complementors to develop for his product platform by supplying compatibility-enhancing interfaces and development toolkits to potential complementors. If a complementor is to be motivated to build new complements, it is essential that he (not the platform manufacturer) retains the intellectual property rights to them and is thus able to sell them to consumers. Platform business models in, for example, Intel, Microsoft, Cisco and Palm (Gawer and Cusumano, 2002) exploit this

[1] The Internet Archive WaybackMachine is a digital library of Internet sites and other cultural artifacts in digital form. Like a paper library, it gives researchers, historians, scholars, and the general public free access to archived versions of Web sites.

model[2]. The advantage of this model to the manufacturer is that when external developers make the complements, it frees the platform manufacturer from the costs of developing the complements. The advantage to the consumer of owning a platform with many complements is the flexibility of being able to choose from a pool of different complements offered for sale by complementors and to swap one complement of the system for a better one. When many quality complements are available an advantageous situation can arise: with platforms, consumers are able to "mix and match" (Matutes and Regibeau 1988; Garud and Kumaraswamy 1995) complements in order to get a product that is more likely to serve their needs. The downside of the model is that the platform manufacturer relinquishes potential business areas (those of complement production) to external suppliers who will also charge consumers for the complements. The tradeoff for the manufacturer is thus one of selling more platforms versus the loss of the complement business areas as well as the lack of control over complement pricing.

Innovative Users as Complementors

Some firms, however, are now using an alternative platform methodology for the production of complements. Instead of drawing on professional developers in the business-to-business context for their complements, manufacturers draw on *user* communities of consumers of the original product for their complement production. Whereas in the "conventional platform model" the final user is limited to purchasing and mixing and matching ready-made manufacturer complements to manufacturer-made platforms, users here create the complements they need themselves. They also share these complements among users/consumers of the platform for which the complements have been made.

We have discovered the modding model of development in the computer games industry. It is called modding because it is characterized by users modifying an existing product (in this case a computer game) where the original product serves as the platform onto which new complements are built and can replace parts of "old" original content in certain areas of the original product. Thus, platform manufacturers who have discovered how this model works have a new option for out-sourcing complement creation – namely, innovative users in a user community connected to the product in question. By their ability to organize and capture the innovation produced in these communities, manufacturers can derive valuable complements at no production cost in a fashion similar to what can be achieved by the conventional platform model.

The main difference when users are complementors is that they act as voluntary providers of complements, which are freely revealed. Thus, in the modding model *new complements appear for free and remain free to all* consumers. This means that when users act as voluntary providers of complements to a commercial manufacturer platform,

[2] In the case of, for example Palm, consumers must first purchase the platform product (a device made by Palm) and may then later acquire the complement CustomCalc calculator (developed and sold by complementor specialist Visacsoft).

manufacturers' complement portfolios are increased at no cost while the value for consumers of owning the platform also increases because all complements remain free to them. The value of owning the platform for consumers is higher than in a platform model with business suppliers because complements are free to consumers. To secure the benefits of the new complement platform manufacturers practicing the modding model have set up an Intellectual Property Rights arrangement that blocks the user innovator from commercializing his complements. This arrangement prevents users innovators from appropriating monetary value for their mods and ensures that mods remain freely revealed.

The readiness of users to participate in the development model outlined above can be explained using the insights from the literature on user innovation. While one can explain why this model may be attractive to manufacturers with the use of straight-forward business logic, a different set of motivations apply to users and explains their innovative behavior. To explain why users may undertake innovative work uncompensated in monetary terms one must look for sources of motivations that not necessarily align with those of commercial manufactures who work for profits. In the user context motivational factors are often the necessity to serve own specific needs left open by commercial vendors (von Hippel 1988), combined with intrinsic factors, for example, the joy and learning related benefits of innovating. In fact, contributors to open source software projects reported that they enjoyed and learned from the coding, thus the actual cost of generating the code may even be seen as negative by the coder (Lakhani and Wolf 2000). It has also been proposed that recognition effects derived from the surrounding environment (Allen 1983) are drivers of innovative efforts by users (Raymond 1999; Lerner and Tirole 2002). Further, with regard to free revealing behavior of users, in the case where innovators are not allowed to commercialize the real costs of free revealing are low and may easily be outweighed by the benefits outlined above.

The organization of modding in computer games

In computer games, mods are made by the general consumer public. These user innovators, or modders as they are called in the industry, are usually highly motivated consumers with technical abilities and specific needs for a novel product feature or a solution to a given problem regarding a product. Through their work user innovators create mods, which can be entire new games including mod features such as weapons, characters, enemies, models, modes, textures, sounds, levels (e.g. landscapes), and story lines. Today these are all written with an existing game's engine and tools. A "mod platform" is a host engine and game that a mod can be written for.

Some mods do not progress very far and are abandoned without ever having a public release, while others – "total conversions" - modify games to such a degree that they bear little resemblance to the original. Total conversions require a large amount of development and person-hours to bring the whole project together. Examples show that the effort of creating a successful mod can amount to three years of development work, 140,000 lines of code and an investment of up to $20,000 US in hardware, software, website hosting etc..

Like Open Source Software development (Lerner and Tirole 2002; Lakhani and von Hippel 2003), modding in computer games occurs through collaborative action carried out on a user basis. In modding, loosely coupled subsets of the overall user community of a given game product form groups of developers to jointly work on a mod and/or product features. The ability to draw on fellow users' knowledge and artifacts for a solution is essential to the functioning of such communities (Jeppesen, forthcoming).

Since mod creators generally work in their spare time through distributed development teams, mod team boundaries are often blurred. As modding includes many different tasks, modding communities have their own internal division of labor in which groups of modders or individuals work separately on sub-projects that can later be integrated. The output of the different community subgroups' modding efforts are then brought together in one functional item (the final playable mod) by the technical interfaces. Teams typically consists of 1-5 core members who take care of central coding tasks, a more loosely connected group of "level designers" which may consist of 2-20 people, and then a group of peripheral contributors making pieces of art and features. This last group can consist of up to hundreds of contributors. Many mod teams have members that have never seen each other in person. However, in computer games modding, online communities facilitate collaboration between users, and communication between users and manufactures. To organize their work, some teams use "lightweight and free communication technologies" such as firm-sponsored online communities and CVS[3], both of which are free, and also have weekly or daily meetings over ICQ or IRC. This distributed development team structure means that more game development efforts are feasible and allows for a very fine-grained division of labor among modders.

Another defining characteristic is, as mentioned, that the final mods are often freely revealed, meaning that no users are excluded from using the new modified version. Thus, almost the entire population of consumers (including the vast numbers of "free riders" not participating in development) can benefit from the value created through the efforts of the modding community. Mod teams typically have their own website from which their mods, additional support information, patches etc. can be obtained.

Figure 1 shows a simplified illustration of the way in which many computer games are structured to allow user innovation to take place in certain areas of the product space. The subsequent section outlines how this structuring of the product for user involvement came about.

[3] The Concurrent Versions System (CVS) keeps track of work and changes in a collection of files in a software project and allows potentially widely separated developers to collaborate.

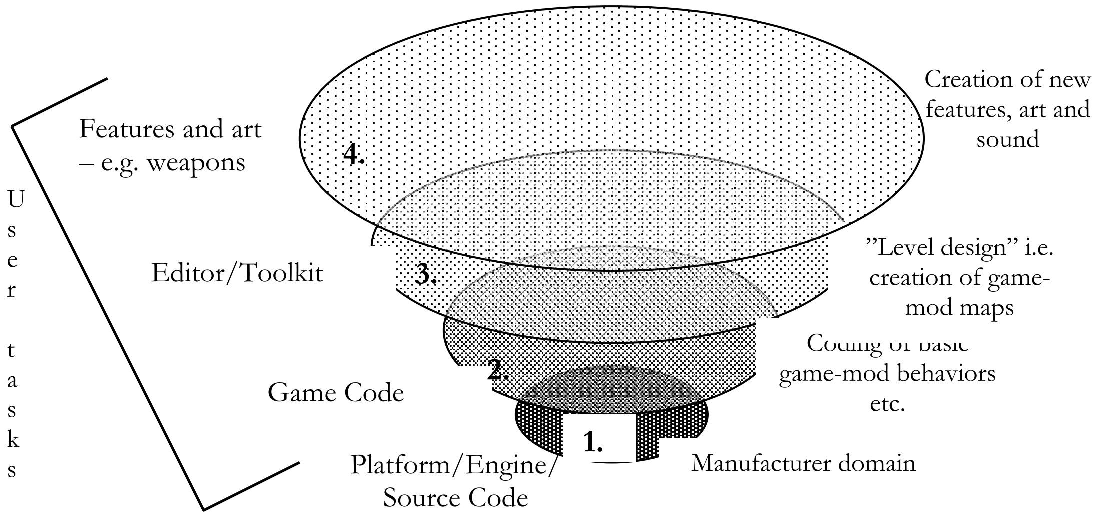

Figure 1: A product architecture of a modifiable computer game and its related division of labor

The evolution of modding in the computer games industry

Although modding now plays a role in many computer games manufacturers’ product development strategies, modding in computer games was not initially invented by manufacturers. In fact, since the dawn of computer games players have always hacked on them and in most cases, manufacturers’ games began to “open up” to modification through unauthorized hacking. Only later did some manufacturers see the opportunity represented by this opening. By monitoring which areas of the original product users chose to work and hack on and the tools they created to modify the product manufactures found inspiration for their own attempts at turning modding into a viable business model. In other words, users took charge of opening up the product in the early stages. Then manufacturers started to structure their product architectures systematically to allow for modding by making code and toolkits available for users (von Hippel 2001). They also sponsored the establishment of an external organization of modders by setting up firm-sponsored user communities centered on the innovation of their own products. Finally, manufacturers have now created business models involving modding and have begun to compete on attracting modders and on their abilities to spot promising user innovations. As the following sections show, in the computer games industry the trend towards what may be called “bottom-up modularization by users” started in the 1980s. Later, in the 1990s, the idea was adopted as a business model and put into practice by manufacturers.

1980s – When modding was hacking – Dead Smurf Software and Smurfenstein

One of the first examples of modding recorded is Castle Smurfenstein. It started in 1983 with a “hack” by Andrew Johnson and Preston Nevins with help from Rob Romanchuk. Castle Smurfenstein was a hack and a parody of the original computer game "Castle Wolfenstein". "Castle Wolfenstein" was a classic arcade-style action game written by Silas Warner (Muse Software) for the Apple II, Commodore 64 and several other computers. The player played an Allied spy fighting with Nazi combatants, who would shout in German as they opened fire. However, the inspiration for the mod Castle Smurfenstein was not so much WWII as a cartoon that ridiculed Silas Warner's original game. As the modders behind Castle Smurfenstein said; “Nazis just didn't seem that threatening to a suburban high school kid in the early 80s. Smurfs did. The Nazi guards became Smurfs, the mostly unintelligible German voices became incomprehensible Smurf voices”.[4] The modders created a new title screen, new ending screen, new opening narration, and an opening theme, and changed the setting from Germany to Canada. This early conversion was straightforward, needing only a paint program, a sector editor, and Muse Software's own voice program. Castle Smurfenstein was a hack that had little effect on the original game.

Mid 1990s – manufacturers facilitate modding and collaborative mod-communities emerge – id Software and DOOM mods

In the 1990s the modding movement began to influence the computer games industry. Especially the products made by id Software had experienced extensive attempts on modding by users. Players had figured out how to create their own levels (new worlds to play in), which they had distributed to the entire community of players. In 1996, alterations to id Software's product "Doom" resulted in modified versions whose popularity came to influence id Software’s product development strategy. This situation, in combination with the founder of id John Carmack's commitment to the principle that the source code for software programs should be made available to the general public, led to the decision to release the code for "Doom" in late 1997. From then on, modders had access to "Doom's" code, enabling them to make more in-depth development efforts. One of the important changes was that mod makers now had various sets of product compatible tools supplied by the community that they could use to work on levels, add features and fix bugs. From "Doom" on, id would release the source to all its games under the GPL (General Public License). However, this would happen only after all of id’s engine licensees had shipped their games. Id’s own developers observed that mods were sometimes of high quality. Some of the mods completely changed the way "Doom" was played and presaged the kinds of designs and ways to play the game by several years.

In return for allowing mods to be created and exchanged, id requested that fans modify only the registered version of "Doom". Almost all modders abided by this request. Not only did this tradition of community self-policing create a bond between id and their best

[4] http://cvnweb.bai.ne.jp/~preston//other/deadsmurf/index.html.

fans, it benefited the company commercially – in order to enjoy all the free fan-created content now becoming available, potential players first had to buy the original game. After Doom, id intentionally built their next game, QUAKE, to be user modifiable. After QUAKE was finished, id released some of the tools they had used to create maps, including tools that allow modders to script new behavior into the game. Since QUAKE, many other developers in the business have promoted mod development by designing their games to be easy to modify. In sum, id software observed that modders were re-designing their product and over time the firm realized the benefits of opening its product architecture to allow modding to happen.

Late 1990s - A business model emerges - Valve Software and Half-Life mods

In the late 1990s two former Microsoft programmers established Valve Software. Without any prior industry experience, Mike Harrington and Gabe Newell created the computer game "Half-Life" (1998). To do so, Valve purchased the right to an id made software engine, which they tailored specifically to Half-Life. Also, a number of key tools were obtained from the existing games user community's private tool builders. The game was thus the result of a combination of already existing assets: a slightly modified engine and tools from the user community. This process made the creation of Half-Life low cost. The estimated development cost of Half-life was about $1 mill.

When Half-Life was released, Valve chose to make available a significant chunk of the product's game code for modification by users. Approximately 80 per cent of the code for HL was released for alteration by modders. The code was restricted so mods still required the core engine of Half-Life. The original product, Half-Life, thus became the platform on which mods were built and on which mod complements had to be played. To match the publication of the code Valve further released a number of tools to the user community, again, many of which Valve initially acquired from users and polished in-house. At the time of the release of Half-Life, Valve obviously did not know whether users would build mods to their platform or what the actual impact of such mods would be. However, less than eight months after the release, British Columbia based student Minh "Gooseman" Le and his mod-team had built "Counter-Strike". While Half-Life is a linear, first-person shooter with some puzzle solving, the total conversion, Counter-Strike, is a team-based, multi-player game, taking place in realistic settings between Terrorists and Counter-Terrorists. Practically the only thing that Counter-Strike has in common with Half-Life is that Counter-Strike requires Half-Life to be installed for it to run. The mod Counter-Strike quickly became so popular that it far surpassed the original game Half-Life.

The creation of Counter-Strike is an example of a user innovator showing a firm the value of opening its product code up to the public for further development. Eventually Valve ended up acquiring Counter-Strike. Valve paid Minh Le's and some of the core members of the Counter-Strike Mod-development team for their work and hired Minh Le to continue the development of the mod in-house at Valve. One of the things Valve did with the newly acquired mod was to "package" it and then release it as a new commercial game (complete with engine/platform). In fact, the new packaged version of Counter-Strike sold over a million copies while remaining a free download to Half-Life. Furthermore, Valve also "ported" Counter-Strike to different commercial hardware platforms such as PlayStation. By doing so, Valve could reach a hitherto overlooked but potentially lucrative (mass-) market of players who do not use PCs for gaming.

Figure 4 below shows the different game platforms to which mods can be made and the actual number of active mods (mods played online) to these different platforms in a period of 14 days.

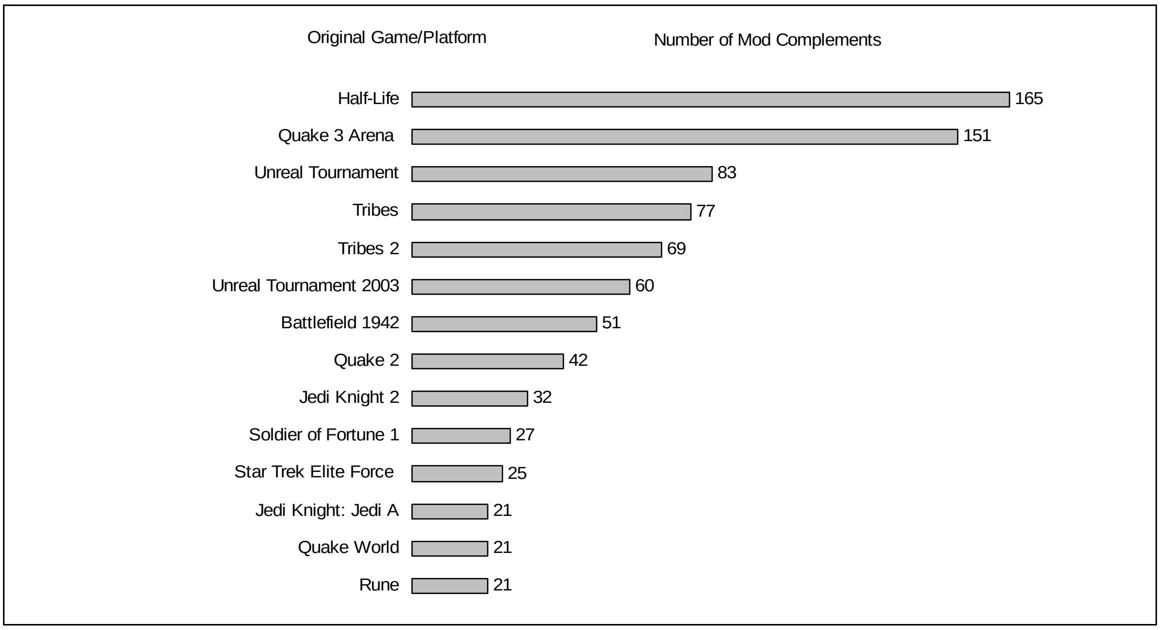

Figure 2: Different platform products and their number of complement mods found in two week period (Dec. 2003). Source: csports.net

The numbers of mods to each platform comprise four different types of mods: 1) mods that were user-made, but which at some stage got picked up by the manufacturer; 2) "in-house mods" made by the manufacturer (i.e. those that are included in the original game); 3) supplier-made mods, and; 4) "autonomous" user mods that drift freely in the community. In the case of Half-Life 3 mods are of the first category, 7 are in-house made mods, 4 are supplier-made and 165 user's mods. As figure 3 below shows, within the Half-Life universe mods have now out-grown the original games. However, manufacturers benefit from mods since their platform sales increase as mods grow popular. Manufacturer supplied mods/levels are often initially the most popular because they are presented first and users have time to get good at them. If a game provides a modding option for users, user mods tend to increase in importance as the game gets older and can be very important after some months. User mods tend to refresh a game and extend its popularity. Half-Life came out in 1998. As can be observed from Figure 3, already in 1999 user mods had taken over. Especially Counter-Strike quickly increased its share of player hours online (the upper curve). So did Team Fortress. Both of these mods were user created and appeared as autonomous mods online, but were also both picked up by Valve in 1999. The main points of the figure are that user mods that were picked up by Valve (labeled CAT 1) outperform the three other categories by far, and further that "autonomous" mods (CAT 4) perform at the level and or even better than in-house made mods (CAT 2).

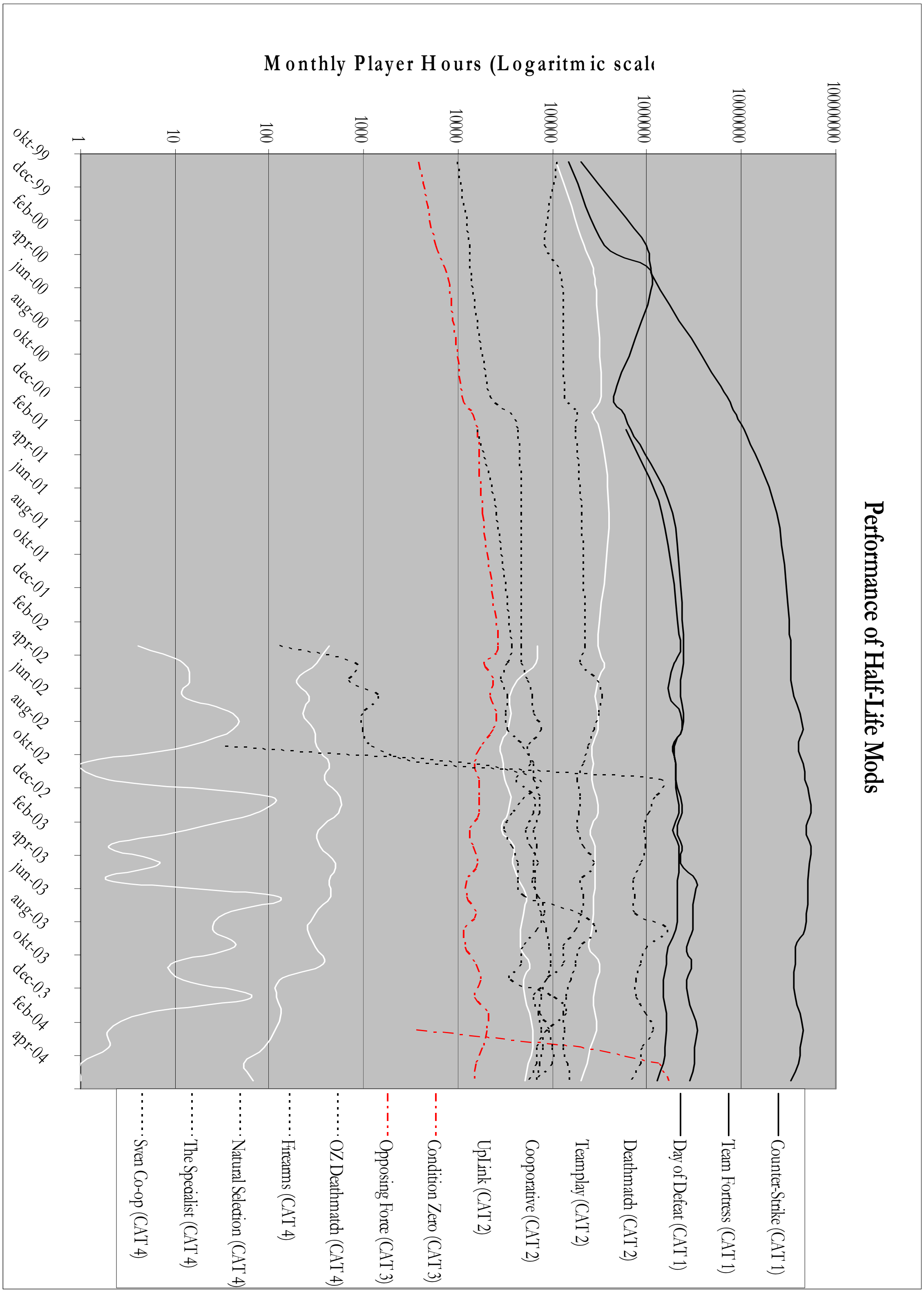

Figure 3: Performance of selected Half-Life mods (source: Csports.net)

As shown in Figure 4, although 98 million total player hours (March 2002 - May 2004) are still generated by the in-house made mods, autonomous user mods are performing at a total of player hours of approximately 403 million (all 165 mods counted), while user mods that were picked up by Valve remain is in it own group with a total of 12967 player hours in this period.

	"Picked Up" User mods	In-house Made Mods	Supplier Made Mods	User Mods	Half-Life Total
Active mods 2002-2004	3	7	4	165	179
Players hours 2002-2004 (in millions)	12967.25	98.05	43.35	402.64	13511.29
Share of total	96.0%	0.7%	0.3%	3.0%	100%
Players hours per mod 2002-2004 (in millions)	4322.42	14.01	10.84	2.44	

Figure 4: The activity generated by four categories of mods (March 2002 – May 2004) (source: Csports.net).

Besides illustrating the hit-driven nature of entertainment industries (Caves, 2000), the superior performance of Counter-Strike, Team Fortress, and Day of Defeat (CAT 1) also shows that users can be a source of products that make a success in the mainstream market.

The benefits in terms of sales of the basic platform derived from having users adding mod complements can be illustrated by the following example. In a typical scenario, even if a game is a mega hit, within eight to 12 months, it disappears from the store shelves. In the case of Half-Life, on the contrary, sales increased year after year. During the first year two million units were sold, in the second year, sales ramped up to 3.5 million units, and in the third year, sales were at 3.8 million units. In total, the entire Half-Life franchise has sold over 11 million units and made an estimated profit of Half-Life is $300 mill. US. Figure 5 below compares the estimated sales curve of a conventional blockbuster game with the estimated sales curve of Valve Software's Half-Life. It illustrates the extension of the product life of the Half-Life game propelled by the continuous production of new mod complements to it.

Another indication of the performance of the mods to Half-life is that, in 2002 it generated more player minutes than, for example, AOL Time Warner's viewer minutes and more than twice the amount of viewer minutes of the Top 10 TV show, "Friends". The number of player hours on Half-life mods in 2002 amount to more than Italy's total Internet the same year and Half-Life occupied approximately 35,000 servers and took up a total of 2% of the bandwidth globally during this period (source: Valve Software).

In sum, at the outset of product development Valve prepared its product architecture to allow modding. As the process of modding took place they discovered the strategies available to derive benefit from modding. Through his creation of Counter-Strike, the talented user Minh Le showed Valve the potential of selectively opening their product architecture to allow modding and the sharing of mods among users. What this story tells is that the wish of users to have modifiable products has basically "pushed" some firms in the industry towards strategies of modding. Essentially all firms would wish to be able to make all mods in-house and sell them to consumers. However, competition in the industry has lead firms to a search for a new strategy in which firms may profits at the same time as it complies with user-demands modifiability. Firms that specialize in games that allow modding have over time rolled their activities back to a more platforms development focused model, compared to firms that still seek to benefit by making expansion packs in-house.

The strategies resulting from modding

When modding can be organized as described above it gives rise to two distinct, but complementary business models, from which manufactures may benefit.

Business model 1: *User complements "drift" freely in the community and generate platform sales*
As shown, user mods can often achieve a high degree of popularity. Mods extend the life of the product. When users add mods to a given platform they enhance the value that consumers derive from owning the platform by providing for "mix and match flexibility" of that product and do so effectively because new complements become available for free. Under these favorable conditions user mods tend to refresh a game and extend its popularity. Mods are free to all consumers; however, consumers must still buy the platform to play the mod. The advantage to manufacturers is that a product platform can keep selling for a longer period when additional complement mods are continuously supplied. Therefore, the value of having a user community that produces complements for members' mutual enjoyment has a positive effect on the firm's sales of product platforms. The effect of modding will usually be observed only after a game has been out for a while. If a game provides a modding option for users, user mods tend to increase in importance as the game gets older and can be very important after some months. To achieve the effect of this strategy a manufacturer should not necessarily take action (apart from providing tools and technology), but rather remain passive and let users create and share complements to their platform.

Business model 2: *Acquire and integrate a complement in an upcoming product:*
The second business model available to manufacturers who provide a modding option for users allows them to make use of users' innovations in their own upcoming commercial products. The strategy is to find a promising mod, clean it up, and launch it as a new retail product. Since the IPR arrangement established by the firm does not give user innovators the right to own and commercialize their complements, the manufacturer is in a favorable bargaining position allowing them to integrate promising complements. This makes it possible for manufacturers to integrate and commercialize parts of or entire user created mod products. To achieve the effect of this strategy a manufacturers can monitor the user environment and chose the most popular or promising mods for integration in the product portfolio. Since mods can be judged promising or not on their past proven popularity it reduces the risk for the firm of commercializing mods that consumers do not want.

Discussion

The observation that user innovators create value is not new - users have been identified as sources of important innovations in industrial fields and in user communities related to consumer goods. Starting to explore how firms can appropriate (some of) the value created by users in a distributed innovation process is an attempt to extend the current knowledge in the field of a growing literature on user innovation. Further, by including "users as complementors" a hitherto unexplored area was also addressed of relevance to the literature on modular platforms as a way to organize product development.

The foregoing empirical section has shown that manufacturers can generate economic benefits by putting a chunk of their proprietary product into the hands of users for further development. To capture the value of users' innovations, manufacturers employ modularized product technology and toolkits for users that facilitate innovation on the levels of the product where such innovation processes are most beneficial to manufacturers. By coupling technological developments with an IPR arrangement that allows users to use and share complements, but not to commercialize them, manufacturers maintain a high degree of control over the complements made by users.

With this set-up in place, manufacturers have two options to exploit the innovations. They can employ a "hands-off strategy", letting the complements drift freely in the community and benefiting from the effect of the availability of free complements constantly fueling the demand for a given platform. As noted, manufacturers can also pick up complements and integrate them in new commercial products and sell them back to consumers. Manufacturers can thus make a profitable business from identifying and mass producing user-developed innovations or developing and building new products based upon ideas drawn from such innovations. Often manufacturers choose to exploit both of the two business models.

Thus, whereas modding and hacking activity is generally viewed as a source of negative spillovers (re the Digital Millennium Copyright Act) and thus as something manufacturers should protect themselves against, an innovative user community can be turned into R&D collaborators that create positive spillovers for the manufacturers of the original product. The modding process is beneficial to manufacturers under the condition that user innovation is facilitated and takes place in areas of the product where such innovation adds user value to the product and does not rob key business activities from manufacturers.

The business models described here are most likely to be realized when there is a significant overlap between manufacturers' interest in having a complement in a specific area of their product and the incentive of the user for working in that same area. The evolution of modding in the computer games industry indicates that such an overlap was present, but had to be realized by manufacturers in the initial phase. Inspired by (unauthorized) modding/hacking behavior of their product users, some firms in the computer games industry learned how to modularize their products for involvement by users and to offer key tools to users. Given the areas of the product in which users initially chose to work/hack and the specific tools they created it could be argued that they initiated the modding model. Product manufacturers later used this structure as a foundation for their own attempts at deriving benefit from the modding activities.

The manufacturer can derive great benefit from modding when users make innovations that manufacturers either are unable to make or find too costly to make because of difficulties of sourcing information from users. Modding thus offers value, when the information held by consumers is "sticky", that is, difficult to transfer from the users to the manufacturers (von Hippel 1994). Information on need is often very sticky. It thus makes sense for manufacturers to study their own products and locate the most intense need information intensive areas and then out-source that portion to users, as is suggested in the user innovation literature (von Hippel, 2001). Alignment of interest between manufacturers and users needed to realize the business model will often exist as user innovators will want to work to satisfy their own specific needs in precisely the areas that manufacturers will want to avoid working in due to costs related to sourcing and iterating sticky need-related user information. When users make the complements and when manufacturers are given access to user-developed prototypes, manufactures no longer require a deep understanding of user needs.

In a situation where modding has been adopted more broadly in the industry, the better the original product technology is prepared to allow users to fulfill their needs the more likely it is that user innovators will be attracted to making innovations for that particular product. Therefore, manufacturers adopting the modding model may compete on their ability to attract users to their platforms. This competition will not take place as in the conventional business-to-business platform model where the complementor calculates how much he can gain monetarily by building and selling complements to a specific platform. As users do not gain (monetarily) from innovation in this context they are attracted simply by the quality of the tools and product technology offered by manufacturers for serving their needs and desires. To achieve a profitable business model, manufacturers should focus on tool building and how to facilitate innovation and manage their community of users in order to motivate them to create valuable innovations. Firms may also compete on their abilities to monitor and identify promising mods of commercial value. Through this process of modding the manufacturer externalizes not only production costs when out-sourcing given tasks of the product development to users, but also the important risk of costly failure of innovation in the given field.

The effect of modding in a manufacturer's product market is that user innovations will tend to fill out existing niches in the market for complements. Theory (Henkel and von Hippel 2003) suggests that innovative users tend to fill out market niches of highly specific individual needs in the periphery of the market that remain unfilled by manufacturers. However, as shown by the example of Valve Software, users' complements do not necessarily find niches outside core segments of the mass-market. The case shows that users' innovations may often become much more popular than the original. It is attractive in itself for manufacturers to have peripheral niche segments and mass-market segments filled by users on the condition that such segments do not rob manufacturers of their own sales. In the present example, the manufacturer benefits from the additional content, which comes at no extra cost and which increases the amount of relevant content available in their product space. This content allows the manufacturer to capture a larger share of markets because he fully controls pricing of the platform and thus can compensate for potential losses arising from the fact that he is not active in the production and sales of complements by selling the platform at a high margin.

Under what condition(s), then, can users address the needs of final users better than manufacturers? Firstly, one may hypothesize that when users are interconnected - as in user communities - they tend to create innovations that not only reflect their own needs, but also reflect to some extent the norms of design and the needs of mod users. Secondly, when users' means and resources for innovation (for example access to technology and complementary skills) are equal or superior to those of manufacturers, user innovation will compete in terms of popularity with manufacturers within the specific areas in which they are allowed to innovate.

It is likely that users hold more accurate information than manufacturers, not only about their own needs, but also about more general community needs derived from the "insider market information" they gain by being "embedded" in the intense use environment. If user information is less sticky to other users, then in situations where manufacturers and users are equally equipped with state-of-the-art production technology such as toolkits and access to code, users may also have an advantage over manufacturers in terms of important information dimensions that are desirable for product development.

Tendencies towards users knowing more about the "real" demand may thus be strongest when users are interconnected, as they are in online Internet communities where information flows intensely between users of mods and user mod developers. This also means that the user community setting may be quite different from that of solitary user innovators and that the most promising innovations may come from users embedded in communities rather than from solitary users.

Challenges to the modding model

Innovations by users can be destructive to manufacturers' business, for example, when they make innovations that spoil the rules of the game. User developed cheat codes for multiplayer on-line games are developed as a form of competition among users. Cheat codes can be used to do the equivalent of cheating in card games, whereas the commercial success of the game is dependent in part upon its being fair. Thus, while manufacturers invest in enabling users' innovativeness, they also sometimes have to invest in stopping innovative behavior when this behavior destroys their product.

Another challenge to manufacturers' attempts to benefit from modding can arise if users go one step further in their efforts and create (and share) game platform technology. The key element of the modding business model presented is the protected core asset - the platform. Unlocking the platform would (as in most platform-based business models) lead to a disintegration of the business model in its present form. Therefore, the most credible nuisance to commercial-based modding business models would come from a potential high quality "open source platform".

Conclusion

Manufacturers can establish a process of user innovation and profit from the outcome by opening up their product to facilitate innovation on the part of users and combine this with organizing user communities. This paper has shown how manufacturers can create a highly advantageous situation if they can manage to encourage users to develop complements to their products. By offering a modular platform with additional tools to users they can facilitate the development of valuable complements by users that they can then benefit from 1) by increased platform sales resulting from the availability of many user developed complements to the platform, and, 2) by their ability to spot the best complements and integrate them (or parts of them) into future commercial products. In the innovation model represented by modding, manufacturers manage to internalize the benefits of complementary user innovations surrounding their product while at the same time externalizing the production costs and the risk of failure in the innovation process to users.

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