Placing Value on Community Co-creations: A Study of a Video Game 'Modding' Community

Leo Poretski
University of Haifa
Haifa, Israel
lporetsk@campus.haifa.ac.il

Ofer Arazy
University of Haifa
Haifa, Israel
oarazy@is.haifa.ac.il

ABSTRACT

Firms developing software – and in particular, video game producers – seek to leverage the community of users/developers in enhancing product offering and increasing sales. Despite the practical importance of this phenomenon, to date there has been very little research on the actual added value derived from community-created modifications (i.e. 'mods'). The objective of this study was to quantitatively assess the effectiveness of firms' efforts to induce community co-creation activity as a means to increase product sales. Our empirical investigation focuses on producers of video games and their user/developer 'modding' community. An analysis of 64 games revealed that when firms successfully engaged the modding community, the 'mods' produced by community members contributed to increased sales of the base product. Implications for research on open innovation and for practitioners are discussed.

Author Keywords

Open innovation; Digital culture; Software development; Game development; Game modding;

ACM Classification Keywords

Categories and Subject Descriptors: H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces---Collaborative computing, Theory and models;

INTRODUCTION

Innovation is a process by which technological novelty is transformed into a commercial product [40]. Traditionally, firms manage innovations by conducting their own research and development activities strictly in-house. The process by which a firm combines all stages of transformation of knowledge into an end-product within its own boundaries is referred to as the "Vertical Integration model of innovation" [9]. However, the Vertical Integration approach becomes increasingly burdensome for companies working on the

creation of software products. Given the diversity of the technologies and know-how integrated in software development, producing and maintaining the knowledge base strictly by means of internal research and development activities is a costly and risky enterprise. Thus, companies may choose to adopt the *Open Innovation* approach to the management of research and development [8], whereby various agents in the firm's external environment collaborate and share technologies and knowledge, thus maintaining a continuous influx of innovations [5,17,20,26,40].

The development of video games provides an especially interesting case for studying open innovation practices within the software industry. Game production is a particular branch of software development, where designers, writers, artists, and software engineers combine their skills to produce an integral interactive experience. Given the ever-increasing scope of modern video games, production through vertical integration is very difficult, even for large game development firms hiring hundreds of professionals. To reduce costs and risks associated with the development, many of the leading game-developing firms have opted to involve external agents – namely, online communities of game-fan programmers – in the development efforts, similar to the hybrid models that have become prevalent in the domain of open source software development [29,30]. The value of such collaborative work is that it allows for the integration of various viewpoints and the incorporation of participants' extensive experience and expertise, thus improving the quality of the innovation without incurring additional costs [1] .

As part of open innovation practices in the gaming industry, once the game is released, contributors devote their time and efforts to produce alterations and additional content for the base software, i.e. 'mods' (short for modification). Mods may include new game models, textures, sounds, game mechanics, or even complete overhauls of the commercial product. Contributors are called 'modders' and the group - a "user/developer community" or "modding community" (these two terms are used interchangeably throughout this paper). According to the research by Postigo [23], a standard large modification for the top action-adventure game requires over a 1,000 hours of work and it is estimated that, overall, modders collectively contributed more than 39,000 work hours to the development of mods for the top seven games in the action

genre. The enhancements made by modders, thus, extend the scope and innovativeness of the game, making it more attractive to players. As a result, modding has the potential to increase the sales and the shelf life of the base product [16]. Sales of video games tend to spike at release time (fueled by producers' marketing efforts), and then plummet shortly after. Modding, thus, may contribute to an increase in long-tale sales, keeping gamers interested in the newly introduced mods. Given our interest in the value provided by modding communities, our analysis focuses on video games' long-term sales (when modding could have an impact).

The available empirical knowledge regarding the relationship between a firm's development efforts, a community's co-creations, and end-user consumption is relatively scarce. There are several known studies that explored the interactions between a firm and a co-creator community (e.g. [2,6,33,41]); however, their examination of these relationships typically comprises case studies and analyses that focus on common practices within the industry. Our aim is to empirically demonstrate the ways in which the open innovation approach benefits firms that involve an external community in the process of product development.

We show the manner in which the firm's support of the community encourages modders' creativity and productivity, and ultimately contributes to the product's financial success. We developed a theoretical model of the relationship between the following three key parties in the video game industry:

- The firm producing the software,
- The user/developer community, and
- The consumers of the final product.

We collected data on the 64 video games that are currently active in the market. Using this sample, we examined (1) how the firm's actions may increase productivity of the user/developer community, and (2) how the increased communal-production output increases the end-users' consumption of the base product.

In the following section, we review the existing research on the relationships between video game producers, modding communities, and game consumers (or gamers). Next, we proceed to develop key concepts and build a theoretical model of the relationship between these parties. Statistical analyses are then performed to test the proposed model. In the final section, the findings are reviewed and discussed.

FIRMS' SUPPORT FOR USER/DEVELOPER MODDING COMMUNITIES

The underlying theme of the research conducted on the topic to date emphasizes the companies' potential to exploit the free labor of users/developers, by manipulating the activities of those developers, and then reaping the products of their labor-intensive creativity without giving back

[15,16,37]. Kuklich [16] defines the work of modders as a "precarious labor", or "playbor" that firms often seek to exploit in an effort to enhance their offerings at little or no cost. If firms were to compensate the creators of 39 large mods, they would have had to pay between 10 and 30 million dollars in wages [23]. Moreover, typically, modders have to conform to license agreements, where the intellectual rights of the modifications made by them are transferred to the firm [2,16,24,32,36]. However, modders are not naïve: they recognize the value they create for the company and often act to promote their interests [2]. Modders are able to influence the game production process by negotiating involvement and by participating in the production network [2].

How can the firm-producer communicate its willingness to collaborate? According to Banks and Humpheys [2], the firm should establish a social platform for ongoing communication with the community, and flexibly coordinate their activity and negotiate commercial rights. Birkinbine [6] demonstrated the idea of firm-community collaboration by referring to the case of OpenOffice software. A flexible negotiating platform was established for the benefit of the company's employees and the community's representatives, through which they could jointly govern the project. Engaging the modding community in the project allowed Sun to generate knowledge spillovers and incorporate the innovations accumulated in the OpenOffice into their own software. However, when Oracle acquired Sun Microsystems, it tried to directly control the community's activity. The members of OpenOffice community forked the project, by creating a new product (Libre Office) based on the former program.

Postigo [25] provides an example from Epic Games: the company released its set of developer tools to support the work on modifications of all games made with the firm's game engine technology. The toolkit was available for free on the company's site, stipulating a 99$ license fee if the modification was intended for sale (where the fee covers extensive technical support). This is an example of the open innovation approach applied effectively. By making the in-house technology available to external agents, the company externalizes innovation activity and makes knowledge spillover possible. By doing this, the industry signals its openness to a participatory culture and its readiness to collaborate with the user/developer communities. Kuklich [16] describes the case of Valve corporation, which in 2002 launched the Steam platform, originally intended to support the distribution of mods for its own games. Since then, the Steam platform has grown to support the games from all major publishers and independent developers. Recently, Steam has extended its scope, by including the Steam Workshop modding platform.

Practically supporting the community in the manner described may be the most effective way to signal the company's openness and to attract a devoted user/developer

community. Creation of specialized tools for modders to work with, such as modification software development kits (SDKs), toolkits, and game editors, as well as providing modding tutorials or holding modding discussion groups, may boost participation of user/developers and increase the value they produce. However, everything comes at a price. As was described earlier, the majority of firms reserve the ownership of the user-generated content. This has become a major point of conflict between the commercial entities and the user/developer community. Prior research [2,16,24,32,36] elaborates on this issue, by analyzing End-User License Agreements (EULA) that users must sign (or agree to) prior to launching any game. The majority of agreements are very restrictive and often explicitly prohibit the creation of user-made modifications without an official written permission from the copyright owners. When the creation of content is not prohibited, the creator is typically obliged to irrevocably transfer to the firm the license for the use and commercial exploitation of modifications.

To conclude, collaborative production of knowledge requires firms to support open organizational management structures and signal their openness towards the user/developer community. There are cases which have demonstrated that practically supporting the community by sharing internal technologies and knowledge has been beneficial to both the user/developer community and the commercial organization [16,25]. Despite this, companies still try to control the activity of voluntary amateurs, by restricting their legal rights [2,16,24,32,36]. However, there is a paucity of documented empirical evidence regarding the relationship between a firm's community orientation and the community's productive output, with the exception of a few well-known cases. In our study, we present additional empirical evidence demonstrating that through their support of the modding communities, firms are able to induce community co-creation activity, resulting in mods for its games.

THE COMMUNITY'S CONTRIBUTION TO PRODUCT'S SUCCESS

Participatory practices of game modding are beneficial for both developers and users alike. When viewed in the context of open innovation, the knowledge spillovers generated by the community output support an ongoing flow of innovation to the firm. They generate additional opportunities that may subsequently be realized in commercial products [38]. The consumers enjoy a diversified experience and extended functionality of the product for little or no cost [30], and overall sales increase.

The benefits that the commercial firm reaps from the user/developer activities are detailed in a variety of studies on the modding phenomenon. First, given the costs of modern video games, the community's added value is attractive to the firm, due to its cost reduction potential [2]. Second, the community is likely to take creative risks that otherwise might be financially prohibitive for the firm

[15,16,23]. This creates additional opportunities from which the firm can profit. The most successful mods may later be developed and monetized as full-fledged commercial products [15]. In short, a community of users/developers serves a wide number of roles in the game development world: innovators, testers, programmers, designers, and managers – all of whom do the work voluntarily. The output provided by the user/developer community produces significant economic value, attracting an increasing number of consumers [15,16,34], [22]. For example, Linn [21] described a case of Portal 2, a video game by Valve corporation. After the release of the modkit for the game, the number of players increased 20-fold.

Despite the wide acknowledgement regarding the significant ways in which user/developer efforts contribute to the success of the game, the scholarly community's empirical investigation of these effects remains limited. To the best of our knowledge, there have been no attempts to provide quantitative evidence of the effect of the community's output on games' popularity and commercial performance. The evidence exists largely in the form of case studies and qualitative analyses of modding practices. Our study aims to fill this gap, by investigating the causal relationship between the firm's support for the modding community, the community's production of mods, and the commercial success of the firm-produced games.

OUR PROPOSED CONCEPTUAL MODEL

In the scope of the current study, we tested the model of the relationships among the three major parties participating in the games' life cycle, as illustrated in Figure 1:

- Firm producer of the software,

- User/developer modding community,

- Consumers of the game.

We propose a mediation model that explores whether the game-producing firm's effect on base-product sales is mediated by modding activity. Namely, our conjecture is that a firm can act to enhance product sales by supporting the modding community, which in turn produces mods that affect base-product's sales. Our model controls for a series of exogenous variables, including product-related metrics, the firm's business model, and sales in prior period.

METHODOLOGY

In the current study, we used the data from the game modifications site *Nexus Mods*[1] to sample the activity of user/developer community. Nexus Mods is the largest modding community on the Internet, featuring modifications for over 250 major PC games. The community consists of over 10,000,000 registered users and adds more than 1,500 new mods to its databases each month. To estimate sales' volume (i.e. the number of game

---

[1] http://www.nexusmods.com

purchasers), we used the data provided by Steam[2], the largest digital distribution platform for PC games. Steam enables users to buy games online through its Digital Store and directly download and install the games purchased on the user's computer. In 2013, Steam accounted for 75% of all game purchases on the Internet [11] and, as of 2015, Steam has more than 125,000,000 active users. Sales' figures were based on the 3-month period from January to April, 2016.
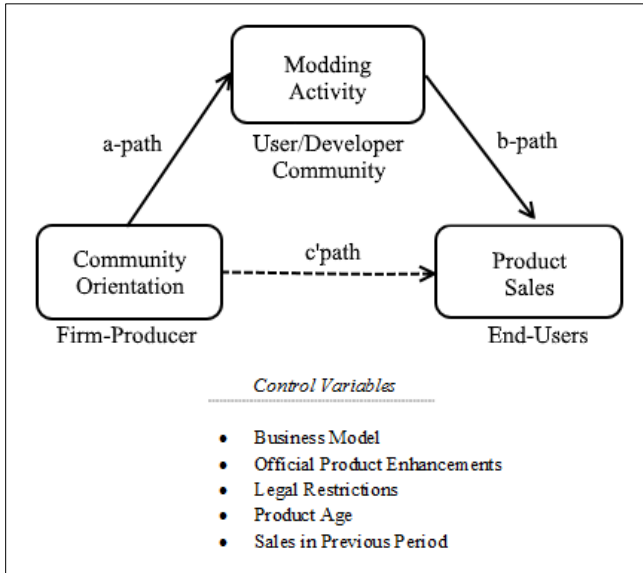
Figure 1: Our proposed model of the relationships between the firm-producer, the user/developer community, and the end-users of the base product

Sampling Procedure
For the purpose of this study, we recorded all games that were sold on Steam and had mods available for them on Nexus Mods prior to January 2016. We centered our investigation on current games, limiting our study to games that were released in the six year period prior to January 2016 (when we started recording sales). We excluded older games (released before 2010), as fluctuations in the consumption of games at the 'decline' stage of their life cycle are often affected by promotional giveaways, incompatibilities with the current generation hardware, and outdated visual and design approaches. Altogether, we recorded 91games on Nexus Mods in this period.

We excluded from the sample games for which the official purchasing figures were not representative of overall consumption. Namely, we did not include massive multiplayer online games (e.g. World of Warcraft or Guild Wars), session-based competitive games (e.g. Counter-Strike, League of Legend), or the games distributed according to the free-to-play scheme that offers a

subscription-based economic model (e.g. World of Tanks)[3]. Finally, we did not account for games with a restricted geographical distribution. Applying these filters left us with 64 games: primarily single-player offline computer games that are released by publisher-sponsored or independent producers.

Statistical Approach
We employed the regression-based multiple mediation approach proposed by Baron and Kenny [3] to test the relationship between our variables of interest. We used a bootstrapping resampling method to account for the non-normal distributions of the dependent variable (see details below). Specifically, we tested whether *modding activity* mediated the relationship between the producer's *community orientation* and *product sales*. According to this procedure, for mediation to take place, two paths need to be statistically significant (please refer to Figure 1):

- "a-path": the effect of a firm-producer's community orientation on modding activity; and

- "b-path": the effect on modding activity on product sales

A complete mediation occurs when: (1) "c' path" - the direct effect of the independent variable (in our case, firm's *community orientation*) on the outcome variable (*product sales*) – is statistically non-significant, and (2) the combined effect of "a-path" and "b-path" (referred to as "c-path) is significantly stronger than the "c'-path". We used Sobel's method [31] to test for complete mediation.

Measurements

Dependent Variable: Product Sales
Product sales were measured through the number of units officially purchased or acquired by other means (such as giveaways, lotteries and presents) on the digital game distribution platform *Steam* during the period from the first week of January to the first week of April, 2016. Data were gathered using the information publicly available on the Steam data aggregators SteamDb[4] and SteamSpy[5].

Independent variable: Firm's Community Orientation
A firm's *community orientation* was estimated based on the extent to which the firm-producer provides practical support to the modding community:

- Issuing official software development kits, or other modification tools; and

- Providing modding guides, tutorials, and discussing spaces on the firm's official site (or on web forums dedicated to the game).

---

[2] http://store.steampowered.com

[3] Those games are usually available for free, but players are encouraged later to purchase subscriptions, premium accounts, and in-game items, in order to gain a richer experience of the game.
[4] https://steamdb.info
[5] http://steamspy.com

Community orientation was operationalized as a binary variable, where 0 indicated absence of support, and 1 indicated presence of the official modkit, tutorial, or guide.

Mediator: Community's Modding Activity
The *modding activity* of the user/developer community was measured based on the number of mods available for the game. For every game, we collected the data about the overall number of distinct mods available on the Nexus Mods site, from the time the game was launched (2010 or later) up to our mods cut-off date of December 31, 2015.

Control Variables
To control for exogenous factors, our model included a series of control variables relating to both the product and the producing firm.

Product age was calculated as the number of months passed from a game's release until the modding cut-off date (December, 2015). This is a particularly relevant control variable as product age can influence a game's sales (please refer to our earlier discussion of the effect of product's lifecycle on sales). In addition, product age reflects the duration available for modding activity, and thus is likely to affect the number of mods created by the community.

Official product enhancements. Game producers often make available additional downloadable content (DLC), including game extensions, new models, sounds, and game mechanics. These enhancements to the game may be provided either for free or for a charge; regardless, they are not mandatory downloads required to play a game and, therefore, may be considered 'official mods'. A game's official enhancement count was measured as the number of distinct content packages issued for the game by the producing firm from the game's launch until the end of 2015[6]. The information regarding official DLC was obtained from publicly available information sources, such as developer websites, game wikis, and information on Steam. For the purpose of the current study, we did not differentiate between enhancement types (features, models, sounds, challenges, levels, mandatory software patches, updates or extensions), or between free and paid DLCs (as long as they were officially offered by the firm). DLCs available exclusively for "remastered" or "definitive" editions were excluded from the analysis (in cases when older games are redesigned or up-scaled for a new generation of game hardware). Also excluded from our study were modules that were only available as a bonus that was given exclusively to those ordering a game prior to its release.

Licensing restrictions. Producing firms often place licensing restrictions on games, in order to limit modifications to the base product, as well as on the creation and distribution of user-generated content. Such restrictions directly affect the user/developer community's ability to produce mods. Commonly, user rights, legal restrictions, and obligations are detailed in the EULA. The standard industry practice is for EULAs to prohibit consumers from commercializing add-on content for a game, while providing game publishers with an exclusive, royalty-free license to commercially exploit the content created and distributed by users [1]. Users have to accept the EULA terms prior to launching the game on their computers. To estimate *licensing restrictions*, we manually analyzed games' EULAs seeking to distinguish between two general approaches: (a) explicitly regulating the creation of fan-made content and ownership rights, as opposed to (b) not engaging directly in regulation of all associated rights. *Licensing restrictions* was then coded as a binary variable based on the category best describing the game's EULA.

Business model. Our operationalization of the firm's model for developing, publishing, and distributing games distinguished between the following schemes common in the industry: (1) employing the services of an external publisher; (2) selling an early prototype (or "build") of the game (usually at pre-alpha stage) for a reduced price, and simultaneously providing frequent updates to the product (i.e. early-access title)[7]; (3) independent development, marketing, and distribution of the game by the producing firm and (4) crowd funding, when the producing firm seeks to finance the development of product (fully or partially) through public micro-investors. *Business model* was coded as a nominal variable, representing the four models described above.

Product sales in previous period. Product sales capture the value created by both the producer firm and external parties (namely, the modding community), and thus is likely to affect sales in subsequent period. Our model's outcome variable measures sales in the period January-April 2016; hence, our control variable of *sales in previous period* included all product sales up to December 2015.

RESULTS

Descriptive Statistics
The descriptive statistics for our model's variables are described in Table 1 below. The distribution of the games according to their product age is shown in Figure 2. As shown in Table 1, both the mediator (*modding activity*) and the outcome (*product sales*) variables show a skewed distribution, with many games exhibiting high *modding activity* and *product sales*, and only a few showing low values. Please refer to Figures 3a and 3b for illustration.

The number of community-generated mods ranged between 1 and 7,193 mods, with a mean of 238 mods per game. Sales volume at the 3-month period ranged between 1,501 and 532,050 units, with mean of 97,373 unit sales. Of the

---

[6] Our count included DLCs that were later incorporated into releases of the base product.

[7] Sales for this model were recorded from the release of the game's earliest "build".

64 games in our sample, 24 were provided with modding support for the user/developer community. Products' age ranged between 3 and 65 months, with a mean of 31 months (see Figure 2).
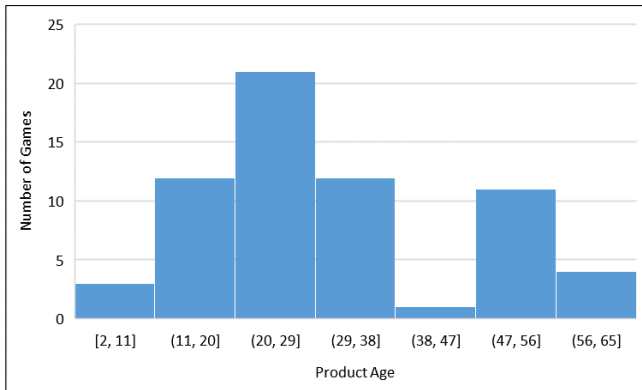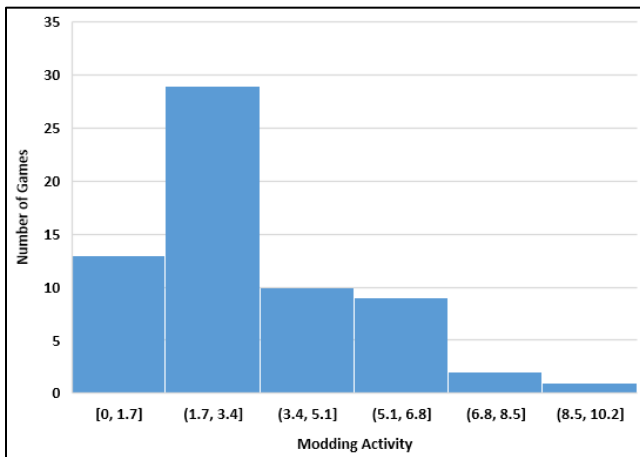

Figure 2: The distribution of games in our sample according to their product age (months passed since game release). Square brackets represent the range of product age for each of the columns.

Results for the Testing the Mediation Model

Before analyzing the model's paths, we tested for multi-collinearity. The correlation coefficients between the model's variables were below 0.5, with the exception of the correlation between the *product age* and *product sales in the previous period* (0.52). Analysis of the Variance Inflation Factor (VIF) showed that the values for all variables were well below the threshold of 2 (highest value was 1.6). We concluded, then, that our model's results are not affected by issues of multi-collinearity.

The results of the mediation analysis [3] demonstrated that *modding activity* fully mediated the relationship between a firm's *community orientation* and *product sales*. That is, a firm is able to affect sales of the base product by enticing the user/developer Nexus Mod community to produce mods (by providing an official software modification toolkit or
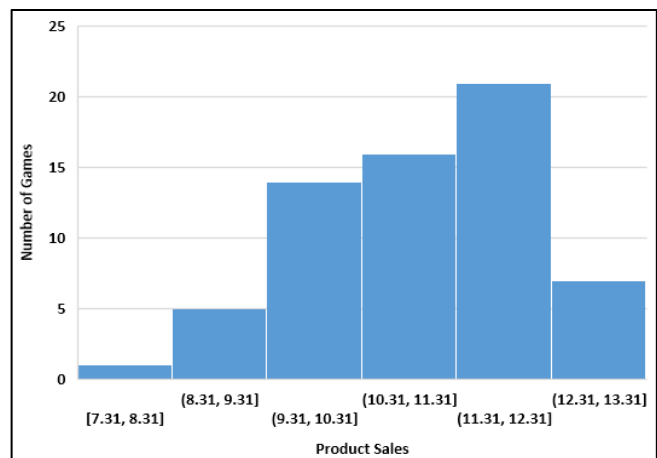
preparing guides, tutorials, and other educational materials devoted to modding the product), which in turn enhance product offering and increase consumption of the base product on the Steam distribution platform. The results

Variable	Mean	Median	SD
Community orientation	0.38	0	0.49
Modding activity	238	14	942
Product sales	97373	65968	102883
Product age	31	26	16
Official prod. enhncmnt	4.60	1	9.86
Licensing restrictions	0.06	0	0.25
Sales at previous period	1427103	1024857	1363430

Table 1. Descriptive statistics

show that both the model's a-path (independent variable => mediator) and b-path (mediator => dependent variable) were positive and statistically significant (*p* values of 0.02 and 0.04, respectively). The direct effect of *community orientation* on *product sales* (c'-path) was non-significant. An adaptation of Sobel's test [31] for the bootstrapping procedure (using 2,000 resamples), which adjusts for non-normal distribution of the dependent variables, had confirmed the significance of the mediation effect with a 95% confidence level. Together, these findings show that modding activity fully mediates the relationship between independent (producers' community orientation) and dependent (product sales) variables. Please refer to Table 2 for details of these results.

A summary of the results suggests that when the firm supports the modding community, the average increase in sales per game (selling at 97,000 units) would be in the sum of roughly 15,000 units (calculation: a firm's community orientation generates on average 560 mods, each contributing approximately 27 units of sales for the base product). Thus, the value proposition for supporting the modding community is a 15% increase in sales. Of course, the results are not that simple as other factors influence sales, as we discuss below.

Figure 3a. The distribution of modding activity for the games in our sample, log-transformed. Square brackets represent the range of modding activity for each of the columns.

Figure 3b. The distribution of product sales for the games in our sample, log-transformed. Square brackets represent the range of product sales for each of the columns.

Path	Type	Variables and Relationship	Coefficient	df1	df2	SE	t value	p value
a path	Independent variable => Mediator	Community orientation => modding activity	559.85	7	54	232.20	2.41	0.02
b path	Mediator => Dependent variable	Modding activity => product sales	26.65	7	54	12.75	2.08	0.04
c' path	Independent variable => Dependent variable	Community orientation => product sales	-33,905.00	7	54	23,090.37	-1.47	0.15
Partial effects	Control Variables => Dependent variable	Product age	-2,552.77	7	54	880.89	-2.90	0.01
		Official product enhancements	1,093.90	7	54	1,221.06	0.90	0.38
		Licensing restrictions	-83,666.94	7	54	47,903.13	-1.75	0.09
		Business model	26,102.55	7	54	12,985.00	2.01	0.05
		Sales at previous	0.04	7	54	0.01	4.18	0.01
Adjusted R square = 0.30								

Table 2. Results for the regression-based mediation model

A few of the control variables exerted statistically significant effects. *Product age* had a significant negative effect on sales ($p = 0.01$), indicating that products that were released close to our study's cut-off date of December, 2015 (i.e. still at their 'introduction' stage of the lifecycle) recorded high sales in the period that followed (January-April, 2016). *Business model* showed a significant effect ($p = 0.049$), suggesting that the way in which a firm chooses to develop and distribute its products affect sales. Looking closer at the various *business model* categories, we found that crowdfunded games were associated with highest sales volumes. *Sales in the previous period* exerted a highly significant (positive) effect on the January-April 2016 sales. This is expected, given that sales at previous period capture the value created by the various entities. The fact that paths in the mediation model remained statistically significant even in the presence of this control variable demonstrates the robustness of our findings. We also note that the effect of *licensing restrictions* was negative and borderline significant ($p = 0.09$). Waiving the legal restrictions on user-generated content may help foster product sales. Finally, our results show that the mods produced by the firm (i.e. *official product enhancements*) had a small and non-significant effect on sales.

DISCUSSION
In this study, we investigated a series of relationships between three distinct parties interacting in the domain of computer and video games:

- The firm producing the base software,
- The user/developer modding Community,
- The end users (or consumers) of the base product.

The primary finding from our analysis is that the user/developer community's *modding activity* fully mediated the relationship between a firm's *community orientation* and *product sales*. Below, we briefly summarize our findings, placing them within the context of earlier works in this area, and discuss our study's novelty and contribution.

A Firm's Community Orientation Influences Modding Activity.
Findings from our analysis show that a firm – by offering an official modification toolkit, modding forums, guides and tutorials – is able to encourage the modding community's co-production activities. Making modifications to computer games is different from other co-creation practices in the digital economy, such as managing a blog or rating a product on Amazon. It requires professional skills in areas such as programming, game design, and 3D modeling [34]. Depending on the game being modified, modders may also need to apply their knowledge in history, physics, and other fields, as well as to have good writing skills (in cases when the mod involves the development of a new story). As demonstrated by Postigo [24], modding activity takes an immense amount of time. Many modders work four or five hours a day, encroaching on their personal free-time.

A firm's support of the community goes a long way to promote the voluntary engagement in such taxing activities, as this type of support is highly meaningful for modders. Our findings suggest that an effective means of supporting the community is by releasing SDKs, modding toolkits ('modkit'), and making specialized knowledge available. Prior studies have described the cases of Valve corporation and Epic Games, which released software that empowered modders [15,24]. Birkinbine [5] described how opening the code and supporting the community helped Sun Microsystems to develop the open source MySQL database management system. While these prior studies were useful in providing anecdotal evidence of a firm's ability to influence community activity, such success stories did not provide sufficient evidence to generalize this finding to the broader practice of community empowerment. The novelty, and thus the contribution, of this study is in providing quantitative evidence, demonstrating that a firm's community orientation has a significant effect on the co-production activity of the user/developer modding community.

Modding Activity Influences Product Sales

Community-generated mods were found to be a significant predictor of base product sales. The more mods were produced for the game by amateur developers, the more people bought (or acquired by other means) the base game on the Steam distribution platform over the three-month period between January and April of 2016. It should be noted that this effect contrasts with the non-significant effect that official firm-produced mods had on sales.

Theorists and practitioners alike have long recognized co-creation practices as beneficial to a firm producing knowledge-based products. Much in line with the open innovation principles proposed by Chesbrough [8], the creativity of external agents results in an influx of commercial innovation. It is nearly impossible for a single firm to generate such an amount of knowledge and innovation by relying entirely on internal resources. Raymond [26] put it simply: "it is often cheaper and more effective to recruit self-selected volunteers from the Internet than it is to manage buildings full of people who would rather be doing something else". Thus, external volunteers are more innovative, because they are intrinsically motivated; in Benkler's [3] terms: the advantage of peer-production is in the "improved identification of human creativity".

Prior research on the game industry has pointed to several concrete benefits that a modding community can provide:

- Production cost reduction [11,12],

- Time-to-market: the ability to release games quicker (often in less polished form) [15]; and

- Contributions to consumption of the final product [12,20,21].

Here, we focus on one key benefit: an increase in the sales of the base product (namely, long-term sales, after the initial surge associated with product's launch). Video games are commercial entertainment products, not unlike mainstream movies or books, and thus games' success is commonly measured in the game industry by sales figures. Viewing the game industry through the lens of the open innovation framework, we note that a key benefit of this approach is the promotion of the firm's own proprietary products [8]. Video games are particularly suitable for open innovation, and game producers can benefit immensely from knowledge spillovers and innovations produced by the community of user/developers. Namely, modifications extend the game content and provide a richer user experience, consequently generating significant economic value [14].

The value of modding is best exemplified in cases where community-produced mods become so popular that the firm decides to purchase the mod and convert it into a fully-fledged commercial product. A noticeable example of this firm-community symbiosis is can be found in the Counter-Strike mod, originally a community-produced modification to the popular first-person action game Half-Life (by Valve Corporation). Recognizing this mod's potential, Valve then purchased it and invested heavily in its further development. Currently, the third generation of this game, titled 'Counter Strike Global Offensive', is among the most popular games in the genre of competitive first-person shooters (over 500,000 players daily, according to the Steam Statistics aggregator SteamSpy[8]).

Research in the area has documented a few success stories demonstrating the value of modding. However, there is a paucity of solid evidence regarding the positive influence of modding activity on games' commercial success. Our study provides solid evidence that community-generated mods significantly affect games' sales (in contrast to firm-produced 'official mods' that – in the presence of our model's control variables – did not impact sales). To the best of our knowledge, this is the first study to quantitatively demonstrate the commercial value provided by user/developer modding communities.

First-Hand Experience with the Games from Our Sample

The analysis of the mediation model described above has identified the factors driving modding activity, and consequently unit sales. To gain a deeper understanding of the characteristics of games that attract modders and as a result demonstrate a surge in sales, we complemented the statistical analysis with a more direct personal approach. We began by identifying the games in our sample for which our model's paths – a-path and b-path – showed the weakest and the strongest effects. We then played each game for a couple of hours, and complemented our experience with a non-systematic examination of the game discussion forums on publicly available information sources (such as Gamefaqs[9], Reddit[10], and Gamespot[11]). The following is a description of the insights learned through these personal experiences.

When examining the games that failed to attract modding activity, what stood out was games' linearity and closeness. We found that these games were rather small in scope, providing a self-sufficient experience; it seemed as though they were designed for a one-time use. Similar to a movie experience, where the viewer does not affect the storyline, when playing these games, we were placed into a fully developed and in this sense "closed" environment (pre-determined by the firm's designers) and then were directed along a fixed linear narrative. Two examples of such games are 'Remember Me' (by Dotnod Entertainment) and 'Undertale' (by the independent developer Toby Fox). Our understanding is that "closed" and "linear" narratives do not attract modding activity, simply because there is no need

---

[8] http://steamspy.com

[9] http://www.gamefaqs.com/

[10] https://www.reddit.com/

[11] http://www.gamespot.com/

for such activity, as the games provide users with the intended experience.

In contrast, we also identified a subset of games for which our model's paths – the influence of the firm's community orientation on modding and the effect of modding activity on product sales – had the strongest effect. This subset included the following games: 'The Elder Scrolls' game series (by Bethesda Softwork), 'Dying Light' (by Techland), 'Dragon Age: Origins' (by BioWare), 'The Witcher 3' (by CD Projekt RED).

In stark contrast to the less-modded games, we noticed that games that attract modders were designed to provide a modular user experience, offering massive feature-rich, non-linear virtual environments. These vast fictional worlds were peppered with various items, events, and non-playable characters, presenting a variety of quests to be taken. Games in this subset afford players an epic, open-ended journey, where the user is free to determine the pace with which the game unfolds.

Our understanding is that the open-ended game design invites modders to add additional content in an appealing and organic manner, without interfering with the overall flow of the game. The user/developer can simply add a single new quest, item, or story content, without affecting the game's structure. Such modular game design promotes an ecology of mods and a collaboration between modding teams. Modders can (and often do) combine and recycle resources from different mods, building one mod on top of another and organizing them within separate projects.

In experiencing the games in the second subset, we used the available mods and felt that they greatly enhanced our gaming experience. For example, with the help of mods, we were able to transfer the medieval battle simulator 'Mount and Blade' (by Talewords) into the 'Game of Thrones' universe (by George R.R. Martin), enhancing the game with exciting intrigues, plots, and battles. Other gamers echoed our experience; for example, an excited player wrote on the game's Reddit discussion thread: "You'll get your money's worth for the game itself, then again ten times over on mods".

We also noticed that games which are modded most are those that explicitly invite modding. For example, one of the leading game producers, Bethesda Softworks, which developed the open-world fantasy-role-playing epic 'The Elder Scrolls: Skyrim', publicly released the internal creation kit, which had been originally used to develop the game, to the modding community. The firm also hosted wiki and community discussion forums devoted to the modding of their product. A non-systematic review of the Reddit discussion forum dedicated to the Skyrim game indicated gamers' enthusiastic reaction. For example, one

player commented: "There is no reason to play vanilla[12] [Skyrim] in 2015" and "When you mod and start a new game, it feels like a whole new game". A similar sentiment was expressed on alternative game-dedicated online resources. For example, a player at the Gamespot gaming online news site indicated that the mods supply a significant enough motivation to purchase a PC version of a game, rather than a console version which does not support modding: "You owe it to yourself to try out all the great mods that the community has put out there for everyone. :) Long story short, yes, the mods are absolutely worth getting the PC version of the game if your computer can handle it".

A vivid account of a firm's ability to entice a modding community to engage in co-creation for its products can be found by comparing two similar games: the open-world fantasy RPG 'Two Worlds' (by Reality Pump Studios; released in 2007) and 'TES: Oblivion' (by Bethesda Softworks; released in 2006). We chose these two games because of their remarkable similarity in terms of their non-linear structure, fantasy setting, and amount of content in the base version of the software; however, the games differed in one fundamental respect: the firm's community orientation. The former was for the most part closed for modding and recorded no activity on Nexus Mods; in stark contrast, the latter game provided the user/developer community with practical support in the form of modkits and guides, and consequently enjoyed the backing of a large community of modders. Interestingly, it also recorded significantly higher sales figures.

An additional insight was yielded by reviewing games' end-user license agreements (EULA). This inquiry suggested that another way for a video game-producing firm to promote modding is through the elimination of licensing restrictions or even the explicit protection of modders' rights. For example, the EULA of the publisher CD Projekt RED (designers of the 'Witcher' game series from our sample) includes the following statement about ownership in their user agreement:

> *"As far as we and you are concerned, you own any User Generated Content you created but we need you to give us certain rights over it so that we can actually transmit it through CD PROJEKT RED games and services."*

It is important to note that while firm producers can encourage modding activity (and indirectly product sales) by removing licensing restrictions, producers still strive to maintain their status as a privileged regulator of mods' distribution. The fine balance between granting and reserving legal rights in the video game industry is an exciting research area that warrants future work [15].

---

[12] In video gaming industry, the term "vanilla" refers to the game's initial version, stripped of enhancements.

Practical Implications

Beyond the contribution to research in the field, our findings also have practical implications. Namely, results from our study highlight the potential value of open innovation in the video game industry. In particular, we encourage managers of video-game producing firms to provide practical support for the modding community: sharing access to information, providing technological tools for communal production, and establishing the social platform for collaboration. We also urge game producers seeking to leverage the user/developer community to design modular, open-ended, non-linear, games that naturally lend themselves to modding. Our findings regarding a game's licensing restrictions imply the need for the corporate sector to review its attitudes toward the legal rights related to modifications created by the user/developer community.

CONCLUSION

In this study we employed a quantitative method in the analysis of 64 video games, seeking to enhance our understanding of the relationships between key entities in the market of video-game software: the producing firm, the user/developer modding community, and the end consumers. Scholars have alluded to the potential value of open-source communities and a few earlier case studies were able to describe settings in which this potential was realized. However, to date, the practical wisdom of firm-community game co-creation was no more than an unproved myth. Our empirical analysis provides solid evidence for the value added by game modders.

Notwithstanding the contribution of this study, our investigation suffers from several limitations which we hope to address in future research. First, some of the measures included in this study do not fully capture the relevant content domain. For example, in order to estimate a firm's continued development effort, we used the metric of official product enhancements (counting the number of official mods). We propose that future research seek alternative ways to measure a firm's on-going efforts to enhance the product. A second limitation of this study is that we relied exclusively on modding activity data from the Nexus Mods user/developer community. Although Nexus Mods is the largest modding community on the Web, modders are also active on other communities. In particular, Steam Workshop is a modding platform owned by Valve corporation, also owner of the Steam distribution platform, and the Steam Store. The integration of modding and game-selling platforms makes it easier to view and install mods, potentially providing modders with stronger incentives. Conversely, a commercial ownership of a user/developer community platform may be perceived by modders as limiting their freedom. We propose that future research in the area retrieve data from a wider variety of modding platforms, specifically platforms that differ from Nexus Mods in terms of their governance model and enabling IT affordances. Given the main goal of our study and the sampling technique, all games in our analysis are associated with modding activity, however small in scope. We propose that additional insight could be gained by analyzing games that have no mods at all. Finally, the current study relies on quantitative methods; however, additional insights could be gained by employing qualitative techniques. For example, interviews with modders (and possibly end-users) could shed light on the role that modding plays in enhancing a game's offerings.

In conclusion, our study provides preliminary quantitative evidence for: (a) a video-game producing firm's ability to entice the user/developer community to create modifications to the base product, and (b) the effect of modding activity on the sales of the final product. Nonetheless, our understanding of the intricate relationships between firms and communities involved in open innovation within the gaming industry is only beginning to evolve. We hope that our study will encourage future research in this area.

REFERENCES

1.   Teresa M. Amabile, Colin M. Fisher, and Julianna Pillemer. 2010. IDEO ' s Culture of Helping. *Harvard business review* January, February: 1–9.

2.   J. Banks and S. Humphreys. 2008. The Labour of User Co-Creators: Emergent Social Network Markets? *Convergence: The International Journal of Research into New Media Technologies* 14, 4: 401–418.

3.   Yochai Benkler. 2002. Coase's Penguin, or, Linux and the Nature of the Firm. *Yale Law Journal* 112, 3: 369–446.

4.   Yochai Benkler. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom.* Yale University Press.

5.   Benjamin J Birkinbine. 2015. Conflict in the Commons : Towards a Political Economy of Corporate Involvement in Free and Open Source Software. 2, 2: 3–19.

6.   Kevin J Boudreau and Karim R Lakhani. 2009. How to Manage Outside Innovation. *MITSloan Management Review* 50, 50413: 68–77.

7.   Henry Chesbrough. 2003. The Logic of Open Innovation: Managing Intellectual Property. *California Management Review* 45, 3: 33–58.

8.   Henry Chesbrough. 2006. Open Innovation: A New Paradigm for Understanding Industrial Innovation. *Open innovation: researching a new paradigm*: 1–12.

9.   E. Gabriella Coleman. 2013. *Coding Freedom: The Ethics and Aesthetics of Hacking.* Princeton University Press.

10.   C Edwards. 2013. Valve Lines Up Console Partners

in Challenge to Microsoft, Sony. *Bloomberg Business.*

11. Ricard Gil and Frédéric Warzynski. 2014. Vertical Integration, Exclusivity, and Game Sales Performance in the US Video Game Industry. *Journal of Law, Economics, & Organization* 0, 0: 1–26.

12. T Godfellow. Civilization chronicles interview with Brian Reynolds. *Civilization Fanatics Center, 2006.* Retrieved February 6, 2016

13. L. Grossman. 2006. Time's Person of the Year: You. *Time.com.*

14. R. Hong and V. H.-H. Chen. 2013. Becoming an ideal co-creator: Web materiality and intensive laboring practices in game modding. *New Media & Society* 16, 2: 290–305.

15. J Kuklich. 2005. Precarious Playbour: Modders and the Digital Games Industry. *The Fibreculture Journal* 05, 05.

16. R. N. Langlois. 2003. The vanishing hand: the changing dynamics of industrial capitalism. *Industrial and Corporate Change* 12, 2: 351–385.

17. Maurizio Lazzarato. 2012. The Making of the Indebted Man: An Essay on the Neoliberal Condition. Retrieved May 15, 2016 from http://philpapers.org/rec/LAZTMO-2

18. Lawrence Lessig. 2006. *Code*. Lawrence Lessig.

19. Ulrich Lichtenthaler. 2011. Open Innovation: Past Research, Current Debates, and Future Directions. *Academy of Management Perspectives* 25, 1: 75–93.

20. D Linn. 2012. Raptr report proves "community as a service" approach vital for gamers, http://blog.raptr.com/2012/10/03/community-as-a-service/, Retrieved February 6, 2016.

21. David Nieborg. 2005. Am I Mod or Not? - An analysis of First Person Shooter modification culture. *Creative Gamers Seminar Exploring Participatory Culture in Gaming*: 16.

22. H. Postigo. 2007. Of Mods and Modders: Chasing Down the Value of Fan-Based Digital Game Modifications. *Games and Culture* 2, 4: 300–313.

23. Hector Postigo. 2003. From Pong to Planet Quake: Post-Industrial Transitions from Leisure to Work. *Information, Communication & Society* 6, 4: 593–607.

24. Hector Postigo. 2010. Modding to the big leagues: Exploring the space between modders and the game industry. *First Monday* 15, 5.

25. Walter W. Powell and Birthe Soppe. 2015. Boundaries and New Organization Forms. *International Encyclopedia of the Social & Behavioral Sciences* 2, 768–772.

26. Eric Raymond. 1999. The cathedral and the bazaar. *Knowledge, Technology & Policy* 12, 3: 23–49.

27. Jeffrey a. Roberts, Il-Horn Hann, and Sandra a. Slaughter. 2006. Understanding the Motivations, Participation, and Performance of Open Source Software Developers: A Longitudinal Study of the Apache Projects. *Management Science* 52, 7: 984–999.

28. W Scacchi. 2004. Free and Open Source Development Practices in the Game Community. *Software, IEEE*: 59–66.

29. Walt Scacchi. 2011. Modding as an Open Source Approach to Extending Computer Game Systems. *International Journal of Open Source Software & Processes* 3, 3: 36–47.

30. Olli Sotamaa. 2003. Computer game modding, intermediality and participatory culture. *New Media*: 1–26.

31. Olli Sotamaa. 2005. " Have Fun Working with Our Product!": Critical Perspectives On Computer Game Mod Competitions. *Digital Games Research Association conference*: 1–10.

32. Olli Sotamaa. 2010. When the Game Is Not Enough: Motivations and Practices Among Computer Game Modding Culture. *Games and Culture* 5, 3: 239–255.

33. Don Tapscott. 1996. The digital economy: Promise and peril in the age of networked intelligence. McGraw-Hill New York.

34. José Pedro Tavares and Licínio Roque. 2006. Games 2 . 0 : Participatory Game Creation.

35. Tiziana Terranova. 2000. Free Labor: Producing Culture for the Digital Economy. *Social Text* 18, 2 63: 33–58.

36. Glen L. Urban and Eric von Hippel. 1988. Lead User Analyses for the Development of New Industrial Products. *Management Science* 34, 5: 569–582.

37. J. West and S. O'Mahony. Contrasting Community Building in Sponsored and Community Founded Open Source Projects. *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*, IEEE, 196c–196c.

38. Joel West and Scott Gallagher. 2006. *Patterns of Open Innovation in Open Source Software*.

39. Joel West and Scott Gallagher. 2006. Challenges of open innovation: the paradox of firm investment in open-source software. *R and D Management* 36, 3: 319–331.

40. S. A. Zahra and G. George. 2002. Absorptive Capacity: a Review, Reconceptualization, and Extension. *Academy of Management Review* 27, 2: 185–203.