Learning from leading-edge customers at *The Sims*: Opening up the innovation process using toolkits

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Abstract:

Recently, toolkits for user innovation and design have been proposed as a promising means of opening up the innovation process to customers. Using these tools, customers can take on problem-solving tasks and design products to fit their individual needs. To date, arguments in favor of this new concept have been limited to the idea of "satisfying each user's needs" in a highly efficient and valuable way.

The aim of this empirical study is to extend our knowledge of *how* users deal with "the invitation to innovate" and *how* attractive individual user designs might be to other users. In studying the users of toolkits for the immensely popular computer game *The Sims*, we found that (1) users are not "one-time shoppers" – in fact, their innovative engagement is rather long-lasting, continuous, evolving, and intense – and that (2) leading-edge users do not merely content themselves with the official toolkits provided by the manufacturer. They employ user-created tools to push design possibilities even further. Moreover, (3) individual user designs are not only attractive to the creators themselves; instead, certain innovative solutions are in high demand among other users. Based on our findings, we discuss how toolkits and their users might add to the *process* of innovation in general. We argue that toolkits could serve as a promising market research tool for guiding a firm's new product development efforts. Furthermore, toolkits may serve as a crèche for interested but inexperienced users who could evolve into leading-edge users over time. These innovative users might then be integrated into more radical product development efforts.

Keywords: toolkits for user innovation and design, open innovation, customer integration, user innovation, leading-edge users, online communities

1. Introduction

A company's competitiveness increasingly depends on its capabilities beyond its internal boundaries. With regard to the process of innovation, companies are intensifying relationships and cooperation with resources located outside the firm, ranging from customers, research companies and business partners to universities (e.g., Howells et al., 2003; Linder et al., 2003). In a recent study, for example, the average share of innovation stemming from external sources was estimated to be around 45% (Linder et al., 2003). The approach of co-innovation has given rise to a model of open innovation (Chesbrough, 2003). In this model (in contrast to its closed counterpart), "the boundary between a firm and its surrounding environment is more porous, enabling innovation to move easily between the two" (Chesbrough 2003, p 37).

One possibility is to use innovative customers as a resource; this idea is referred to as *community sourcing* in open innovation literature (Linder et al., 2003). It is widely underestimated that users might be highly innovative themselves, especially users at the leading edge in a certain area. Empirical studies on the sources of innovation have revealed that in the fields of both industrial and consumer goods, users are often the initial developers of products, prototypes and processes which later gain commercial significance (e.g., von Hippel, 2005). Moreover, empirical studies have demonstrated that up to 30% of respondents reported that they had developed a new product for personal or in-house use. This supports the idea that user innovation is not a rare occurrence (von Hippel, 2002).

A recent approach which takes this phenomenon into account is that of toolkits for user innovation and design. This concept involves systematically outsourcing certain design and innovation tasks from the locus of the manufacturer to that of the customer. Such tools

enable customers to create a product in response to their individual needs (Thomke and von Hippel, 2002; von Hippel and Katz, 2002; von Hippel, 2001). So far, it has been assumed that the primary benefit of this approach is to satisfy customers by delivering a product which is tailored to their specific needs. For example, Franke and Piller (2004), Schreier (2005), and Schreier and Franke (2005) have shown in experiments that the added value exceeds 100% in terms of the user's willingness to pay for self-designed versus standard products.

There is, however, hardly any empirical data available on *how* users actually handle the "open invitation to innovate." In this paper, we aim to close parts of this gap by studying (1) the types of innovative activities carried out by different users, (2) the handling of official toolkits (i.e., those provided by the manufacturer), and (3) the relevance of a user's output to other users.

Building on these findings, we will also discuss the implications for toolkit providers and whether a firm can *learn* anything from these toolkit users with regard to more general tasks in new product development (NPD). This seems particularly relevant, for example, in relation to the third question in our empirical study (the relevance of a user's output to other users). Answers to this question could lead us in two directions: On the one hand, as individual users create products which are responsive to their specific needs, one might argue that the output will be of little interest to others (due to heterogeneous needs, reflecting the implicit notion in the current literature on toolkits). On the other hand, we know from prior research on user innovations that certain ideas and products created by certain types of users can be highly attractive to others – despite the fact that the user-created product is only a solution to one individual's problem (e.g., von Hippel 2002). If the latter scenario also holds true for toolkits, we might be able to extend the current implications of the toolkit approach to the more general process of innovation. When it comes to developing new products, a firm

might, for example, draw ideas either from the objects created by certain users or employ the creative potential of the users themselves. Therefore, we believe it possible to make a valuable contribution to the current literature on toolkits for user innovation and design by providing empirical insights into this new application of the toolkit approach.

One of the first industries to place emphasis on the idea of systematically empowering its customers was the computer games industry,[1] indicating that this field is at the forefront of applying the toolkit approach (e.g., Jeppesen, 2002; Jeppesen and Molin, 2003; Pearce, 2002a). We therefore chose to address our research questions by studying the users of toolkits for *The Sims*, a computer game which has long enjoyed immense popularity.

This paper is structured as follows: First, we briefly describe the background of toolkits for user innovation and design. Next we describe our specific field of research (Section 3) and outline the method applied in the study (Section 4). This is followed by a presentation of our empirical findings (Section 5). Building on this, we then discuss the managerial implications of our findings (Section 6).

2. Background: Toolkits for User Innovation and Design

An economic explanation for the general shift of innovation-related problem solving toward the user can be found in the theory of sticky information, that is, information which is costly to acquire, transfer and use (von Hippel, 1994). Problem solving in general – and product development in particular – are iterative processes of trial and error (Arrow, 1962; Baron, 1988; Rosenberg, 1982; Von Hippel and Tyre, 1995). In this context, the sticky information required by product developers is in the hands of both the manufacturer and the user. Information on possible solutions and production process is provided by the manufacturer, and information on needs as well as insights into the usage environment can be found at the

locus of the customer. In the toolkit approach, the task of product development is re-partitioned into sub-tasks, each primarily requiring information from either the user or the manufacturer. As a result, those tasks which primarily involve sticky solution-related information remain with the manufacturer, whereas sticky need-related information and design tasks are shifted to the user. Instead of the time-consuming and costly ping-ponging between manufacturer and user in the course of the development process, iterative learning by doing and trial-and-error cycles for each sub-task are carried out entirely by the user or manufacturer (von Hippel and Katz, 2002; Thomke and von Hippel, 2002; von Hippel, 2001).

One of the first manufacturers to employ the toolkit concept was LSI Logic, a start-up manufacturer of application-specific integrated circuits (ASICs). They had found that the costs of not understanding user needs had reached unacceptably high levels (von Hippel, 2001). Therefore, LSI Logic decided to open up the innovation process by systematically outsourcing certain design and innovation activities to its customers. They developed a design tool and made it available to their customers, who in turn could act as developers of their own products. The concept proved successful and soon became the industry standard. The market for such custom integrated circuits grew to more than $15 billion, development time was cut by two thirds, and development costs were decreased significantly (Thomke and von Hippel, 2002).

Another example is the slightly different approach employed by the statistic software company Stata. Although the company sells a *standard* software package, it also enables users to modify the software using a toolkit provided along with the standard product (von Hippel and Katz, 2002). This allows users to adapt the standard software to their individual needs (e.g., programming new statistical analysis functions). Similarly, a number of

computer games such as *The Sims*, Half-Life or NHL 2001 (to name but a few) are frequently accompanied by tools which enable the individual user to modify the standard game as needed (Jeppesen, 2002; Jeppesen and Molin, 2003; Pearce 2002a). Strictly speaking, the latter strategy constitutes a service rather than a product. In either case, however, the underlying principle is the same: Customers with heterogeneous needs are given the opportunity to get exactly what they want and take on the role of an active problem solver.

As the manufacturer's fundamental concern is to have a user's design produced without frictional loss, there are some natural limits to what toolkits can allow users to create (specifically in the case of tangible, i.e. non-digital, goods like ASICs[2]). Hence, one important dimension differentiating these toolkits is their *scope*. The scope of a toolkit describes the user's design possibilities, that is, the user's degree of design freedom (Thomke and von Hippel, 2002). Whereas a toolkit with a very narrow scope might only enable the user to choose components passively from lists (as in the case of typical mass-customization sites), a wider scope will allow users to create novel products actively (as in the ASICs toolkits). With regard to the toolkit's scope, Franke and Schreier (2002) therefore differentiate between high-end and low-end toolkits. Whereas the former are aimed at innovative new products (which focus on innovation), the latter can be used to exploit seemingly mature markets (which focus on individualization).

Furthermore, high-end toolkits tend to be more challenging to use and demand greater skill on the user's part. For this reason, they might be better referred to as *expert* toolkits. Low-end toolkits, on the other hand, are much easier to use and can be operated by almost any user; thus they might also be referred to as *basic* toolkits. Against this backdrop, there seems to be a trade-off relationship between the design freedom offered and the costs of use.

3. Computer games as our research context: *The Sims*

Following a number of researchers in innovation management (e.g., Aoyama and Izushi, 2003; Jeppesen, 2002; Jeppesen and Molin, 2003; Prügl and Franke, 2005), we have chosen the computer games industry as the field of research for this paper. The important role of the user in this industry can be traced to its very roots: In 1961, long before entrepreneurs[3] recognized the commercial potential of computer games, it was a user – not a manufacturer – who "invented" the first video game: Steve Russell developed the game "Spacewar" at MIT (see Aoyama and Izushi, 2003 or Castronova, 2002, for example). Today the industry has a worldwide sales volume of more than USD 18 billion (MCV online, 2003).[4] With regard to open innovation in general and toolkits for user innovation and design in particular, the industry is at the cutting edge. For example, in March 2001 the Best Rookie Studio Award at the renowned *Computer Game Developers Conference* was won by Counter-Strike, a game created entirely by players using the toolkit (i.e., the *level builders* in the Half-Life game engine). The game was made available as freeware on the web and quickly became one of the most popular games in its genre ("Online First Person Shooters"; see Pearce 2002a).

Furthermore, Jeppesen and Molin (2003), for example, recently conducted a survey of 94 computer games and found that 35% of them already included toolkits for their users. Toolkits in practice with computer games range from what are called *level builders* (which allow players to create their own game environments) to *character-building kits* (which enable users to create individual avatars). Some games even provide users with the code or scripting language to create their own games; these functions are referred to as *mods* (Pearce 2002a).

Like scholars from other fields (e.g., Chan, 2003; Frasca, 2001; Nutt and Railton, 2003; Pearce, 2002a; Tsikalas, 2001), we selected the game *The Sims* as the object of our research.[5]

The Sims holds a premiere position among computer games and allows its users to "manipulate" the possibilities available within the game, that is, users can employ an integrated toolkit to modify the game to suit their needs and tastes. The game was developed and published by Maxis (now EA Games) and is said to be one of the best-selling PC games in history (Pearce, 2002a). In 2002, the 28th million unit of *The Sims* game series was sold since its release in February 2000 (EA Games Germany, 2003). The game has won highly prestigious prizes such as the Academy of Interactive Arts and Sciences' Game of the Year 2000 (Nutt and Railton, 2003).

The Sims does not fit comfortably into any existing game genres, which makes classification difficult (Nutt and Railton, 2003) It is often described as "the yuppie game," "the IKEA game," "Big Brother," or the "virtual dollhouse" (Pearce, 2002a). More generally, it is also referred to as a "god game" or a "people simulator" (Tsikalas, 2001), that is, a game which lets you create and control the lives of virtual people. "God games" give the player god-like control over a simulated world and allow the player to modify the environment and to some degree its inhabitants as well (Laird and van Lent, 2001). *The Sims* enables the player to create individual characters (units) that have significant autonomy. These characters have their own goals and drives, but "God" (the human player) can come in and control these units by managing either the individual characters and/or their environment (Laird and van Lent, 2001). The game focuses entirely on these virtual people called "Sims," giving the player control over the Sims' daily activities such as "recycle the newspaper" and "kiss Betty Goth" (Chan, 2003), to name but two examples. The objective of the game is to organize the Sims' time and help them reach goals of personal advancement (a screenshot of a typical scene from the game is provided in Figure 1).

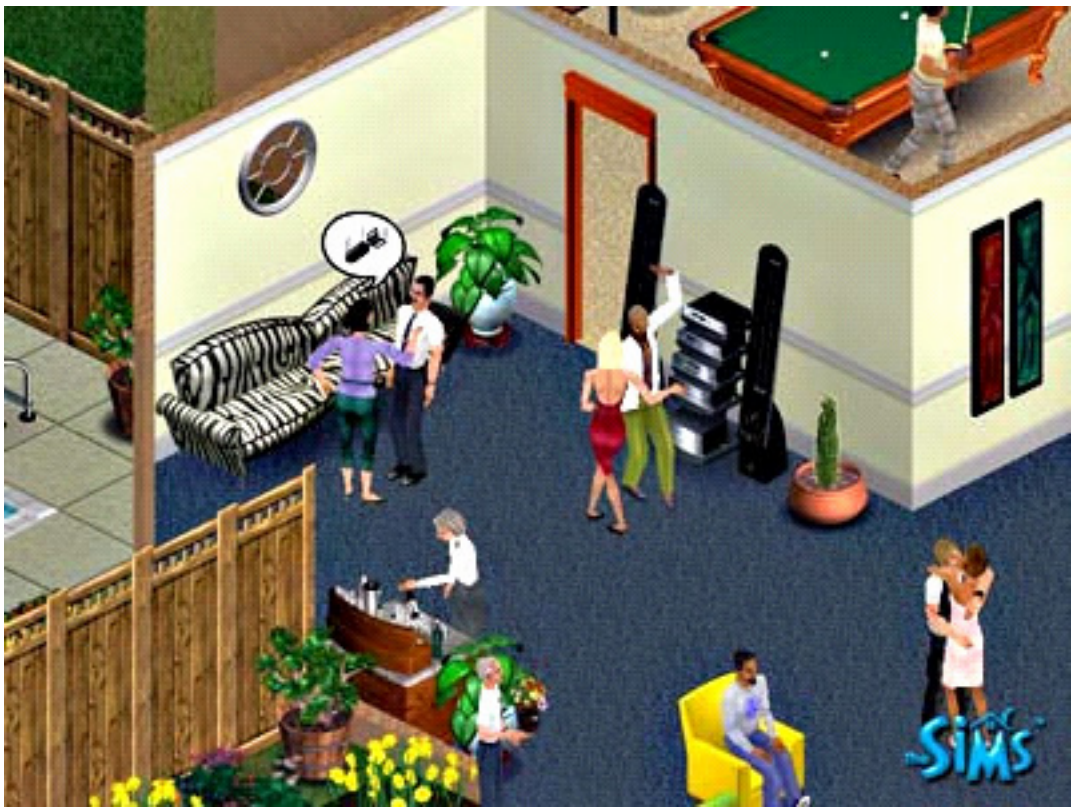

Figure 1: Screenshot of *The Sims*

The official game's manual describes the game as follows (EA Games, 2000): "*The Sims* is a full-blown world, but one that is intimate rather than expansive. It's a world of your own handiwork […]. However, you're much more than merely an observer, watching the myriad details occurring moment-by-moment in a household, and in a neighborhood […].You create the very electronic marrow of these beings [your *The Sims* characters], assign subtle personality traits, and set them in a home of your own design."

The publisher opened up the innovation process even *before* the game was released by providing "*The Sims* HomeCrafter" and several other official toolkits via the World Wide Web (a screenshot of the "*The Sims* Creator" is given in Figure 2). The publisher made great efforts to build a web-based community a full year before *The Sims* was shipped. By the time the game hit the shelves, *The Sims* already had a strong user base, including many user sites.

The official toolkits enabled users to modify *The Sims* according to their specific needs and desires (modification units are integrated into the individual game in the form of *files*). More precisely, users can create their own narratives and customize characters (referred to as *skinning*). One example of this is a user who designed a Star Trek Enterprise crew with original uniforms (Nutt and Railton, 2003; Pearce, 2002a).

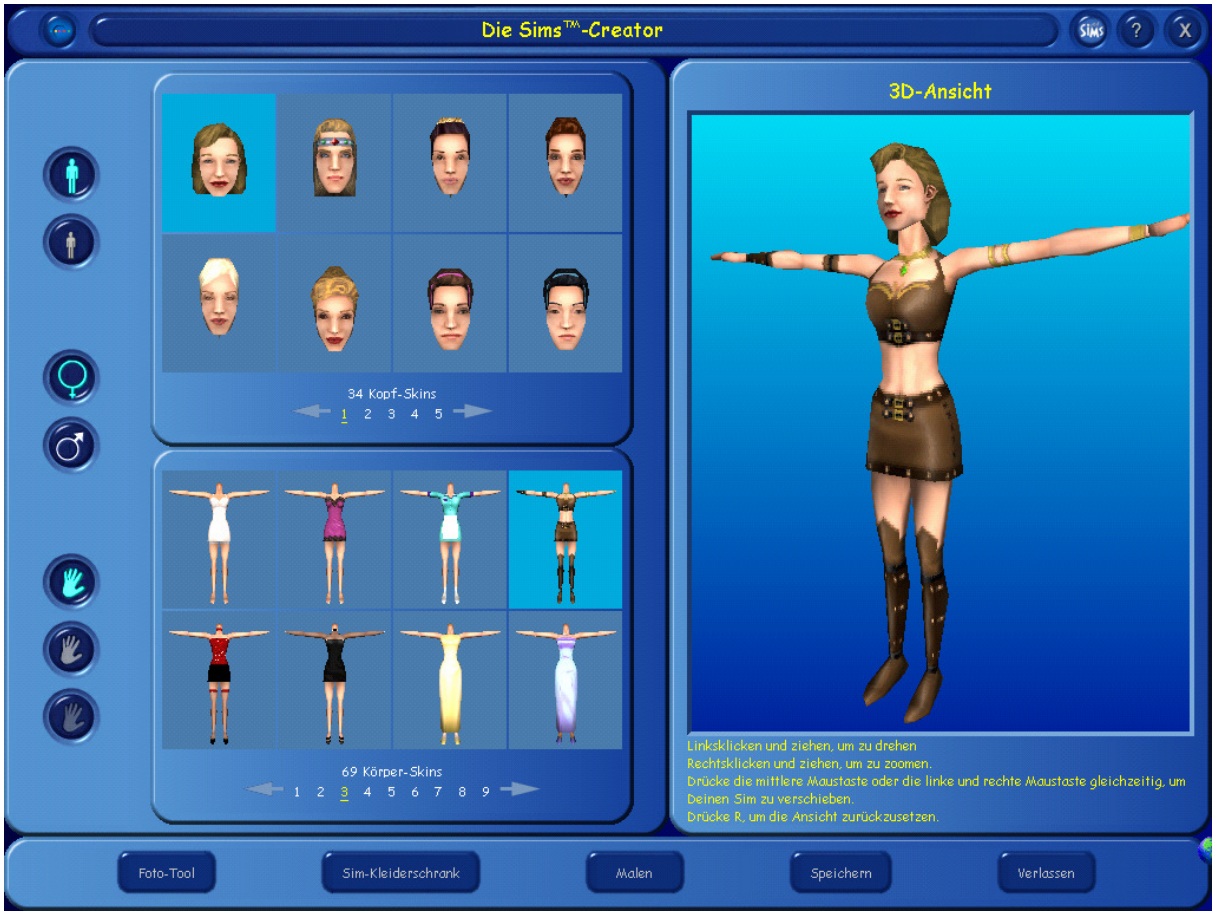

Figure 2: Screenshot of "*The Sims* Creator"

4. Study method

The method applied in our study involves a two-step approach. In the first step, we conducted a *pilot study* to gain important initial insights into the users' general file creation behavior. On that basis, we designed the questionnaire for our *main survey*.

4.1 Pilot study

In the course of our pilot study, we (1) observed important online communities and the innovative activities of their users, and (2) conducted semi-structured interviews by telephone and e-mail with two managers from EA Games (the official German and US online community managers for *The Sims*), ten online community webmasters (e.g., Simzone, Simforum, and Shaklin's Simspage), and several highly active online community members.

We found that users not only share game hints and tips (Nutt and Railton, 2003) but also toolkit-related knowledge (i.e., discussion groups on how to use toolkits efficiently) as well as user-created files made available as downloads. Therefore, a single user's output seems to bear a certain relevance to other users as well.

Furthermore, we were able to establish that user output (i.e., user-created files for *The Sims*) varies widely in terms of novelty or degree of modification (also referred to as innovativeness below). Webmasters and highly active users unanimously indicated that there are basically three different types of file creations possible: (1) *New colors* indicates that the user only changes the color(s) or the design of a specific object (e.g., the skin or clothes of a person, the color of a TV, or a wallpaper design). This constitutes a minor adaptation or change to an existing object and can be considered the least innovative category. (2) *New designs and shapes* means that the user creates completely new forms of existing objects (e.g., a new laundry machine, a new bookshelf, or a new CD rack), thus the outcome may be somewhat more innovative. (3) "*Created completely from scratch*" implies that the user creates an object that is completely new to *The Sims* (e.g., an ice skating rink or bowling alley). This is the most radical way of modifying the game, meaning that *The Sims* takes a real functional turn.

Finally, we found that there are many toolkits available to users. Interestingly enough, users do not limit themselves to the official toolkits provided by *The Sims*. Instead, users began employing tools from other fields and even creating their own tools to design files, after which they made them available to others (e.g., SimsBlender).

4.2 Data collection in the main survey

On the basis of these initial insights, we designed a questionnaire to shed more light on the users' file creation activity, the types of files created using different types of toolkits, and the relevance of a user's output to other users (i.e., the market for user-created files). Therefore, the unit of analysis is the user who has already created toolkit-based files.[6]

The questionnaire consisted of three main parts (see Appendix 1 for specific items): (1) The first part covered the users' file creation history (mostly closed questions). (2) The second part dealt with the types of files created. Users first had to indicate which of the three general types of file modifications they had already engaged in, describe some of the files they had created in each category, and indicate the tools with which they created each type of file. (3) The third part of the questionnaire dealt with the availability and relevance of users' output (i.e., the user-created files) to other users. Whereas the first part was measured by the users' propensity to share their files with others, the latter was measured by actual download figures for the most popular (i.e., most often requested) files in 2003. In this way, we attempted to identify supply and demand for user-created files within *The Sims* online community.

In our pilot study, online communities which showed a high proportion of file creators were considered candidates for the survey. We were able to persuade five online community webmasters to support our project by posting our survey on their websites for ten days (July 10 to July 20, 2003). Specifically, we collected data from the online communities N99

(http://games.groups.yahoo.com/group/n99/), Anna's Treasures (http://www.annas-treasures.net/), Shaklin's Simspage (http://members.lycos.co.uk/shaklin/index.php), Simszone (http://www.simszone.de/), and Simsforum (http://www.simforum.de/). These online communities had an average of 15,000 registered users (as of July 2003) and showed an average of 760 distinct/active users during data collection. As in any online survey, we can not calculate precise sample populations and exact response rates per sample or online community (as opposed to sending the questionnaire via e-mail, which would not have been feasible due to the online communities' privacy policies). However, we were able to use website data and estimates from webmasters to approximate a general response rate.

According to the webmasters' estimates, the share of users who actively created files (i.e., the target population of our study) was between 5% and 25% of each online community. A total of 177 questionnaires were returned. Based on an estimated total population of 950 file creators (i.e., a cautiously estimated 25% of five online communities with 760 distinct users each) we can estimate the response rate to be 18.6%.[7]

Multi-sampling generally implies the risk of overlapping populations (i.e., the inter-sample problem), indicating that response rates might actually be *under*estimated. In our case, it is likely that a certain fraction of file creators belong to more than one of the online communities surveyed. This is confirmed by both the webmasters' estimates and the results of our survey. The latter revealed that 50% of respondents were members of *more* than one online community, with responses ranging from two to seven. A conservative estimate of 50% overlapping in our total sample population might therefore imply a reduction of our total population from 950 to 475 *unique* file creators, which would increase our total response rate from 18.6% to 37.2%.

The 177 file creators were 26 years old on average (SD 11.19) at the time of the survey. Most

of them are either from Germany (47.5%) or the US (30.5%). The remaining respondents (22%) are spread all over the world, ranging from Austria to Australia and from Brazil to Japan. The strong representation of females (71.5%) reflects the sales figures of *The Sims* – roughly two thirds of *The Sims* buyers are also female (Time.com, 2002).

5. Results of the main survey

5.1 File creation activity and its output

In terms of the *process* of creating files, the majority of respondents are highly experienced – 69.3% started creating files at least one year ago. Moreover, 63.1% of those surveyed indicated that they had created a file in the preceding week (19.3% had done so during the preceding month). File creators also invest a substantial amount of time in their creative work: Whereas 44.5% spent up to five hours a week, 24.9% invested between six and ten hours, 18.5% between eleven and 20 hours, and 12.1% more than 20 hours (see Table 1). A conservative summary of this time investment (mean of each class, lower boundary of 20 hours for the fourth class) for our sample of 177 users yields an impressive total of 1,463 hours per week. This user-based resource is equivalent to 36.6 full-time employees (on a 40-hour basis). Furthermore, 91% of the respondents indicated that they intend to continue creating files. In summary, creating files is a long-lasting, continuous, evolving, and intense activity among these users.

In terms of *output,* the average user in our sample creates 12 files per month, with responses ranging from 1 to 200 files (SD: 22.60). Over his/her entire file creation history to date, the average user has produced a total output of 355 files, with totals ranging from 1 to 10,000 files (SD: 1,015.37). In total, 177 users create 2,160 files a month and have created a total of 62,203 files so far.

File creation activity

	One month ago	Six months ago	One year ago	More than one year ago	*Total*
When users started creating files (n=177)	8.0%	22.7%	26.7%	42.6%	*100%*
	In the last week	In the last month	More than one month ago		*Total*
Last time they created files (n=177)	63.1%	19.3%	17.6%		*100%*
	≤ 5	> 5 ≤ 10	> 10 ≤ 20	> 20	*Total*
Hours devoted to creating files (weekly) (n=175)	44.5%	24.9%	18.5%	12.1%	*100%*

Files created

	Mean	Median	SD	Min	Max
Number of files created (per month and user) (n=177)	12.27	5	22.60	1	200
Total number of files created (per user) (n=176)	355.45	100	1,015.37	1	10,000

Table 1: File creation activity and output

5.2 Types of files created

As noted above, user output varies widely in terms of newness or degree of modification. Table 2 provides several examples of user-created files for each of the three file creation types mentioned in Section 4.1 (Pilot study). Whereas 9.1% of respondents reported that they had created *new colors* files (e.g., "skins for men, women, and children Sims"), the majority of our sample (68.2%) created *new designs and shapes* files (e.g., a "white marble kitchen set […]"). The remaining 22.7% engaged in the most radical form of modification – objects *created completely from scratch* (e.g., "a voting card. It allows your Sims to vote on things").[8] In the following paragraphs, we will refer to new colors as the *first* group, new designs and shapes as the *second* group, and "created completely from scratch" as the *third* group.

Type of file	Examples
First group: (1) New colors *9.1% of users*	• *"It is a clone of the most expensive TV (the plasma tv). The TV is recolored a dark purple plus the 4 television screens have been changed to different pictures. They are now pictures from the shows 'Dragon Ball Z', 'X', 'Sailor Moon', & 'Dragon Ball'."* • *"A girl's skin, purple top, white capris, purple trainers, all skin tones."* • *"Skins for men, women, and children Sims."*
Second group: (2) New designs and shapes *68.2% of users*	• *"A skin created to look like a popular anime (Japanese animation) characters"* • *"Beatrix Potter Bed - object, canopy single bed (sims could sleep in it)"* • *"White Marble Kitchen Set - Cheery finishes on the cabinets with white marble tops, whole kitchen set, includes appliances and dinner area"*
Third group: (3) Created completely from scratch *22.7% of users*	• *"A voting card. It allows your Sims to vote on things."* • *"The smokable smokes. They required object hacking, new sim animations, a new mesh and new graphics. They provide a pack of smokes that sims can take a smoke from and smoke to increase their fun rating."* • *"A 'martial arts mat' - Sims stand on the mat and practice karate moves. The object builds body points."*

Table 2: Examples of user-created files

5.3 Tools used to create files

While analyzing the tools used to create files, we found – in line with the findings from our pilot study – that users employ not only the toolkits provided by *The Sims* but also user-created tools. Upon closer investigation, we identified systematic differences when cross-tabulating the files created with the tools used (see Table 3). Files of the first group are *exclusively* created by toolkits provided by *The Sims*. On the other hand, *none* of the files in the second and third groups employed the official toolkits, in other words: It seems that more invasive changes to the game are not possible with these kits due to the restricted solution space offered. We were able to confirm this in our interviews with highly active users. Apparently, the needs of the individual user go far beyond the individualization possibilities offered by these official toolkits, and users do not content themselves with them. Users succeeded in overcoming this restriction by developing, searching for and employing more advanced toolkits which allow them to make more radical changes to existing standard files. Furthermore, in terms of the tools used we found no overlaps between the second and third groups of file creators, with the third group working with the most sophisticated toolkits.

Type of file	Tool used for innovation activity	
	Firm-constructed tools (Provided by the developer of *The Sims)*	User tools (provided / applied by leading-edge users)
First group	*The Sims* Homecrafter, *The Sims* Creator, *The Sims* Art Studio	*None*
Second group	*None*	SimsBlender, iSim-Skinner
Third group	*None*	T-Mog, Blueprint, SimCategorizer, IFFPencil 1 & 2, Object Editor, Rhinoceros 2.0 , Bryce, Milkshake, HexEdit

Table 3: Toolkits employed for different types of files created

Upon analyzing these findings in connection with the users' file creation activities, we found that users in the first group tended to be the least experienced in our sample, whereas 80% of the third group, for example, had started creating files at least one year prior to the survey. Thus there seems to be a certain life cycle pattern among file creators. The official tools provided by the developer of *The Sims* serve as a gateway for inexperienced users who wish to make minor changes to the game. Once they gain experience in creating files, they tend to ascend toward more innovative activities, allowing them to adapt the game more radically to their specific needs. Consequently, a certain fraction of users evolve over time from amateur status to highly innovative leading-edge users.

5.4 The online community market for user-created files

The basic idea behind toolkits is to allow individual customers to modify standard products to their individual needs. Hence, the underlying assumption is that these needs are highly heterogeneous (leaving many customers dissatisfied with standardized products). Against this backdrop, one might plausibly argue that one user's solution to a specific problem might not be very attractive to other users. In the course of our pilot study, however, we also found that users actively exchange the files they create, meaning that there is also an "online community market" for the files themselves. However, there is no traditional market

mechanism – users generally do not "charge" anything for their files (e.g., monetary compensation, barter trade), that is, these exchanges are predominantly free of charge. Consequently, we tried to capture the supply and demand sides of this "online community market" for user-created files systematically.

Supply of files. First, we analyzed whether users are *willing* to share their created files with others. We found that 34% of all respondents indicated that they do share *all* files with others free of charge (see Table 4). Another 41% share some but not all of the files they create. A substantial portion (25%) would not share any of their objects. Upon analyzing file sharing habits across the three types of files created, we also found significant differences. We observed that file creators in the first group show the lowest propensity and those in the third group the highest propensity to share. Only a small percentage (7%) of the latter group is not willing to share any of their files. A closer look at this group of non-disclosers reveals that they do not reveal their files for reasons such as low perceived quality or low perceived interest among others in their files (50%), or they had not found the right place to offer them (23%). Only 16% indicated explicitly that they do not *want* others to have their files.

Supply of files

*File sharing**	Share all files with others	Do not share all files with others	Do not share any files with others
Overall sample (n=175)	34%	41%	25%
First group (n=16)	12%	25%	63%
Second group (n=119)	34%	40%	26%
Third group (n=39)	44%	49%	7%

*Differences significant at $p<0.01$ ($\chi^2=18.39$; df=4)

Reasons for not sharing any files (n=44)	
The files are not good enough / others would not be interested in them	50%
Have not found the right place to post yet	23%
Explicitly do not want to share	16%
Other reason	11%

Table 4: Supply of files

These findings indicate to a certain degree that the supply of files follows a self-selection pattern. Innovative files which are likely to be attractive to other users (i.e., more radical changes to the game) are placed on offer, whereas less innovative files which only constitute individual solutions with low value to others are not. Therefore, the supply side of this market seems to be subject to a self-regulatory power in favor of innovative solutions.

Demand for files. The files offered constitute the supply side of the online community market. Generally speaking, the users surveyed indicate that they have a good overview of the supply of files, which implies a high level of perceived transparency in the files offered (see Table 5). Another interesting question concerns the demand satisfied by this supply. Do users care about files created by others? Are there any systematic differences with regard to the types of files created? One means of measuring demand for files is the number of downloads. For this purpose, we used the download figures for the most popular user-created

files in 2003. Note that although only file creators are represented in our sample, download figures capture demand for files among other file creators *as well as* online community members who do not actively engage in file creation. Due to the nature of our survey, however, we can not distinguish between these two groups.

In general, we found a widely varied picture. Download figures ranged from 12 downloads of a single file to 1.14 million, with a mean of 58,914 (median: 2,500; SD: 197,166). With respect to the type of file created, we found a generally positive relationship: The more innovative the file, the more often it was downloaded. The mean, median, and maximum number of downloads were significantly and substantially higher for files created completely from scratch (third group) than for files which were "only" new designs and shapes (second group). In turn, the latter group showed considerably higher download figures compared to the first group. (Note that only *three* users from the first group indicated download figures for their files, as only three of the sixteen users from this group in our sample offered their files via a website.)[9]

Aside from patterns in demand for specific types of files, we also found that demand is not "accidentally" high for some and rather low for other users. Instead, we discovered that the most popular files are created by experts or leading-edge users. However, instead of a linear relationship between file creation activity/history and download figures (r=0.12; n.s.), we observed a certain threshold pattern: For example, files which were downloaded more than 10,000 times are exclusively from highly experienced users (all of whom have created more than 100 files to date). The next threshold was that of the few "high flyers" (more than 100,000 downloads) who are even more experienced and have a file creation history of more than 200 files.

In total, the single most popular files of only 53 innovative users in our sample (who (1) offered files to others via online community download and (2) knew precise download figures) resulted in 3.12 million downloads, indicating that there is not only a strong supply but also robust demand for innovative user-designed files. Hence, the vision of *The Sims* has become reality:[10] The toolkit approach has turned the game into its own "self-generation content system" (Pearce, 2002a).

Demand for files

Overview of supply	Mean	SD	
I have a good overview of the current files offered (n=177)*	3.06	1.81	
*Number of downloads of 53 users' single most popular files in 2003***	Mean (median)	SD	Min / Max
Overall sample (n=53)	58,914.38 (2,500)	197,165.90	12 / 1,140,000
First group (n=3)	82.33 (100)	30.60	47 / 100
Second group (n=31)	6,669.03 (1,944)	12,407.39	12 / 59,766
Third group (n=19)	139,467.29 (6,000)	299,278.52	12 / 1,140,000

*Measured on a 7-point rating scale (1=strongly agree; 7=strongly disagree)
**Differences between second and third group are significant at $p<0.05$ (t-value=-2.396)

Table 5: Demand for files

6. Discussion and managerial implications

The objective of this study was to extend our knowledge regarding the customer-as-innovator approach (e.g., Thomke and von Hippel, 2002; von Hippel and Katz, 2002). To date, the potential benefits of toolkits for user innovation and design have been restricted to the idea of satisfying the individual's needs in a highly efficient and valuable way. In our study of innovative users of *The Sims*, our most important finding was that an individual's output might be beneficial to other users as well. Specific innovative solutions created by certain users are highly diffused among *The Sims* online communities. Furthermore, we find that leading-edge users do not confine themselves to using official toolkits but also employ user-

created tools to meet their specific needs.

In this section, we discuss the managerial implications of our findings for companies which already use or plan to use this "open invitation to innovate." The implications are threefold: First (and closely related to the toolkit approach), one toolkit may not serve all users effectively. Second (with regard to a firm's general process of innovation), user-created objects might be a valuable source of market research data. Third, certain leading-edge users might be identified easily and subsequently integrated into more radical new product development projects.

Considering the *first* aspect, we found that users were not content with the toolkits offered by the developer (i.e., the manufacturer) of *The Sims* (Maxis, part of EA Games). Instead, they tried to surpass the limits of the design freedom provided in firm-constructed toolkits by employing tools from related fields and by expanding the scope of existing tools or even creating their own toolkits. According to their underlying needs, users chose the appropriate toolkit from a broad range of available applications. Thus, different types of users employ *different types of tools*, which in turn lead to different types of innovation activities. Therefore, one toolkit is unlikely to serve all users. Instead, a manufacturer might be well advised to offer different sets of tools in line with customers' needs. Whereas low-end toolkits which focus on customization (by allowing minor product adaptations) could serve as a gateway, sophisticated high-end toolkits with more innovative design freedom might be offered to more experienced users (Franke and Schreier, 2002). Furthermore, the existence of user-provided tools supports the findings of Jeppesen and Molin (2003), who argued that leading-edge users are able to learn at higher levels. In this context, higher-level learning means challenging the limits of existing (firm-constructed) tools. This type of learning tends to be experienced by certain users over time. Hence, in parallel (or as an alternative) to

supplying a diversified toolkit, a manufacturer could also decide to reveal the source code of the toolkit itself to users and thus enable them to push a toolkit's design limits "in the name of the manufacturer" (Thomke and von Hippel, 2002).

With regard to the *second* aspect, we found that users are generally willing to share their output with others. In addition, we found that other users also demonstrate strong demand for certain innovative objects created by others. Upon observing these interactions, the game developer started to market a number of expansion packs which extended the variety of options of *The Sims* (e.g., *The Sims* Living Large and House Party, see Pearce, 2002a). On the basis of our interviews with *The Sims* representatives, we found that the innovative activities of users generally help product developers to improve future product lines. Screening these online communities constitutes an active part of their development efforts. For example, they stated that "by having open lines of communication with our online community we better understand what they like about our games and what they hope to see in the future […]" and that "community requests for additions to the game carry a tremendous amount of weight to their development efforts." Furthermore, precise exchange information (i.e., download figures) can also be used for market research purposes. This becomes most understandable in light of findings from other studies. According to Rogers (1983), for example, the features of an innovation and a new product's innovativeness largely influence both the extent and speed of diffusion (which agrees with our finding that more invasive, i.e., more innovative, modifications of *The Sims* are met with higher demand). Therefore, diffusion can be taken as an indicator of innovative performance. Furthermore, diffusion within a certain sub-group (i.e., *The Sims* online community) might be an early indicator of broader diffusion outside the community. Franke and Shah (2003), for example, have shown that the extent to which innovations within a certain community are diffused is highly correlated (r=0.58) with diffusion figures outside the community. Consequently,

information on supply and demand for user-created objects can be used to identify important market trends. In addition, a company might integrate highly innovative solutions directly into later products using expansion packs, a practice which is already common at the statistics software company STATA (von Hippel and Katz, 2002).

The *third* aspect accounts for leading-edge users themselves as a valuable resource in a firm's innovation process. Von Hippel and Katz (2002), for example, argue that the toolkit approach might be combined with the lead user approach (e.g., von Hippel, 1986). This is in line with our findings with regard to *The Sims.* First, outstanding innovative users might be identified easily (e.g., by tracking download figures and innovation-related history), a task which is generally rather difficult in other contexts (Lilien et al., 2002). Next, these users might be integrated into more radical product development tasks. In this way, for example, the lead user method (e.g., Urban and von Hippel, 1988) might take a promising turn. This approach follows the idea of relying on users who are ahead of the general market both in terms of needs and solutions. Empirical studies have shown that this method might be superior to traditional screening of the broad market. For example, empirical research at 3M demonstrates that the average sales potential of lead user concepts is over *eight times higher* than traditionally developed concepts (Lilien et al., 2002). Although this is very promising, one practical challenge in applying the lead user method was the efficient and reliable identification of lead users. However, recent research on this topic has identified pyramiding (instead of often-used screening processes) as a means of increasing the effectiveness and efficiency of lead user identification (von Hippel et al., 2005). In light of our findings, a manufacturer trying to integrate leading-edge users might change its role even more radically, from that of a 'hunter' to that of a 'planter' (Franke and Schreier, 2002). Instead of hunting for this type of user, toolkits can serve as a crèche for interested but inexperienced users who might evolve into leading-edge users over time.

Finally, we also have to question whether our findings on the innovative activities of toolkit users in a digital environment can be generalized or transferred to non-digital industries. For example, one might plausibly argue that in the case of physical goods there might be a greater tendency towards intellectual property issues from the users' point of view. From prior research in the field of user innovations, however, we know that these considerations also play a highly ancillary role in non-digital environments. Users are typically generous with their innovations and make them available to others free of charge (e.g., Franke and Shah 2003). Nevertheless, we can observe companies in various industries producing physical goods in line with the customer-as-innovator approach (e.g., GE Plastics, International Flavors and Fragrances, LSI Logic, Nestlé; see Thomke and von Hippel, 2002; von Hippel and Katz 2002). For example, the European ski manufacturer Edelwiser recently started allowing its users to design their own skis using a toolkit. In addition to offering individual users the opportunity to design skis according to their specific needs, Edelwiser plans to incorporate user-to-user exchange via its online community. Consequently, Edelwiser's business model will allow users to decide whether they wish to (1) publish their design free of charge, (2) sell their design (including limitations on their "edition"; the user can also define the margin to be charged), or (3) keep their design "secret" (block it for all other users).

In summary, toolkits for user innovation and design hold great potential when applied as an "open innovation gateway." Although practical cases of companies employing the toolkit approach are growing in number, scholarly knowledge related to the implications of this open innovation model are still rather limited. Therefore, interested scholars should join this line of research to shed more light on these relevant issues.

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Appendix 1: Questionnaire

File creation history. When did you create a file for *The Sims* for the first time? (one month ago/ six months ago/ one year ago/ more than one year ago) When did you create your last file for *The Sims*? (last week/ last month/ more than one month ago) How many files are you creating for *The Sims* at the moment?(on average __ files/ month) How many files have you created for *The Sims* in total? (I have created (about) ___ files in total.) How many hours a week do you on average spend on file-creating? (≤ 5 hours/ > 5 ≤ 10 hours/ > 10 ≤ 20 hours /> 20 hours) Are you planning to create files in the future? (yes/ no) Are you a member of one or more online communities or an online forum concerning *The Sims*? (yes/ no) If yes, in which one(s)? http://_____/ http://_____ http://_____ http://_____ http://_____ **Types of files created.** Which of the following type of files did you already create? (New colors*,**/ New designs and shapes*,**/ Created completely from scratch*,**) *Please describe the file (what did it look like, what type of file, how could you use it). **Please describe in short which tools you used to create that file. **Availability and relevance of user-created files.** Do you share the files you created with others? (I share all files with others/ I do not share all files with others/ I do not share any files with others*) *Why do you not share any of your files with others? (The files are not good enough i.e. others would not be interested in them/ I have not found the right place to post yet/ I explicitly do not want to share my files with others/ Other reason:_____) I have a good overview of the current files offered (7-point rating scale with 1=strongly agree and 7=strongly disagree) Please describe your most popular file in 2003, i.e. the file downloaded by others most frequently (what did it look like, what type of file, how could you use it). The link to download that file is: http://_____ It has been downloaded approximately _____ times.

Demographics. Age: _____Sex (female/male) Country:_____

Endnotes

[1] In this paper we generally use the term "computer gaming" to cover all types of games played on a console, a digital TV, LCD display, a personal computer or self-contained devices such as a Game Boy. A similar approach is taken by Bryce and Rutter (2003), and a detailed discussion of the definition of computer gaming is provided by Smed and Hakonen (2003). In all other cases, we refer to the type of game specifically (e.g., personal computer games).

[2] ASIC: Abbreviation for application-specific integrated circuit. A custom-designed integrated circuit.

[3] Inspired by "Spacewar", Nolan Bushnell founded Atari and developed the first commercially successful game "Pong" in 1972. This provided the spark for an entire industry which had grown to $200 million in 1978 and reached $1 billion in 1981 (see Aoyama and Izushi, 2003).

[4] In 2003, for example, more than 239 million computer and video games were sold, which corresponds to almost two games for every household in the US (ESA, 2004 http://www.theesa.com/, retrieved 12/29/04).

[5] We have based our research on *The Sims 1* and its extension packs. We explicitly do not consider *The Sims Online* or the recently released *Sims 2* in this paper.

[6] For this reason, we will not address any issues related to non-innovative community members. However, future research might analyze the role played by these peripheral users

(e.g., testing user-based solutions and providing feedback). For insights into the role of peripheral members, see Lave and Wenger (1991), for example.

[7] One possible shortcoming of collecting data this way (as opposed to an e-mail survey, for example) is the fact that we do not have any data on individual samples (e.g., one community with a very high response-rate versus another community with a very low response rate). Related problems such as non-response bias (Armstrong and Overton, 1977) can not be analyzed in this way.

[8] Although we account for the fractions of each group in our sample, note that we do not make any claim that the data is representative of the community populations. For example, our sample might be biased towards more innovative file creators, thus underestimating the proportion of the first group. As we used an online survey, we can not calculate early versus late response bias in order to analyze this potential effect. This might have been possible in an email survey, as the time of survey delivery might have been contrasted with the precise response time. However, this is not the aim of our exploratory investigation.

[9] Future research might address this shortcoming by drawing larger samples with respect to the types of files created in order to validate our findings.

[10] *The Sims* designer Will Wright developed a vision for user-created content – the 10% rule. If 10% of the players are highly skilled content creators (people creating their own characters and objects), then 100,000 content-creation experts will be available for every million players. The result is that the game has become its own self-generation content system (Pearce, 2002a; a detailed interview with Will Wright can be found in Pearce, 2002b).