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When Does an Idea Become an Innovation? The Role of Individual and Group Creativity in Videogame Design

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Theme A

WHEN DOES AN IDEA BECOME AN INNOVATION? THE ROLE OF INDIVIDUAL AND GROUP CREATIVITY IN VIDEOGAME DESIGN

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Abstract
In between creativity studies of idea generation and knowledge management studies of the codification and transmission of knowledge are a fuller set of cognitive activities, including problem-solving and creative impulses. This paper examines the case of designers in the US videogame industry to develop a set of frames for determining how their ideas come about, how ideas are transformed in the process of product development, and when different models of organizing innovation are efficacious. It is found that different types of creativity are used in game design, that sometimes the individual is more influential, but that in many cases, the group is essential.

Keywords: entertainment industries, videogame industry, creativity, knowledge creation, innovation, product development
JEL codes: L86, O31, O32

Theme A

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1. Introduction

The fact that there are creative industries and that they operate in different ways from traditional industries is increasingly recognized (Caves, 2000). Works from the economics perspective focus on the differentiating characteristics in these industries, such as the economics of these industries and the organization of work. Recent studies have shown how idea generation operates in a number of industrial sectors such as industrial design (Sutton and Hargadon, 1996) and music (Frederiksen, 2002).

The field still lacks an integrated view that more fully describes the creative process of a technological artifact, yet can involve multiple levels of analysis, as well as the role of cognition within that. The challenge to be explored is the discovery of the connections between creativity, innovation and knowledge creation. However, analyses of these phenomena are for the most part done separately from one another. The creativity literature typically focuses on the creativity of the individual. The literature on the management of innovation looks at group processes such as brainstorming, and the literature on knowledge creation or knowledge management looks at the codification and transmittal of knowledge. To describe a more integrated view, the segregated nature of each of the literatures has to be bridged.

The broad research question posed in our study is that of how creativity is practiced and exercised in the videogames industry. Videogames are an emergent creative industry, and in particular, one that is subject to rapid technological change. We also chose the videogame industry in part because of its connections and reliance on many other influences and industries. We focus on the US videogame industry, in particular, the personal computer segment, because of the larger degree of innovation in that segment historically.

Surmising all our data and analysis, we seek an answer to one specific question: ***When does an idea become an innovation?*** Put another way: Many teenagers or young adults have a fantasy to make a videogame. They all have seemingly great ideas. And yet, the number of great ideas made into great games is far and few in between. To answer what really makes the difference between a great idea and a great game, i.e., an innovation (and a successful one at that), we look at how the professional game designers accomplish their tasks. The answer is composed of a complex set of issues involving creativity, organization and process. By examining different notions of creativity and the roles that creativity plays, we can further illuminate the transition between ideas and innovations. Our study focused on both individual and group creative processes, the individual designer's background, and the product development lifecycle. We

focused on game designers as not only the instigator but also conveners of the creative process in games.

The study focuses on interviews of game designers who were engaged in work on major products. We also rely on another set of project reports on the product development process, as well as interviews conducted by various other sources.[1]

Section 2 briefly reviews the literature on creativity, while section 3 discusses our approach and framework. Section 4 discusses aspects and models of creativity that emerged from our interviews, while section 5 describes the product development process, using it as a context for framing the creative process.

2. Review of the Literature on Knowledge Creation

This study takes as its starting concept the notion of "knowledge creation", which broadly speaking refers to the knowledge created in the development of a product. This contrasts with the term's use in the knowledge management literature, where knowledge creation is most commonly inferred to consist of organizational knowledge codification and transfer (Nonaka and Takeuchi, 1996). Similarly, in the study of the economics of knowledge, codification is an important focus (Cowan et al, 2000), as is the examination of routinized knowledge or organizational routines (Nelson and Winter, 1982). In contrast, the new product development literature's focus is often on the multidisciplinary nature of the teams, or on the variety in the backgrounds of team members (see for example, Vissers and Dankbaar, 2002).

More recently, both Nelson and Nelson (2000) and Pavitt (2002) suggested that cognition is a useful field for innovation studies to broach. We also feel that approaches which attempt to uncover the cognitive basis behind innovation are more promising. A number of historical case studies of engineered technologies have discussed how engineers come up with their inventions, though not so much in cognitive terms as in more personal terms (see for instance, Vicenti [1990], Petroski [1994]).

The notion of cognitive innovation has also surfaced in various other works and disciplines oriented around product development. For instance, Dahl and Moreau studied how analogical thinking influenced originality in the act of new product creation (Dahl and Moreau, 2002). However, an understanding of the fuller cycle of creation of products is yet to be attempted. On a more theoretical level, Nightingale's cognitively driven notion of knowledge as innovation involves the recognition of patterns. This is not unlike the psychological study of analogical thinking (Holyoak and Thagard, 1995; Holyoak and Thagard, 1997). Nightingale goes further in his process model to infer that the scientific process really involves a sequence of scientific breakthroughs and experiments together with the ability to apply problem-solving techniques from the "art and science" of design. While not driven by creativity, the scope of Nightingale's

[1] Two complementary sub-studies are being done on the project and firm-industrial levels to better illuminate the entire picture of creativity in the industry.

approach appears to mirror certain aspects of creativity studied by psychologists: namely, analogical knowledge transfer, and the notion of engineering as problem-solving.

Looking more carefully at the psychology literature on creativity, we are confronted with a wealth of often disparate concepts on the creativity of the individual. Many of these are based on psychological tests of subjects, often using a battery of measures of creativity. These are often criticized as lacking a systemic view, and a broad range of systemic views have arisen as a result (see Sternberg (1999) for examples). In some of these, the concept of stages is quite important. The classical staged process is Guilford's four stage model of preparation (i.e., research or learning), incubation (allowing time for ideas to percolate), illumination (or the point of insight) and verification (or the time of confirming or rejecting the idea) (Lubart, 2000). This has also partly made its way into the business study of creativity, namely, in Amabile's model of creativity (Amabile, 1996). These types of processes add structure to the problem-solving process, and are likely to be seen in some form in product development settings. Other stages have also been added in variants, such as the stage of problem-identification (something other psychologists increasingly subscribe to).

From this brief review, it can be seen that the studies from each perspective only highlight phenomena of a specific interest. The study discussed in this paper seeks to provide a more synthesized view of creativity and knowledge creation as it pertains to processes of innovation.

The Videogame Industry: The Industrial Context for Creative Thinking

The videogame industry has changed complexion completely, going from its initial beginnings as students' larks or fun things to do on university mainframe computers in the 1960s, through an "era of innovation" on consoles and early personal computers in the 1970s and 1980s, to the maturity and focus (some would say the death knell) in the 1990s and the current age, what with the seemingly overwhelming focus on action, war and violence. Despite this, sales from the videogame industry has exceeded movie ticket sales in a number of countries by now, most notably in the US and UK.

The structure of the industry is for the most part composed of independent studios and publishers, with the studios being funded by the publishers to develop games. Increasingly, the publishers are becoming conservative, and as a result, studios are focused on producing "less innovative" "proven intellectual property, high return" products. The fact that the industry is maturing, with many product development teams in the 30 to 50 range, budgets in the few million US dollars range, development cycles in the two to three year range, and ever greater competition, means that risks are high and margins for error small.

Genres and innovation. Our measure of the degree of innovation in a game is based on the game's genre - the convention the industry uses to represent games. There is always some subset of games that attempts to define themselves across selected genres, and an extremely small set that will be genre breaking or (new) genre creating. While the notion of a genre is somewhat fuzzy, it traditionally provides a benchmark for understanding the atypical type of gameplay, and

the degree to which the type of narrative, content and gameplay plays a part, in a subset of games. The main genres represented in personal computer (PC) and consoles were investigated in this study, particularly the genres of real time strategy (RTS) (e.g. Age of Empires), the first person shooter (FPS) (e.g. Half-Life) (which shows the user perspective as the player navigates an environment three dimensional in perspective), the platform shooter (e.g. Mario), simulations (consisting of the simulation of anything from people to cities) (e.g. the Sims and Simcity), the god game (a subgenre of simulation), other strategy games, and music games. These genres were covered in the scope of our interviews by virtue of our interviewees' experience.

3. The Study

Given our focus on creating additional perspectives within the innovation and knowledge management literatures, we broadly examine the notion of creativity in our study. Our approach examines creativity within the individual as well as within groups, using the product development process as the context for when and how creativity operates. However, our intent is not to focus on contributing to the psychology literature on creativity, although the holistic and product/process-oriented view we present may shed some new light there. At the same time, while we sought to find out what makes innovations, the purpose of the study was not to precisely define types of innovations. From industry press information, we are able to deduce that most of the designers we interviewed were in fact innovative or quality conscious in their work, particularly as relating to the games we followed with them.

We adopt a grounded methodology that allows different aspects of creativity to emerge through our semi-structured interviews. The study consists of interviews made of 17 mostly well-known or successful game designers in three locations: the Boston area, the San Francisco area, and the Los Angeles area (including San Diego and San Luis Obispo).[2] Fifteen of these were deemed complete enough to be included in this analysis. Efforts were made to interview the lead designers working on successful or innovative products. These were mostly products for the Windows-based personal computers (PCs), but developers for a few dedicated game consoles and other platforms were included. Information on product design decisions was also gathered from other interviews made with the press and other academics that were published on the Web. Finally, additional data on the product development process are synthesized into our framework.

3.1. The Framework for the Study

Traditionally, knowledge management studies focus on social knowledge creation and the distinction between tacit and explicit knowledge (Nonaka and Takeuchi, 1995). Some studies have paid more attention to the cognitive processes involved (e.g. Nahapiet and Ghoshal [1998]), though not so much as they relate to creativity. In similar vein, our framework takes as its starting point the distinction between individual and group knowledge, as well as the potential for interplay between the two levels. We consciously avoid getting involved in the debate on tacit and explicit knowledge in our interviews, in part because these academic concepts do not

[2] Additional interviews are being conducted in a follow-on stage of research.

resonate easily with industry people, and in part because the process of creativity is largely tacit anyway. However, we attempted to broaden our scope to focus on additional creative thinking and problem-solving styles and processes as found in the mainstream psychology as well as broader (non-mainstream) psychology literature on creativity. Needless to say, the creativity literature is much too vast to cover in a single study, so our interview instrument only focused on selected psychological aspects of creative and brainstorming processes. We also provided room for the designers to describe in their own words what they saw as their pattern of thinking.

Our future intention is to link these patterns of knowledge creation to broader levels of analysis within the industry, so as to understand how and in what way different innovations and models of innovation are emerging across the videogames industry. For the current study, we focused on a limited notion of innovation, such as new genre creation and innovations within or between the genres. We used data from our interviews, supplemented with data from industry reports, to develop a picture of the product development process. This process is used as a template to situate the various thinking models and issues that arose in the interviews.

Videogames being a technological industry, it also necessary to focus on the industrial aspects (i.e., demand and user perspective) as well as the technology (e.g. technology push versus technology pull) elements of game design. Within the industry, there is still no clear codified and established body of practice on game design, let alone a categorization of design characteristics (aside from genres), although some frameworks are just now being proposed.

Our interviews focused on eliciting information from developers on how they think as the development proceeds, including how they interact with other team members, and how particularly innovative ideas are arrived at. We also retrieved background information on the developers and companies they work for through the web. The main information elicited or issues that surfaced during the interviews consisted of information on:

- Backgrounds of the designers.
- Thinking and idea generating skills, styles, techniques and circumstances.
- Individual and group mechanisms for organizing product development.
- The process of game development, particularly concept formation in its early stages.
- Constraints and other factors in game development, namely, players and player communities, markets and publisher-studio relationship, and impacts of or use of technology.

In order to present the information in their most natural settings, in the following sections, four aggregated discussions of creativity are presented, each oriented around a different perspective:

- The designer's thinking styles.
- The model of organizing creative work.
- The game as an innovative artifact.
- The product development process for games.

4. Creative Thinking

4.1. Individual Creativity: The Influence of Background

The literature on creativity is too vast to cover in a single study, so we rely on the approaches more relevant to the study of creative people's lives and works. One approach utilizes the examination of life histories, and of how the background of creative individuals comes into play in their work. Classic examples include Gardner's case studies of seven geniuses (Gardner, 1993) and Simonton's study of genius (Simonton, 1999). Many other perspectives on genius also exist (Sternberg, 1999). Some psychologists use grounded methods to study artists, writers and other creative individuals (Mace and Ward, 2002). There appears to be less systematic study of the backgrounds and thinking processes of individuals in technological industries, with the exception of case histories on how certain engineers worked, and the psychologists' study of scientists (e.g. Simonton, 1999).

As Table 1 shows, in the companies we interviewed, while programming is a major part of some chief designers' formal training and interests, there is a great variety in others as far as their background and training. Perhaps the single most important factor in influencing individuals to pursue a design career is the love for games. Another important factor worth noting is that at a younger age, many of the professional designers liked to construct or reconstruct the rule sets of games (especially board games). The games industry also revolves so much around an "interactive" experience that it requires the designer to have a high level of empathy with player needs, such as understanding what a player likes to see and do, or whether something will appeal to the player. In this sense, being a game player is essential to making good, appealing products that resonate with players.

[Table 1]

4.2. Individual Creativity: Thinking Styles

A second major creativity issue is the thinking styles and thought processes that designers possess and use. The psychological literature treats problem solving as an analogical process, while other broader takes on creativity also include such general skills as recognizing patterns, dimensional thinking, modeling, transforming, playing and transforming (Root-Bernstein and Root-Bernstein,1999). Note that while in psychology, the term "problem-solving" is used to describe creative activities as well, we seek to distinguish between (what we call) mundane problem-solving and creative thinking styles, and especially the more creative problem-solving processes. This is in order to distinguish the types of thinking and quota of creativity within the design process from the "cookbook" approaches known to be used in traditional engineering processes. A better classification of these types of skills can help our understanding of what it takes to develop games, and especially, innovative games.

In our interviews, a wide variety of creative and problem-solving processes seem to occur in line with the broader discussions of creativity (e.g. Root-Bernstein and Root-Bernstein, 1999),

though not in any regularly occurring or generalizable fashion. As shown in Table 2, the various game designers discuss using a variety of skills and techniques such as:

- Problem setting or framing
- Out of the box thinking, including techniques like imagining the reverse of a problem or objective, or bringing clashing ideas together
- Visualization of dynamic consequences (of design decisions)
- Cross-pollination
- Intuition
- Listening and communicating to the team.

[Table 2]

It is apparent from the table that the thinking skills roughly fall into two categories: creative (e.g. intuitive or involving divergent thinking tools), and problem-solving or analytical (e.g. problem structuring or constraint satisfaction). Furthermore, in many instances, designers reported using both types of skills (analytical and creative) either together or in a back and forth way in the design process. This is apparently due to the nature of the artifact being technologically complex, yet requiring of artistic or intuitive inputs.

Creative Thinking

It is worth noting that what is traditionally seen in some circles as creative thinking skills – lateral or divergent thinking – only has one equivalent here: out-of-the-box thinking. There are many other skills or thinking styles which are creative in themselves, if not complementary to creativity. One creative skill that shows up fairly dominantly in our interviews is analogical thinking.

Analogical thinking in the sense that is conventionally studied (e.g. a scientist mapping past knowledge onto a new situation) is only partly seen in game design. In game design, it is trickier to identify analogies as they do not just occur within a clearly demarcated context such as science. Sometimes, a designer directly uses a metaphor or real world analogy in a situation, or remembers a past incident that might help this particular design problem. However, other forms of analogy are more likely to take place, as when a designer directly adopts a feature seen in other games into his or her game (but possibly even in a different genre). At least one designer (RockStar Games) noted that he reused ideas wherever possible, and yet the designs he participated in were sometimes considered substantially innovative. Another designer for Tilted Mill noted that they tried to bring as much of the fantasy environment and experience (from either books like Tolkien's or "pencil and paper games") into their games. This latter is a form of analogical thought, but rather than translating from one situation to another, they are actually translating from a different medium, and in the process, also transforming the concepts. This type of analogical thinking is quite common as games are essentially constructed from (the designers' experience) of different media. A typical game involves some combination of narrative (i.e., story), character generation, sound, visual effects, and gameplay. Each of these presents an opportunity to form analogical material in games from their original media (i.e.,

books, books and movies, movies, music, and other games respectively). From our interviews, designers were constantly relying on their past backgrounds and experiences (e.g. material from side interests in reading) for their design work.

Problem-solving

The occurrences of problem-solving may be classified into two forms: mundane problem solving and creative problem solving. Mundane problem solving (i.e., reading from a cookbook) is probably not a critical part of an innovate game, but what we call "creative problem solving" appears to play an important part in game development. This is located somewhere between "pure creativity" in the random or intuitive sense, and mundane problem-solving. Creative problem-solving sometimes involves reframing the problem to make it amenable to solution, but can also come from innovative solutions to the problems.

The Centerscore approach involved breaking down a problem technically, which involves analytical or rational approaches, then "creatively" solving the individual problems. This approach was also described by the designer at Insomniac Games. The Centerscore designer commented with an interesting metaphor that creative problem-solving could be requiring more variety in way of additional "cookbooks", rather than the traditional cookbook needed for a more mundane problem-solving exercise.

In general, the interviews in Table 2 substantiate that the thinking styles involved in game design appears to range from the totally creative (e.g. random, intuitive or out of the blue) thinking, to analytical, structured thoughts. The analytical part is self-evident if one thinks of games as much like any other type of software – high level code or representative components will have to be structured, layered, and laid out (via a high level systems analysis), then coded and fitted together. Thus, fairly analytical issues will have to be addressed in narrow domains. But where games differ from ordinary software is in that the designer, and often, the programmer or artist, will have to make "creative tradeoffs" or other actions (e.g. to adjust the code) in order to achieve a certain visual or other effect, and in this, intuition of the user's response and other "creative thoughts" can come into play. Thus, in addition to the more mundane programming tasks, we see game programming as involving detailed design (i.e. creativity) sometimes, and also involving of creative solutions. This role is also seen when we talk to designers about how reliant they are on the team. An example is that of modeling an explosion on screen. The designer may just design "the fact" that an explosion will take place somewhere in a play sequence when something triggers it, but the programmer could spend weeks just tweaking it to look "just right" to a player (interview with designer at Irrational Games). The same could occur with an artist who may be modeling the explosion's graphics.

4.3. Models of Organizing Creativity

We next discuss different models for organizing creativity at the individual and group levels. Models of organization will help in our search for creative models by providing us with the links between the various individual and group level phenomena. These models help to synthesize some of the background information and thinking models into processes and overall modes by

which designers operate in their pursuit of innovation. At this stage, we do not focus on where the designers get their influences from for their creative acts (this is covered in the later section on idea conception).

[Table 3]

From the table, we can distill certain things about individual control over creativity and direction, and team contributions to creativity.

Individual Models of Creativity and Control

Beyond the fact that designers participate as individuals in game design, there is a lot of mileage that can be gained from looking systematically at different roles in "controlling creativity" that they may have. From our interviews, at least three models of creative control are seen to occur at the level of the individual:

- The solitary developer, who fully controls the whole process either up to the core concept refinement stage or through project completion.
- The vision builder, who controls some core concepts, especially at the initial (conceptualization and core concept refinement stages)
- The coordinator, who takes the vision as defined elsewhere and implements it

Looking at purely innovative games, it becomes clear that certain individuals could maintain a solitary vision and control over a project, often one where they alone or a very small team did everything. This is particularly true of designers who got their start in the earlier 'golden age of innovation' in videogames, circa 1980s. People like Will Wright, Sid Meier, Danielle Bunten Berry and Chris Crawford were for the most part lone designers in the beginning of their careers (which was a time when games were simpler), and could keep control over their work and vision.

There is an exception to this, which is the designer who, not so much with innovation or desire to control in mind, still exercises most of the control over the design. This incident occurred in one designer's past studio, run as an inhouse studio for a large publisher, which because of extreme time pressures, required the designer to exercise total control over the design. The designer wrote all the design specifications (design document - defined later) and gave it to the team to implement. This model is probably not unheard of, even though it occurs at the end of the non-innovative, control-oriented spectrum.

Nowadays, with complex projects of larger sizes, it is harder to be the solitary controller creative type (and being the control oriented type may even work against one). The lead designers that we interviewed nowadays seem more to act as co-participants and shepherds in the creative process, often maintaining the vision for others who may have set it, on top of exercising their role to provide more detail on the design.

A second type of designer seeks to set the "tone" or style of the game. These designers pay especial attention to the style of the game. The designers for Carbon 6 and Oddworld were two such individuals. The designer for Carbon 6 brought in darker influences from his side interests in order to foster a dark look to his game. This is not uncommon in "art-driven" games. Similarly, the programmer-designer at Gas Powered Games controlled much of the innovation and gameplay as the game's development proceeded.

The third type of designer is one who is not fully responsible for coming up with the initial vision, but takes as given the core game concept from someone else (or from the group if it's a group's idea). He or she then guards the game vision through the process by coordinating the implementing group. This is not to say that an innovative game cannot come out of the process (for instance, Irrational Games appears to have used this to come up with a fairly innovative game).

Design experts and newer group processes alike appear to require substantial time before their work fully blossoms. This is not unlike studies of other masters and experts, such as Chase and Simon's study of chess grandmasters, but in the technology setting, it is the co-evolution of the game technology, the maturity of the designer, and the maturity of the design, that allows this to happen. A perfect example of this is the game Grand Theft Auto (GTA) 3, which, despite receiving the most negative press ever for a videogame, has also won many major awards (implicitly involving design) this year. The game design is nearly perfect, but it took three iterations on the same theme (GTA 1 and 2), and a technological advance in the game's engine for dynamic visualization in 3 dimensions, before the game could "blossom".

As noted by a few designers (particularly those with film industry experience), the main difference that the game industry has with other creative industries such as film is that almost all the designers profess that they depend heavily on the rest of the team for their creative inputs and eventual success in developing the game.

Group Models of Creativity: Beyond Brainstorming

In reading typical writings in the videogame industry by game reviewers, the picture of the lead designer as "lead player" or leader distinctly emerges. However, our interviews suggest that many designers consider this a necessary but inaccurate evil of an industry in search of role models or success stories to advertise with. They actually consider their role as necessary, but not sufficient for the job to get done. It is almost a philosophical question: without the designer in question, the game almost certainly would not have been made that way, but could another person have filled his shoes? The designers we interviewed certainly had a major impact on the products that were discussed. However, they clearly also could not have made the product without a successful team effort, and in many cases, a brilliant team at that.

Brainstorming processes, once considered inefficient and out of vogue by psychologists (Stroebe and Diehl, 1994), have recently resurfaced in the business literature. Leonard and Swap detail how brainstorming done properly can benefit outcomes from groups (Leonard and Swap, 1999).

Similarly, Sutton and Hargadon (1996) found that when the outputs are measured properly, brainstorming has positive outcomes, particularly in design intensive firms.

Engineering is known for its team-based nature and in the development of technological products in general, group processes are taken for granted. But since creativity is one important essence of games, it is useful to look for further confirmation of what exactly groups do in game development. It appears that few have examined the whole process of creative product development for tasks beyond the initial brainstorming. In some sense, brainstorming is simply the act of new idea creation, but having the idea take on more form and substance is a substantially different issue.

In the game development process, one important set of issues that has emerged has been the importance of group processes. At one extreme (particularly with regards to creativity) is the "cabal" form of model, in which the entire team participates more or less equally in the creative parts of the product development process, from the initial conception of the idea to the final implementation. This term was coined by the studio Valve in their development of Half-Life, a game that set new standards of quality of experience (but not necessarily innovation) in the first person shooter (FPS) genre. However, there were few serious innovative features in Half-Life, and perhaps the most innovative feature overall was the game's ability to draw the player into the setting through various techniques, e.g. interactive non-player characters. The "cabal process" at Valve is unusual in that it has been recorded as a process where literally the whole team was involved in the entire design, and no lead designer was involved.

Somewhere in between the "cabal" or pure group process and the designer as individual (discussed earlier) is the model of creative interaction between individuals and groups. Our interviews suggest that the group level processes are intricately tied up with individual level processes. By examining the group process more from the perspective of the individual, we can uncover new processes at work beyond the typical models of organizational knowledge creation or brainstorming.

In many situations, individual team member contributions are invaluable. Many of the designers we interviewed paid great tribute to the creativity of the teams they were involved in. Thus, it is quite clear that while an individual designer may be responsible for anywhere up to most of the core beginning concept (e.g. one designer who was well known in the industry for his game designs still only claimed up to 50 to 60 percent of the credit for creative input), the team will be responsible for the rest of the creative inputs and innovations.

The type of group creativity most commonly discussed in our interviews is the "riffing" model, akin to a brainstorming process where the team members "pile in", bounce ideas around, and overall, causes ideas to take shape (this appears similar to the "jamming" process seen in other creative activities). Sometimes the first seed of the idea may have been interspersed by someone inside or outside of the group. For instance, the designers of the game Thief were the first to think of having a character sneaking around like a thief, involving different weapons and tactics than a frontal attack type of character would have had. This came about from two or three leads

in the company bouncing ideas around, with the original seed for the idea coming from one person (interview with Irrational Games).

Another example of games that followed this is Ensemble's game Age of Mythology, where the seed was planted by one of the company heads, after which the whole team piled in on the design (interview with Ensemble). Even in such circumstances, a designer usually has to take charge of the process, guiding it, and making executive decisions where necessary.

4.4. Moving from Creativity to Innovation: Focus on the Product

The last two sections discussed elements of how creativity works in and is organized in game design. The distinction between problem-solving and creative thinking in section 4.2 raises a general issue: that of how an innovation is partly creatively based, but also involves a rational process of problem-solving that delineates the components of the game. Further, the fact that some game designs are organized wholly around an individual, and others are group-based, indicate something innately different about the structure of different types of games. In this section, we highlight the product's point of view with a discussion of the innovative nature of games in order to tie these issues together.

Traditionally, studies of creative work suggests that exposure to broad influences can help an artist or creator. For example, the studies of IDEO and other design firms by Sutton and Hargadon (1996) suggests that access to more knowledge bases can help designers brainstorm more creatively. Our study appears to paint a similar picture. We found that designers (and other members of the team) rely on their backgrounds and influences from different spheres of experience, and will often piece these together into a cohesive whole and a compelling experience. How they piece their experiences together depends on the model of innovation being pursued. However, the technological and constructivist nature of games paints a more complex picture. To distinguish amongst these, we classify games into different types of innovations, and the models by which the products are created:

- Piecemeal creation - in which the spine of the game is loosely developed (e.g. based on an existing game genre) and game elements added on piecemeal to the spine.
- New genre creation – in which the designer comes up with enough innovative features or an entirely new game, that as a whole, can be classified as a "different animal".
- Imitation.

The distinction between problem-solving and creativity is quite inherent to the piecemeal approach, although both types of thinking may occur in any of the three models. The fact that structure generally must exist and be imposed on game design in a top down way suggests that games may actually be developed in the same manner as construction systems, and may require more in the way of thinking of a constructivist approach. This piecemeal approach may involve analogical thinking as well as additional skills like synthesizing abilities, that is, to be able to weave concepts from different media and past games into a coherent and "fun" whole. Perhaps

even more importantly, this infers a type of thinking that involves greater tacit knowledge of "what works" in general and over multiple specific situations.[3]

Even imitative games and fairly innovative games can be seen to be developed in a constructivist way, that is, by piecing together elements from previous games, designer's experiences, and work. For instance, a fairly innovative game, Startopia, was developed by blending a few different genres, namely, real time strategy, simulation, and the "god game simulation" genres. The piecing together of the game came about not so much through a brilliant insightful creative episode, than through a mixture of high concept, game design, and creative problem solving.

Likewise, it is clear that imitative games also require a type of analogical thinking involving the direct translation from one context (i.e. a previous game's design) to a new context. This may be most heavily used in games that are sequels to other games, or that are ports of movies, both of which are considered typically less innovative.[4] The transport of specific game elements (as opposed to the whole game), such as scripts and specific gameplay, can also sometimes involve analogical thinking, for instance, the porting of a story about races fighting each other for survival is a common and overused theme in many war, fantasy or science fiction strategy games.[5]

The other innovation link is that of the relationship between new genre creation and the need for individual control over creativity. The wide variety of backgrounds and broad side interests seen in our interviews directly contribute to the designers' creative work on these types of innovations, particularly the first two types. The designer's background and interests (in the player model or vision) can be critical particularly if the designer is seeking to create a new genre or subgenre. This may also require the designer to be evolving a model of how players play (discussed more in a later section). However, very few seem to embark on the new genre creation approach, in part because the need to respond to commercial pressure may force them to develop in the piecemeal or imitative way, and in part because it requires real genius, abilities and opportunity to take risks, in order to come up with a new genre. The ones that can tackle this approach successfully have the genuine respect of almost all their peers and players alike.

5. The Videogame Product Development Process as a Context for Creativity

Thus far, we have been examining the creative processes somewhat independently of the product development process. In this section, the focus is on the different stages of the product development process, and how the role of the individual and group, and the manner of creativity

[3] This is why so many good designers and developers are game players themselves (as shown in the earlier table), and why organizers of teams demand such interests of their new members. The coding or designing of something that has to be interacted with requires great amounts of experience.

[4] These are also less likely to make a company or designer "known" for creativity (but has the advantage of more guaranteed or increasing sales).

[5] In a way, player familiarity and expectations of "something familiar" are what drives these scripts and forms of gameplay to be overused, are what drives genres to stay together (i.e., new games to continue down the same path), and are why many decry the decreasing innovation in the games industry.

changes across different stages. For this, we rely on data from our interviews, as well as from another set of project level data on product development.

Product development and the associated creative acts can occur in roughly three stages:

- The first level consists of an idea conceptualization phase, where the larger picture or vision is fleshed out, including some core concepts which differentiate the game – this appears to be where the broader creative sketch of the whole game occurs, and is followed up by an initial concept/proposal phase (resulting in a document from one page to a few dozen pages long).
- The second level consists of the design detailing level, in which the whole game is fleshed out – this results in a design document of a couple hundred to a few hundred pages, and is essentially a detailed road map for the game to be developed. The design document codifies most of what was tacitly known before at the idea inception phase, and ensures a "doable" project.
- The third level is the implementation level – this involves individual programmers, artists and other team members actually implementing the design document specifications.

Different creative processes may occur in different stages of the product development process, for instance, the idea conceptualization may involve one or more designers or team members riffing or working off one another. The core design (still at the first stage) may involve one or more people working together. Design detailing can involve one or more people as well (the extreme is the publisher owned studio model described earlier, where the designer fleshed out the entire game in detail). Finally, creativity is still inherent in implementation, as when programmers have to face technical challenges in coding, or when they have to make decisions on how the code will make something beautiful or appealing (e.g. the explosions example earlier).

In our interviews, much of the concrete evidence on creativity appears to be situated in the initial idea conceptualization stage, but lower level (design-wise) acts of creativity do occur in the rest of the product development process.

5.1. Creativity during the Idea Conceptualization Stage

The initial idea for a game may come from a number of sources, the more spontaneous being situations such as when a designer is driving along, thinking by himself, or riffing with colleagues. This section examines the variety of influences on idea creation. One of the beginning premises of our study was that brainstorming and brainwaves were largely responsible for innovative products, and that creativity was most clearly marked in the initial brainstorming of a game concept. Analogical thinking is probably one of the key mechanisms by which new ideas are created (Dahl and Moreau, 2002), but this still falls mainly in the "illumination" phase of the typical staged process of creativity. When we asked designers open ended questions about what had led them to come up with their game ideas, the range of responses our interviews elicited indicates a more complex picture of idea creation.

Just following idea creation is an additional important step involving the sketching out of the bare outline of the game. That is, in the playing of the game, what would differentiate it from other games and make it interesting. By the end of this process, the idea would have been fleshed out in some detail. The initial game design can often be summarized in a page long document, detailing the basic idea of the game, including and relevant distinguishing characteristics, such as the style of gameplay (or how the player interacts with the game), the story, and the visual style. While this would appear to be a simple matter to do, in many cases, the document would have to encapsulate the designer's knowledge of existing and future capabilities of technology in order to be realized.

Table 4 lists various ways in which designers described how their ideas came about. For the most part, these were the individual designers' contributions to the games. Each game appears to come about from a particular focused influence, but sometimes, as in a well-established genre, the designer may focus on a particular "style", "look" or "purpose" of a game. Finally, as we noted earlier, while certain types of games are designed as piecemeal artifacts, the contributions may not necessarily be fully attributable to a single influence or even a single person.

[Table 4]

These and the additional information we obtained can be summed up as five factors influencing the idea or concept of the game:

- The designer's background
- Inspiration via an act of stimulation
- An outside-defined need
- Own research
- Evolution towards a vision of a "player model"

Background

As noted in Table 1, background is a useful indicator of the type of game the designer may make, either through their familiarity with the material, or their interest in making a game on what they have a side interest in. As shown in Table 4, a few designers professed to have many interests which they continued to follow and to rely on for inspiration. Such commonplace inspirations can appear at either the beginning of a game's conceptualization, or as in pieces added onto a game's main spine.

Inspiration via stimulation

While there were a number of instances where brainwaves stimulated ideas for games, this is still far from a general model towards creative thinking. Brainwaves may be linked in complex ways, for instance, external inputs may trigger a process of analogy, or may lead to a new way of thinking about a game, e.g. the linking of two very different phenomena into a fusion concept. Furthermore, inspiration may involve an already existing deeper interest, e.g. the designer for Alice already had interests in "dark" subjects, so the inspiration to do a dark design for an

unrelated title (i.e., what is normally thought of as a children's title) was a matter of bringing the two unrelated concepts together.

Research
There are at least two purposes for research: Some designers do research to back up an initial vision or idea, while in rare cases like Will Wright's, research is done in order to uncover the new concept itself (as it emerges in the designer's mind). Research is sometimes linked to interests. For instance, Will Wright's years-long research on systems dynamics and other forms led to his path-defining SimCity, while his research into new architectural paradigms led to his recent The Sims, the biggest PC game seller in history. While research was the hallmark of Will Wright's games, these occurrences are quite limited.

Need
For many designers, the current product is defined by the heading/direction of the product line or perceived direction of the genre. This is where the market oriented or commercial nature of games are most evident. Most designers acknowledge having to operate under constraints. Thus, when the product has to be a sequel as demanded by the market or publisher, this constrains any new features to be at best an extension or addition to a previous product's features.

Evolution of a Player Model or Game Design Philosophy
Some designers are driven by a lifelong "quest" or evolution towards some higher refinement of their games, usually based on interactive elements or a similar vision. Experimental methods or numerous refinements may be geared towards this unknown or less explicated "model" within the designer's mind of how the game players' experience can be enriched, not simply through more compelling or visceral visuals (which many technologists and action game developers subscribe to), but through refining the complex mechanics of gameplay, replication of a real world experience, or other means. This model typically applies more to the standout designers who are attempting to refine their game design skills over time.

Some of the leading designers that we interviewed discussed at length about what they sought to make in their games. As their career progressed, they appeared to be reflecting more on what makes their (or other) games fun or to be able to standout. Some of these "player models" or game design philosophy included: realizing a more complete and consistent fantasy world (Tilted Mill), attempting to make music accessible to non-musicians (Harmonix), creating multiple optional paths in a game (Irrational), creating emergence (unintended dynamics) (Gas Powered Games), modeling thinking and interactivity (Chris Crawford), and building experiences based on alternate recreations of life (Carbon 6). As can be seen, these goals seem almost like quests that lead the designers to evolve their art and technology to greater forms.

5.2. Creativity During the Fleshing Out or Pre-Production Stage

Beyond the initial conceptualization of a game, the final stage (with the exception of testing and quality assurance) is often a preliminary stage to concretizing the idea of a game, either in a formal or informal way. In the formal sense, the industry refers to pre-production as a key stage

for ensuring a smooth production and implementation process (interview with Rockstar Games). The informal equivalent is where the idea is "fleshed out" by an individual or group working together. This may occur in earlier, newly set up or messily run studios. (For our purposes, we refer to both informal and formal processes as pre-production.)

The pre-production stage is where a creative designer appears to lay down much of the core or groundwork for the rest of the game's implementation. Following the metaphor of the spine of a story or a tree, the core design can be considered to be the trunk and main roots, from which the branches and "smaller roots" (i.e. details such as the specific features, graphics, user interface, and gameplay [or manner of interaction]) can be "grown". It can take up to a few months or more of work to define the game at this level, although seriously playable product or testing would take place as yet.

From many of our interviews, it appears that creativity at this stage really involves the team members following the "vision" laid down in the initial conception stage. This involves maintaining the innovative path for the game design that was laid out in the conception stage, in terms of energy and creative input.

Perhaps the most common model mentioned for this stage is that of a lead designer or small core team (e.g. several people) led by the lead designer setting the core visual style or a playable sequence (i.e., code that can be partially played to "experience the game). The designer or company can then use this to convince the broader company or a publisher of the importance of the game and the need to get on board with the project. Pre-production sometimes results in a document dozens of pages long, with accompanying artwork, which may be used in a proposal to a publisher. Examples of the pre-production stage in our interview sample included Alice, which took 3 months to develop. Designers involved in new genres may take even longer. For instance, although Will Wright also took months to develop the core of his games, Wright backed this up with two years or more of research, often reading widely. Many teams also take on the order of months for pre-production. Sometimes, in the case of very detail-oriented designers, pre-production may have resulted in a longer hundreds of pages long document, effectively a design document.

Ideas are Cheap, but Implementation is Everything

Time and time again, the designers we interviewed noted that "ideas are cheap" or "plentiful", and that implementation was key to a game's development and eventual success. That is, the difference between the inspiration for a "creative idea" and a successful innovative game is made up with a lot of hard design, technical problem-solving and regular old programming/art/other work.

This also directly addresses the issue of how much a creative idea contributes to an innovative game. While with some path breaking games, it appears that the designer was primarily responsible for the core concept, many designers have also noted that the successful games (innovative or not) were ones where many creative and important problem-solving acts took

place on the road to the product's success. This is the process of implementation, and it starts from pre-production, and lasts all the way to production and even after release (with the fixing of programming bugs and design flaws).

While the creativity in a game sometimes rests in the concept, the process to arrive at the concept is sometimes transparently obvious (a reversal of an original concept, e.g. Dungeonkeeper, which reverses the role of the player, so that instead of controlling the party entering the dungeon, the player controls the dungeon), while in other instances, like the Sims (playing "computer peoples' " lives out on the computer), is seemingly mundane, but leads to a revolutionary product. This points to another skill in creativity: the ability to recognize a bad idea from a good one.

5.3. Creativity During the Production Stage

The full implementation of a detailed design takes place at the stage of production. At this stage, a larger scaled-up team (usually about 15 to 30 strong, and sometimes, more) of programmers, artists, level designers, and other employees (e.g. writers, sound, testers, etc.) are involved in building up the game line of code by line of code, image by image, and level by level.

This stage usually commences with a thick document of a couple to a few hundred pages detailing every feature of the game. The design of levels is usually an ongoing process, and proceeds well into the game's development. For many teams, the core idea of a game is often locked at the stage of the design document, although the details (and therefore the document) can change to reflect changes in smaller or other features. In some cases, a team will continue to revise the design (and design document) as needed.

The process of developing a game involves much more creativity than the simple inspiration or need at the conception stage. From our evidence, it seems that a game becomes an innovation more because of the implementation of the idea than the fact that the designer has a miraculous brainwave. ***This suggests that a more continuous form of creativity rather than just a flash of insight is the underlying cause of an innovative game.***

In further support of this, our interviews suggested that a great deal of creativity was exercised in a detailed way by all members of the team. This may include such ways as the coming up of an idea to add to the game, or the actual way an idea is implemented. Even the instance of a programmer who has to implement design details such as how a certain explosion would look could be "creatively" tweaking the code and its effects for weeks till the effect looks "just right". This requires an element of both technical sophistication, as well as a tacit (even empathic) appreciation of what works, and what the user would enjoy.

Of course, the insightful idea should have been compelling in the first place, and the synthesis of the elements comprising the idea done well, but in the end, the actual implementation is still necessarily important. All it takes is a single flaw, e.g. in the user interface, to render the game playing experience unplayable or un-enjoyable for the player. This is why more than a few designers noted that they considered the implementation of a game to be far more important than

the idea itself. In their estimation, any good designer should have been able to come up with a surfeit of good ideas to begin with.

6. Conclusions

In answer to our question, "when does an idea become an innovation?", it is clear that creativity plays many different parts, and that different perspectives have different things to say.

Firstly, the definition of creativity influences the answer. When creativity is distinguished from problem-solving, we can see that the location of the innovation's gestation changes from the initial inception of an idea to the actual creative problem-solving acts taken after the sub-problems are structured and laid out. Furthermore, the types of creativity applied to game design may include analogical thinking and other means, but as we show, is complicated by the technological and complex character of modern videogames. For instance, analogical thinking can mean many things in the constructivist mode of videogame design.

Secondly, by examining the locus of creative activity within the individual and group, we can see that it depends on the type of innovation and the particular game in question. Some innovative activity occurs more within individuals, and others within groups. As a whole, individual creativity appears to be more important for innovative products such as new genres, but truly creative individuals (or the right circumstances that allow them to operate) are far fewer. On the other hand, creativity can involve a group as much as an individual, particularly at later stages of the product development process, and for any but the most innovative games. There are circumstances where the individual designer's role may be critical in forming the core of the game, at least through the stage of pre-production, but that is not sufficient either.

Thirdly, by looking within the backgrounds and influences of individual designers, we see complexity in the source of ideas, and sources that are intermingled. For instance, a designer's previous inclinations towards certain styles can be coupled with an inspiration or need at a particular moment to help him or her to realize the core concept for the game.

In sum, it is clear that videogame design is a complex process with many paths. Creativity is strewn along each path, and indeed, innovation is as much in the implementation, that is, the entire road taken, as it is in the idea at the start of the road. That there are many paths to innovation is perhaps aptly captured by the metaphor of one designer's goal: to allow for the emergence of as many alternate paths through his games as possible.

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Interviewee	Background skills	Interests
Tilted Mill	Designer 1: Art, music	Designer 2: plays games, designed paper/pencil games
Harmonix	Music, MIT media lab graduate	Music
Irrational Games	Script-writing, Hollywood scriptwriter	Designed board games, comics, war history
Gas Powered Games	Programming	In games his whole life, reads widely, board games background, plays games
Chris Crawford	Programming, MS in physics, previously a teacher	Book knowledge (reads widely), analyzed pattern of play of war game
Carbon 6	Programming (wide background), started in industry in tech support, then level design, then producer	Games, music, movies Likes the "dark" look/style
Oddworld	Film – started as photo illustrator, then art director, then games	Movies, TV, books (mainly about stories)
Insomniac Games	Art for games	Has inventor side, likes to tinker, program, read, movies
Naughty Dog	Economics Started with some programming, then some art, then management First few games were failures	
Centerscore	Electrical engineering (other 3 partners were CS majors) had consulting or engineering jobs)	Game players, programmers (for fun) Won contest for innovative ideas
Ensemble Studios	Political science/English, did other things for a while	Game player, made board game rules
Rockstar games	Started in testing for Bullfrog	Game making, reads widely
Nihilistic Software	Worked as level designer, moved up. Trained as architect	Movies, role playing (pencil and paper) games
Maxis	Programming	Broad reading interests (architecture, systems dynamics, biology)
Relic Entertainment	Programming, then design, then moved into running the business	

Table 1. Background Factors for Fifteen Designers

Interviewee	Thinking styles/Thought process
Tilted Mill	Good at visualization – the ability to see thru consequences of design decisions.
Harmonix	
Irrational Games	
Gas Powered Games	Creates by thinking the opposite, communicates by metaphors. Cross-pollination occurs through "just doing".
Chris Crawford	Thinks in exploratory fashion, then researches and analytically approaches problems
Carbon 6	His problem-solving and creative abilities count - creativity seen as discovery. He creates by thinking the opposite, "collision, evolutionary and shotgun thinking" "Big on metaphors", reframing issues. Creativity is married to the technical (constraints etc.).
Oddworld	
Insomniac Games	Thinks on his own, but as lead designer, works with team, must communicate well. In game creation, he moves back and forth from right (artistic) to left side. Creativity is an "intuitive thing", like a "cloud", something he finds fun is important. Break down requirements analytically, then creatively work on each part. Also can start with high concept creativity, e.g. design of level.
Naughty Dog	Collaborative - with partner (programmer).
Centerscore	Both general creativity and problem solving are used - framing the problem is technical, then solving is more creative. To solve problem, must know "a lot of cookbooks" – technical problem solving Need to understand the player better than average, need to love games.
Ensemble Studios	Creative and critical thought process necessary. Mark of talented designer is knowing how to shape game mechanics.. Problem solving and creativity are intertwined. Designer's role is to listen, communicate. No ego, quite realistic.
Rockstar games	Given an idea or concept by others, and has to use analytical skills to design. Skills: Some is intuition and some is research (on what worked before). Have to satisfy constraints, using creative problem solving. Level headed, no ego, must rely on people around him.
Nihilistic Software	Concept was passed down, and he made use of it. Very collaborative design process where communication with team is key. Riffing on his own, i.e., taking a theme, playing with it a little bit, then mixing it up to have more fun. Trying to know if something is "fun".
Maxis	Came up with concept on his own after much research into various areas.
Relic Entertainment	Came up with concept by brainwave

Table 2. Thinking Skills and Styles Cited in Interviews

Interviewee	Creative models: How is creativity practiced?
Tilted Mill	2 models possible: (1) total designer control, (2) give team control. In general, team members need to be given space to do what they want, but should be kept from doing the "crazy" things.
Harmonix	Team model, but one individual coordinates.
Irrational Games	Individual does vision (set goals), and some of the detailed design (e.g. dialogue) that helps to set the style of the game. Creative contributions of team are essential.
Gas Powered Games	Individually "swims" in the material. Actively manages team, depends on creativity of others, e.g. via "natural idea mutation".
Chris Crawford	By himself ("innovation doesn't happen by committee").
Carbon 6	Does thinking up front by himself, then with core group, to set the style of the game. Creativity relies on team "95%", but needs an executive decision-maker (need to maintain a single vision).
Oddworld	Sets the vision, then tries to infuse team with it (but not easy). He wants team to co-create but has to take lead role for now, giving high concepts.
Insomniac Games	Now, group comes up with vision, but structure held together by a single individual (company head). Sometimes, a group-think comes up with weird ideas, sometimes, it's a single designer coming up with the idea.
Naughty Dog	Group collaboration – but reflected through eyes of one. Group ideas are more complex and impossible for an individual to come up with. Lead designer and he hold the vision– he controls a lot.
Centerscore	2 or more models can occur in the company: 1. Mutual buildup of ideas (different backgrounds help with brainstorming) and team will "pile on". 2. Original idea rests with one, but group helps that person.
Ensemble Studios	Everyone on team helps to iterate on basic idea once it's formed, then in implementing and contributing to it. Designers guard vision and keep the team together.
Rockstar games	In past, he worked at a flat organization (no official designer), all teamwork, but lack of formal process hurt efficiency, helped innovation. His designer role is a more structured role, putting in place game mechanics, coordinating things.
Nihilistic Software	High concept handed to him. Leading design requires collaboration on design. Challenge to be creative in "a small space".
Maxis	Did the high concept and initial game prototype
Relic Entertainment	Came up initial vision, and put together team to make it happen (became his company)

Table 3. Creative Models Described by Designers

Interviewee	Innovative Ideas/games	How ideas came about
Tilted Mill	Lords of Magic (RPG/RTS)	So obvious to them as players, Influences from fantasy worlds, but consistency is important
Harmonix	Frequency (first US music game)	Stimulated by Parappa the Rappa (first Japanese music game)
Irrational Games	e.g. Innovative gameplay in Thief, Freedom Force (based on comics)	Own passion to develop games based on his interests
Gas Powered Games	e.g. Total Annihilation – emergent game style	Follows from interest in subjects Gets "a kick out of innovating"
Chris Crawford	e.g. Trust and betrayal – first simulation of diplomacy and emotions	Inquiry into fundamental need, flaws in games: how thinking processes affects design issues
Carbon 6	Alice (innovative dark take on Alice in Wonderland theme - RPG)	Driving along – flash of insight for theme Brought in dark influences from his own side interests
Oddworld	Oddworld – compelling characters and environment	Desire to represent real world inequities –as in film
Insomniac Games	Ratchet and Clank platform game - Innovative level (i.e. stage) design	Many influences from movies (e.g. level with moving train came from movies about trains)
Naughty Dog	Crash Bandicoot platform game – 3D look based on innovation	The idea started with a problem setting exercise (how to accomplish a certain look)
Centerscore	Cellphone games	Creativity coupled with problem solving, "Riffing" with team
Ensemble Studios	Age of Mythology RTS game	Group sat down – initial seed may have been planted by studio director, but group riffed, vetted design and added to it
Rockstar games	Startopia (previous job) – innovative space simulation/strategy game	Theme was handed to him and he designed gameplay and other elements (sometimes, key people are asked to come up with concept)
Nihilistic Software	Platform game currently under development	Concept came from licensed property that they eyed, and saw opportunity to develop further
Maxis	Sim City, The Sims	Concept came from research and inspiration from reading. Started out initially as a serious simulation, not a game
Relic Entertainment	Homeworld	Concept came from inspiration and vision to make first movie style game in 3D

Table 4. Influences on Designers' Innovative Games and Ideas