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OCTOBER 2008

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gamedeveloper

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UNDER PRESSURE

GAMES PR IS A CONSTANT SOURCE OF FRUSTRATION. This is true for me, and for pretty much anyone else writing about games who wants to go above and beyond the normal regurgitation of press releases. I want to preface by saying that this editorial is not an easy one to write. There are a number of people in PR who I respect, who are good at their jobs, and very helpful. I think any PR person that actually takes the time to read *Game Developer* in its print form can assume that most of this editorial does not refer directly to them, though it still may peripherally.

Why should developers care about their PR? Well, what is said about you reflects on you, and the way in which your products are presented and represented do as well. In many cases the brunt of a bad experience will lie with the rep him/herself, but in other cases, it can cause a flustered journalist to simply start ignoring any emails or calls related to that company.

LOVE WHAT YOU DO

The most frequent problem I see is lack of familiarity with the product, and with games in general. This is more common with external/agency PR, but is also seen internally as well. Journalists expect PR people to know less about your game than we do, and especially much less about the developer and its pedigree. This is because PR and marketing are viewed as universal skillsets. The idea is that if you can do public relations for soda, snowboards, or watches, you can do it for games. That may be true in other industries, but it's not true in a creative industry.

As an example, I once asked internal PR for a large game company if the director of the original games was working on the new version. The PR person had never heard of the director of this long-running series. To me, that is a problem, and highlights a general lack of interest in games.

If you talk to a film or book publicist (granted this is slightly different from PR) and mention the name of a director, an actor, a screenwriter, a novelist, or a graphic novel artist respectively, there is a real good chance they will know who you're talking about. In games, this would hardly ever happen. Try asking games PR if they've heard of Warren Spector, Atsushi Inaba, Fumito Ueda, or Cliff Bleszinski, and see how many blank stares you get.

Can you promote something you don't like, or aren't truly interested in? Many seem to think so. It makes such a huge difference when the person trying to get a journalist to cover a game actually likes it, and actually plays games for entertainment. When this lack of familiarity is combined with badgering, via frequent emails or calls about products I've already told someone I'm not able to cover, that's when I start ignoring people. It is possible to cold-call journalists and have them be receptive—the PR person just has to initiate a conversation, figure out if it's a fit for the publication, be humble, and not act like this product they don't actually understand is the new Jesus.

REAL TALK

The biggest thing that's been getting to me lately is the constant lying. Not lying to people strikes me as a basic human courtesy, but it happens so frequently in my interactions with PR as to cause me to lose respect for the people that do it, and want to deal less with those companies. When I ask a question, and am told "no," but the answer is really "yes, but I can't tell you," that's a lie. When someone says, "We're not doing any interviews," but really means " ... with you. We're only doing video." That's a lie, too. Just tell me you can't do an interview with me, because you're only doing video! It makes your life harder, but at least you're being honest with me, and you don't lose my respect.

It's almost impossible to lie to a journalist and have them not find out about it, when you're telling another journalist something else. We all talk to each other! I can't respect someone who lies to me, not in any sort of relationship, professional or otherwise.

OUTSIDE-IN

The number one thing you can do to avoid bad PR is to keep as much of your PR internal as possible. Show them your process and introduce them to your team leads. Try to get people who actually have an interest in games, and who will read game news because they're interested in it, not because it's their job. We talk about passion a lot in this industry, and rightly so—it should be ubiquitous, all the way down to your PR. Don't just accept someone who "played the NES as a kid."

Good PR can really help you. It can get your game noticed, it can get good coverage (though contrary to what some believe, it can not—or at least should not—determine review scores), and it can help you build relationships with good journalists. Bad PR can inspire people to ignore your company completely. Let's make it better.

—Brandon Sheffield

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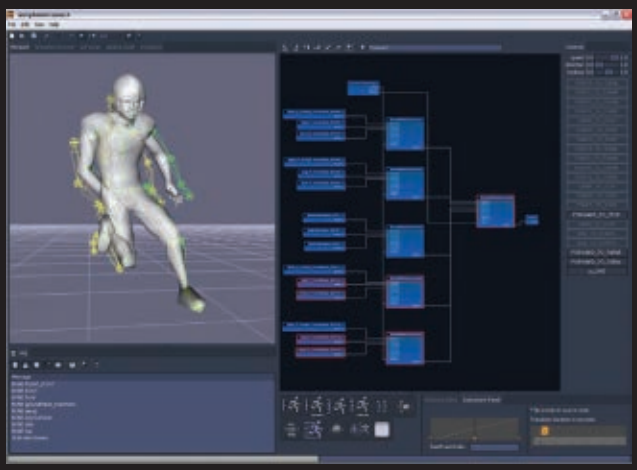
morpheme™
advanced animation system



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morpheme:runtime ships with full source code and integrates seamlessly with euphoria, NaturalMotion's Dynamic Motion Synthesis technology.

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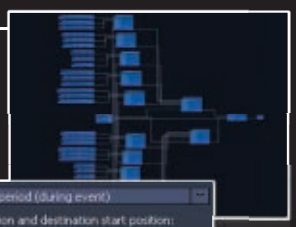
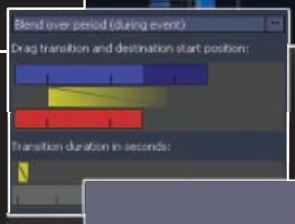
blend tree

Advanced graphical tools for building complex blend trees. Real-time visualization of animation source contribution through node highlighting



blending

Graphical control of transition blending between states in the transition graph



multiple characters

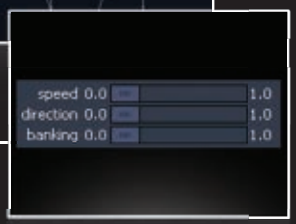
Visualization of multiple runtime characters in morpheme:connect for easy authoring and analysis of character interaction

network

Advanced graphical tools for creating and visualizing transition networks through drag-and-drop

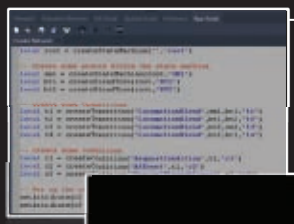
control parameters

Exposure of custom high-level controls for entire animation system. Real-time manipulation through sliders or game pad controller



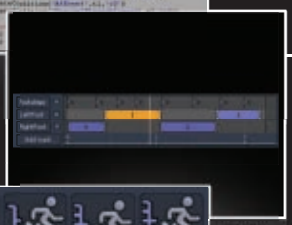
scripting

Full Lua scripting for automating tasks, adding AI logic or polling game pads for real-time input



timeline

Graphical mark up of animation data to add one-shot and duration events, for highlighting footfalls, sound effects, etc.



node palette

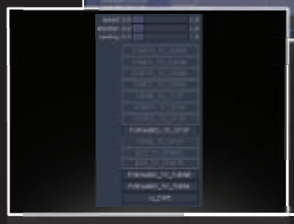
Advanced blend notes for dragging and dropping into transition network. Fully customizable node types through C++ and scripting

animation browser

Easy browsing and selection (drag & drop) of source animation. Animation list is automatically updated to reflect changed source files

transition requests

Exposure of custom transition messages. In-tool emulation of interaction between morpheme:runtime and game AI system



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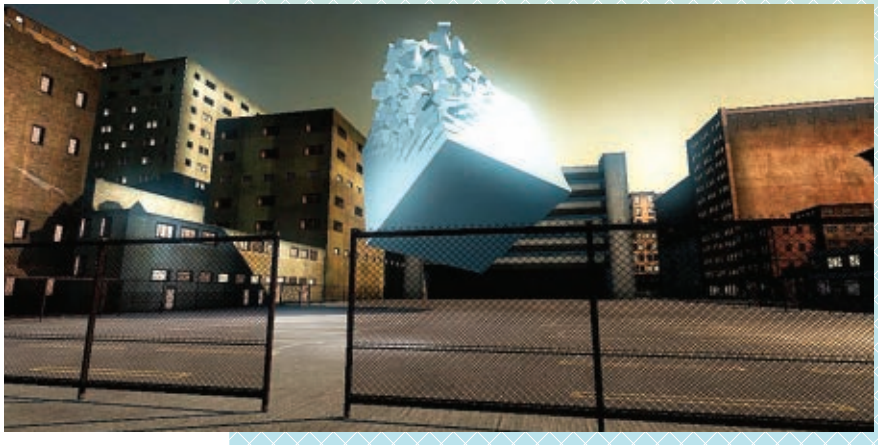
THE DEMOSCENE AT NVISION 2008

NVISION 2008 WAS NVIDIA'S FIRST EVER "VISUAL COMPUTING" festival. Held in late August, the festival encompassed everything from auto manufacturers, through game tools, competitive consumer gaming galore and, gadzooks, even the demoscene. It was an interesting mélange of different industries and interests—both developer and consumer-focused—which spread out across the San Jose Convention Center and the surrounding hotels.

While there were games such as MIRROR'S EDGE and CRYSIS WARHEAD playable on the exhibit show floor, and game tools companies presenting at the adjoining hotels, something that stood out for me was the NVScene event, described on the website as "... the largest-ever US gathering of creative minds interested in demoscene, machinima, and digital art."

While I hear the general sessions were extremely well attended, I think it's probably safe to say that the actual attendance at NVScene wasn't what some might have hoped. That may be due to the lack of a major, cogent demoscene in North America—it's always been the Europeans that lead things—rather than any intrinsic problems on the organizers' part.



A scene from Farbrausch's '.debris' demo.

One of the highlights—and a flagship for both the amazing code skills and what I'd describe as the 'ship in a bottle problem' for the demoscene, was a talk from Dierk "Chaos" Ohlerich of Farbrausch. The German demoscene group is possibly the most technically astounding demo creators of the last ten years, thanks to their work with procedural content.

Try watching their demo '.debris' on YouTube and remember all the way through it that it's created in just 177k, using an insane custom tool, Werkkzeug. On NVScene's HD projector and large sound system, Ohlerich's replaying of the award-winning 2007 demo was pretty much mind-blowing.

It's definitely true that Farbrausch's amazing procedural creation tool allows you to do things that just wouldn't be possible if you fired up Photoshop or 3D Studio Max (reminder, what procedural means here is that no pre-rolled textures or shapes have gone into the demo. It's all created using mathematical formulae, extrusions, Perlin noise, and so on.)

It's also somewhat of a breakthrough to have a completely self-contained tool for demo making—well, RSI Demo Maker was one about 20 years ago, but that's hardly counted. The point is, with the correct flow, you can make almost anything from scratch. But another timely question nowadays is ... why, and who will care? Isn't the final product the equivalent of putting a model ship in a bottle—a big 'how did they do that' impressed moment, but no real takeaway?

Well, I do care, because it's art, and it's beautiful, and because wringing that kind of performance out of your PC in real-time is breathtaking. In fact, you should be downloading the executable, not looking at the YouTube version, and that's where the demo paradigm starts to fall down nowadays. Demos arrived when there was no streaming video on the Internet, and the subtlety of something being created in real-time wasn't necessary to explain—because that's the only way it could arrive on your screen from your Commodore 64 or Amiga.

Ohlerich, a beautifully acerbic German, expectorated at some point in the talk: "Almost everything we do almost kills us." But he went on to say that it was worth it, and for those who understand what a big undertaking it was to create the demo (or their previous 96k FPS game, .KKRIEGER procedurally), there may be things to build on and use in other arenas.

In some ways, Farbrausch's predicament—and why I might feel the need to over explain why their accomplishment is important—is a wider metaphor for why Nvidia's entire message at Nvision was hard. People—that is to say, average people—are just not impressed by graphics or 'visual computing' unless it improves their entertainment experience or directly touches their lives in some way, and tangibility is still thin on the ground—see the success of the Wii, and a recent Game Developer magazine editorial.

But there are ways in which this 'ship in a bottle' tech is breaking out and actually making things that couldn't be done before. For example, the SPORE folks used procedural texturing and other procedural elements heavily in the dynamic creation in the CREATURE CREATOR—one of the first times that really complex procedural elements have been successfully implemented in games.

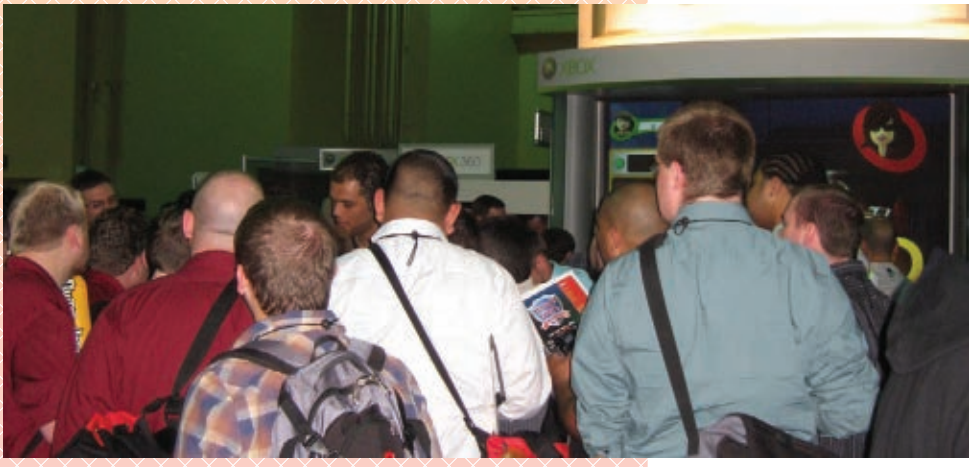
This is an interactive leap made possible by the kind of real-time elements the demoscene has been playing with for some time, and it's a hint at some of the really neat, sophisticated advances that may be coming—as long as they're actually pertinent to the audience.

—Simon Carless

GAMESTOP EXPO LAS VEGAS

THIS YEAR, I ATTENDED THE RECENT GameStop Expo in Las Vegas and found it to be a mini E3-of-old, with comparatively tame but still compelling booths from major and minor publishers.

The intent of the show is to educate and excite the store managers of GameStop's approximately 5,000 retail locations about the upcoming fall games; GameStop's executive vice president of merchandise and marketing Tony Bartel commented that it's even better-timed for this purpose than was the old E3—which was heavily attended by GameStop and its predecessor companies' staff—as the games are in better shape for the managers to play by September.



THE GAMESTOP EXPO, ITSELF

The show, while expanded in size from last year, taking up an entire hall of the Mandalay Bay, seemed a little less focused, with a shorter duration of just three and a half hours.

In an interesting move, some publishers were moving more toward debuting new playable builds of games that did not have previous exposure during press events. Square Enix showed a build of its Unreal Engine-powered RPG THE LAST REMNANT that it will not be showcasing at next month's Tokyo Game Show, and Atlus brought the first English build of PERSONA 4, the latest in its cult-classic RPG series. Interestingly, consumer sites were on the show floor to play games and report, E3-style, suggesting a potential increase in the show's profile and relevance beyond its traditionally GameStop-internal purview.

Though managers were officially required to visit every booth on the show floor, no obvious organizational system seemed to exist to ensure their dedication, and in fact hordes of GameStop employees were already wandering away from the show onto the Mandalay Bay casino floor by 7:30 PM (the show began at 7:00). However, it's worth mentioning that these deserters were outnumbered by the general enthusiastic crowds who surveyed the show and played games, many of whom also engaged company representatives in conversation.

BIGGER PICTURE: THE GAMESTOP CONFERENCE

The Expo is part of a larger GameStop Conference that took place from Saturday, September 6 through the morning of Thursday, September 11, though not all staff were required to attend all events. Presentations on games from publishers such as Sony Computer Entertainment, which brought in Insomniac CEO Ted Price to present RESISTANCE 2, and Electronic Arts, which offered EA Sports president Peter Moore, were a big part of the event, as were classroom sessions. Press were not invited to these proceedings. Mandatory "vendor training" sessions showcased the output of 19 companies, including game publishers, peripheral manufacturers, and strategy guide publishers.

In essence, the GameStop Expo and its surrounding conference continues the work that the E3 started with its historical facilitating of retail business—while narrowing down the participation to only one retail organization. This has its positives, as one of the biggest complaints many attendees had with E3 was the clog of general gamers—many of whom were retail employees—preventing business from getting done.

The expo's presentations are also targeted by the publishers directly for an audience of store managers, who will return to their GameStop shops and sell those publishers' games. The relevance of GameStop as a retailer can't be ignored, and with publisher participation in the show all but required as part of doing business with the chain, there's little doubt that it will continue to expand and refine its role.

—Christian Nutt

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THIS YEAR'S GAME DEVELOPER TOP 20 PUBLISHERS REPORT sees an industry changed. Last year, Nintendo claimed its place at the top of the publishing heap, due to the overwhelming success of its DS and Wii consoles, and the progress of those two systems has in no way abated. This year's list seems to have been influenced somewhat by which companies could adapt with the times, and capitalize on the so-called "emerging markets" of casual and online games. That said, most of the publishers in our top 20 have a decided console focus, demonstrating that the adaptation of new forms of games into the existing model will take some time.

This year, Atlus left the top ranking due to a strong showing from Codemasters, which re-entered the list for the first time since 2005. Sony made a significant jump of three places, reflecting the company's increased interest in publishing titles itself, particularly on PSN—a jump similar to Konami's, but in Konami's case this had much more do to with the release of a full stop METAL GEAR SOLID title than any change in trajectory. The largest decline went to Eidos, which didn't have a breakaway hit in the time recorded, and saw a number of financial difficulties.

One thing to note is that this is the final year for Activision and Vivendi Games to have separate listings, as the merger happened after the discussed timeframe. This could potentially make for a very interesting ranking shakeup, depending on how the company performs in the coming year.

This year's ranking was calculated by considering number of releases, average review scores, and revenue for the period reaching from August of 2007 until July 2008. We've also factored in the results of a Gamasutra.com survey we conducted to gather opinions on 28 major publishers. Over 300 survey respondents—industry professionals—were asked to first give their opinions on the reputations of each publisher in the survey, or any we had missed. Then the respondents were asked for any specific comments they might have on each of the publishers. Finally, specific feedback on publishers in the form of number scores and comments was gathered from respondents who had direct experience with said publishers. Each of these factors was carefully weighted to produce the ranking you see below.

[A full list of statistics, ratings, and the complete survey will be available in the Top 20 Publishers 2008 report from the Game Developer Research division. For more information, check www.gamedevresearch.com.]

CONTINUED ON PG 8

TREVOR WILSON *is a web developer and freelance journalist from Utah. Email him at* **twilson@gdmag.com.**

CONTINUED FROM PG 7

20. MIDWAY

Year formed: 1988
Headquarters: Chicago
Studios: Austin; Chicago; Los Angeles; Newcastle (U.K.); San Diego; Surreal Software (Seattle)

DESPITE A YEAR FRAUGHT WITH STRUGGLE, MIDWAY CLUNG TO THE number-twenty spot, the same position it occupied last year. Review scores rose slightly while the number of releases was trimmed a bit—but revenues did not match those recorded last year.

Anchor titles WHEELMAN and THIS IS VEGAS were delayed, and BLACKSITE: AREA 51's under performance resulted in layoffs at Midway's Austin studio. The publisher's financial reports showed losses posted once again this year, but the MORTAL KOMBAT series, UNREAL TOURNAMENT 3, the NBA BALLERS franchise, and titles based on the HAPPY FEET movie license were high notes for Midway this year.

19. SCI/EIDOS

Year formed: 1990
Headquarters: London
Studios: Beautiful Game Studios (London); Crystal Dynamics (Palo Alto, Calif.); IO Interactive (Copenhagen)

THIS YEAR'S BIGGEST FALL GOES TO EIDOS INTERACTIVE PARENT SCi, down to #19 from #10. The UK publisher owes the drop to a release schedule slashed by more than half compared to last year, as well as lower revenues and a flat average review score. SCi killed its internal studio Pivotal Games (known for the CONFLICT series) and cut staff across the board as it canned many titles in development.

The publisher was seeking a buyout this year, but when interested parties moved on, there emerged instead a publishing partnership with Warner Interactive and investment from NBC. Mediocre survey scores did the publisher no favors, and a review-score scandal surrounding Eidos title KANE & LYNCH earned the ire of several survey comments.

18. CODEMASTERS

Year formed: 1985
Headquarters: Southam, U.K.
Studio: Southam, U.K.

BACK ON THE RANKING AFTER A TWO-YEAR ABSENCE, UK-BASED Codemasters reported record revenues in 2007, scooped up Sega's abandoned Racing Studio, and formed a partnership with casual games publisher and portal MumboJumbo.

The company's 65 percent review average beat last year's scores, and readers praised the publisher's "great racing games," saying how it "really set the bar high for GRAN TURISMO." Other readers painted the publisher as an underdog that's "ambitious and focused on quality." On our detailed survey, respondents gave high marks to Codemasters' pay and perks, as well as its milestone payments.

17. LUCASARTS

Year formed: 1982
Headquarters: San Francisco
Studio: San Francisco

JUST AS WITH LAST YEAR, LUCASARTS' LINEUP THIS YEAR RELIED heavily on LEGO-based titles, complemented by a multiplatform THRILLVILLE sequel. Both series were generally well-received, and this year they allowed the publisher to maintain a 74 percent review average (fifth in our study), in addition to a beefed-up lineup for the year.

The new FORCE UNLEASHED shows promise as a pending release (as of press time), but do June's layoffs bode ill for the publisher's well-being? Reputation and detailed survey scores were merely average, and a couple of readers had harsh words for the publisher regarding the marketing of upcoming title FRACTURE.

What tools are you using?

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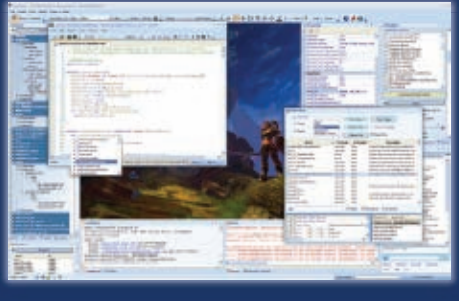

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16. DISNEY INTERACTIVE STUDIOS

Year formed: 1994 (previously Buena Vista Games)
Headquarters: Burbank, Calif.
Studios: Avalanche Software (Salt Lake City); Fall Line Studio (Salt Lake City); Propaganda Games (Vancouver, British Columbia); Black Rock Studio (Brighton, UK); Junction Point Studios Inc. (Austin, TX)

DISNEY'S GAMES DIVISION SAW REVIEW SCORES AND NUMBER of releases down sharply this year. Readers contributed a few backhanded compliments for the publisher's lineup, calling it "generally shovelware, but at least it's quality-ish shovelware."

Detailed responses praised the creative freedom available when working with the company and were grateful for "the time and resources to make better games." The publisher received lower-than-average marks on reputation and middling-to-good scores on the detailed survey, with particularly high marks for overall experience and for pay and perks.

15. NCSOFT

Year formed: 1997
Headquarters: Seoul
Studios: ArenaNet (Bellevue, Wash.); Austin; Mountain View, Calif.; Seoul

AS OF THIS YEAR, NCSOFT'S MAINSTAY GUILD WARS SERIES HAS passed the 5 million mark, however sales flagged 50 percent during the year, signaling a trailing-off for the brand. The MMO-centered Korean publisher showed signs of transition during the year, as it dropped the spacefaring MMO BLACKSTAR, acquired a 100 percent share in the CITY OF HEROES IP, and opened a new studio in Mountain View, CA.

NCsoft traditionally maintains a conservative release schedule, but this year saw three titles for last year's four, and the company's review average was down to 71 percent from last year's 79.5 percent.

Publisher	Rank					Final Score	Number of Releases	Average Game Review Score
	2008	2007	2006	2005	2004			
Nintendo	1	1	2	4	10	305.37	25	74.52%
Electronic Arts	2	2	1	1	1	282.77	123	72.45%
Activision	3	3	3	2	7	237.20	79	65.33%
Ubisoft	4	4	8	6	5	190.51	70	62.73%
Sony Computer Entertainment	5	8	4	5	3	183.73	47	75.76%
Take Two	6	6	5	10	8	183.53	41	74.09%
Sega of America	7	7	10	9	14	178.16	65	61.52%
THQ	8	5	7	8	4	177.59	84	65.89%
Microsoft Game Studios	9	9	6	3	2	161.01	14	78.46%
Square Enix	10	11	13	16	16	160.84	17	78.20%
Konami	11	15	9	7	15	152.86	47	65.86%
Vivendi Games	12	13	12	12	11	152.73	10	62%
Namco Bandai Games	13	12	11	11/17	20/-	147.65	23	66.45%
Capcom	14	14	14	15	-	146.90	23	70.91%
NCSoft	15	16	15	-	-	137.38	3	71%
Disney Interactive Studios	16	17	18	-	-	133.46	22	59.62%
LucasArts	17	19	17	20	-	133.29	18	74.94%
Codemasters	18	-	-	18	12	123.82	15	65.14%
Eidos Interactive	19	10	16	16	6	123.61	21	63.42%
Midway	20	20	20	19	17	120.74	20	60.94%

14. CAPCOM

Year formed: 1979
Headquarters: Osaka
Studios: Capcom Interactive (Los Angeles); Cosmic Infinity (Burlington, Ont.); Flagship (Tokyo); Team 1 (Osaka); Team 2 (Osaka)

REVENUES WERE ESSENTIALLY THE SAME AS LAST YEAR FOR THIS Japanese publisher, but while review scores fell, the surveyed period brought an expanded plate of releases. Survey responses praised the company's stable of well-maintained, classic franchises and called its multiplatform strategy "an excellent choice."

The cross-platform release DEVIL MAY CRY 4 was the company's big hit for the year in the West, but in Japan the MONSTER HUNTER PORTABLE machine just can't be stopped. Japan loves portable hunting, and the franchise has sold more than any other series on the PSP, bar none, with latest release MHP 2G having sold over 2.3 million copies.

13. NAMCO BANDAI GAMES

Year formed: 1950 (Bandai); 1955 (Namco)
Headquarters: Tokyo
Studios: Banpresoft (Tokyo); Bec Co., Ltd. (Tokyo); Namco Tales Studio, Ltd. (Tokyo); San Jose, Calif.; Yokohama; Tokyo

THE ARCADE BUSINESS IS AILING ACROSS THE GLOBE, AND Namco Bandai's operations are no exception to the rule: the conglomerate announced plans to jettison fifty to sixty percent of its arcade business this year, blaming the Wii in particular for decreased arcade attendance. But on the flipside, Wii software was responsible for much of this year's sales, with Japanese sales of DRAGON BALL Z BUDOKAI TENKAICHI 3 of particular note.

On the American side, ACE COMBAT 6 and NARUTO helped add to the bottom line, and the latest Japan-only TAIKO NO TATSUJIN title for DS and GUNDAM BATTLE UNIVERSE (part of an ever-growing series and a perennial brand) for PSP also contributed to sales. Overall though, revenues from Namco Bandai's home video games were down compared to last year.

12. VIVENDI GAMES

Year formed: 2000
Headquarters: New York
Studios: Blizzard Console (Aliso Viejo, Calif.); Blizzard Entertainment (Irvine, Calif.); Blizzard North (San Mateo, Calif.); High Moon Studios (Carlsbad, Calif.) Massive Entertainment (Malmö, Sweden); Radical Entertainment (Vancouver); Sierra Entertainment (Bellevue, Wash.); Swordfish Studios (Birmingham, U.K.); Vivendi Games Mobile (Los Angeles; San Mateo, CA)

IN THE LAST YEAR PRIOR TO THE MERGER OF VIVENDI'S GAMING unit with Activision, WORLD OF WARCRAFT powered sales year round, though financial reports cited the lack of a new WoW expansion as the cause of lower-than-expected revenues.

Outside of WoW, Vivendi's release schedule—populated in large part by F.E.A.R. sequels and movie licenses—was slim, review scores were unimpressive, and ratings given by our readers were mediocre. Reader comments were unkind to the publisher as well, though as one commenter acknowledged, this may all be academic, with the merger now finalized.

Reputation Ranking	Detailed Survey	Number of Internal Studios
7.5	9.6	8
6.4	7	22
7.4	6.2	12
7.1	7.4	20
7.1	8.6	20
6.9	7.4	14
6.1	7.2	6
6	5	17
6.5	6.6	7
7	8.3	4
6.7	3.5	5
6.3	4.8	9
6	5	5
6.7	6.7	5
6	8	4
4.8	7	5
5.7	6.4	1
5.6	5.3	1
5.1	5.6	3
4.9	6.9	6

11. KONAMI

Year formed: 1973
Headquarters: Tokyo
Studios: Blue Label Interactive (Los Angeles); Hudson Soft (Tokyo, Sapporo, San Francisco); Konami Computer Entertainment (Tokyo); Konami Software Shanghai; Kojima Productions

THIS YEAR KONAMI CLIMBED FOUR SLOTS IN THE RANKING IN PART through doubled revenues that quarterly reports attributed to sales of the latest PRO EVOLUTION SOCCER and the long-awaited METAL GEAR SOLID 4. Music titles were as important an asset as ever for this publisher, and DDR HOTTEST PARTY, KARAOKE REVOLUTION, and AMERICAN IDOL all sold well during the year.

Review scores improved year-over-year too, and Konami expanded its release slate slightly. But while many of our readers had brief but enthusiastic praise for MGS4, some expressed a desire to see Konami return to "better multiplatform support and diversity of titles."

10. SQUARE ENIX

Year formed: Enix (1975); Square (1986)
Headquarters: Tokyo
Studios: Community Engine (Japan); Taito Corp. (Japan); Square Enix China (Beijing); Tokyo

THIS RPG GIANT ENDED THE YEAR WITH MORE RELEASES AND A higher average review score than last year, helping it move up one slot in the ranking. But revenues and profits for the period fell noticeably compared to last year, due in part to falling sales of aging MMO FINAL FANTASY XI. Titles that performed better included DRAGON QUEST IV and ITADAKI STREET DS (in Japan) as well as FINAL FANTASY XII: REVENANT WINGS (in the West) and CRISIS CORE: FINAL FANTASY VII (around the globe).

This is one consistent publisher when it comes to review scores, and this year is no different: Square Enix achieved a 78 percent average score, second only to Microsoft Game Studios.

9. MICROSOFT

Year formed: 1975
Headquarters: Redmond, Wash.
Studios: ACES; Ensemble Studios (Dallas); Lionhead Studios (Guildford, U.K.); Microsoft Game Studios Japan (Tokyo); Rare (Twycross, U.K.); Turn 10 (Redmond, Wash.); Wingnut Interactive (Wellington, N.Z.)

HALO 3 WAS THIS CONSOLE MANUFACTURER'S BIG HIT FOR THE year; meanwhile, MASS EFFECT, NINJA GAIDEN II, LOST ODYSSEY, and AGE OF EMPIRES III, each made respectable showings. Microsoft's plate of releases had one fewer title than last year's 15, but a number of critical darlings pushed the publisher's average review score all the way up to 78 percent, the highest in this year's study.

Microsoft received only average marks on our reputation and detailed surveys: pay and perks were rated highly and the publisher was praised for its "serious effort(s) to develop long-term relationships," while readers felt Microsoft's marketing was somewhat poor.

8. THQ

Year formed: 1989
Headquarters: Agoura Hills, Calif.
Studios: Big Huge Games (Timonium, Maryland); Blue Tongue Entertainment (Melbourne); Sandblast (Seattle, WA); Heavy Iron Studios (Los Angeles); Helixe (Burlington, Mass.); Incinerator (Carlsbad, Calif.); Juice Games (Warrington, U.K.), Kaos Studios (New York); Locomotive Games (Santa Carla, Calif.); Mass Media (Moorpark, CA); Paradigm (Dallas); Rainbow Studios (Phoenix); Relic Entertainment (Vancouver); THQ Studio Australia (Spring Hill, Australia); THQ Wireless (Calabasas Hills, Calif.); Vigil Games (Austin); Volition (Champaign, Ill.)

2007-08 WAS A DIFFICULT PERIOD FOR THIS LOS ANGELES-BASED publisher. THQ posted losses throughout the year, and flagging sales on key original franchises forced layoffs and reorganizations. Cancellations and delays of titles like DESTROY ALL HUMANS! PATH OF THE FURON and DE BLOB, respectively, further hurt revenues.

Despite that, THQ's release schedule was dwarfed only by Activision's, and its inclusion of WWE and Pixar-licensed titles were the publisher's sales highlights for the year. Original titles MX VS. ATV UNTAMED and FRONTLINES: FUEL OF WAR were important successes during the year, and THQ seems to be depending on SAINT'S ROW and RED FACTION sequels to steer the company back toward profitability.

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TOP TWENTY PUBLISHERS

7. SEGA

Year formed: 1952 (Sega); 1975 (Sammy)
Headquarters: Tokyo
Studios: Creative Assembly (West Sussex, U.K., Fortitude Valley, Australia); Secret Level (San Francisco); Sega Shanghai Studios (Shanghai); Sega Studios (Tokyo); Sega Studios USA (San Francisco); Sports Interactive (London)

FLAGGING ARCADE PERFORMANCE CAUSED DECLINING REVENUES and increased losses for Sega parent Sammy, and as a result, construction of a major arcade center was ended and 400 employees were laid off. But Sega's sales of home video games were up for the past year, as combined sales of MARIO AND SONIC AT THE OLYMPICS passed seven million copies.

Sega showed signs of continued improvement in the home market, with a publishing deal inked with dream-team developer Platinum Games, as well as strong sales of Japanese-made SENJOU NO VALKYRIA and a just-before deadline smash with PHANTASY STAR PORTABLE. A release schedule double the size of last year's helped ensure that Sega held its position.

6. TAKE TWO

Year formed: 1993
Headquarters: New York
Studios: 2K Czech (Brno, Czech Rep.); 2K Boston (Quincy, Mass.); 2K Australia (Canberra, Australia); 2K Marin (Novato, Calif); Cat Daddy Games (Bellevue, Wash.); Firaxis Games (Hunt Valley, Md.); Kush Games (Camarillo, Calif.); PAM Development (Paris, France); Rockstar Leeds (Leeds, U.K.); Rockstar North (Edinburgh); Rockstar San Diego; Rockstar Toronto; Rockstar Vancouver; Visual Concepts (San Rafael, Calif.)

EA'S BID FOR A HOSTILE TAKEOVER LOOMED OVER TAKE TWO FOR much of the year, bringing with it much speculation and unrest, but as of press time, no deal has been made. The spooky BIOSHOCK and cash cow GRAND THEFT AUTO IV generated this publisher's best sales and critical reception this year. GTA IV alone doubled Take Two's profits in their second-quarter results, and has sold 8.5 million-plus units to date.

A new casual games label, 2K Play, is set to absorb the Global Star Software label and will brand the already-successful CARNIVAL GAMES series. And while Take Two released fewer games last year than the prior year of our study, the company's average Metacritic review score increased by a good seven percent.

5. SONY COMPUTER ENTERTAINMENT

Year formed: 1993
Headquarters: Tokyo
Studios: Bigbig Studios (Warwickshire, U.K.); Bend, Ore.; San Diego, CA; Cambridge, U.K.; Bangalore, India; Contrail (Tokyo); Evolution Studios (Cheshire, U.K.); Foster City, Calif.; Guerrilla Games (Amsterdam); Incognito Entertainment (Salt Lake City); Liverpool, U.K.; London; Polyphony Digital (Tokyo); Santa Monica; Seoul; SN Systems (Bristol, U.K.); Sony Online Entertainment (Austin, TX; Denver, CO; Los Angeles; San Diego, CA; Seattle; Taiwan); Tokyo; Zener Works (Tokyo); Zipper Interactive (Redmond, WA)

SONY'S FIRST-PARTY PUBLISHING EFFORTS BROUGHT NEARLY double the number of releases, compared to last year, and the average review score rose a percentage point to 75.5 percent—the fourth-highest average in this year's study. But slowing sales of PlayStation 2 software counteracted revenue gains from PSP and PS3 sales that were more brisk.

Sony's strongest titles this year were its original properties—such as GRAN TURISMO 5 PROLOGUE, UNCHARTED: DRAKE'S FORTUNE, and GOD OF WAR: CHAINS OF OLYMPUS—and 2007–2008 saw the publisher looking to secure more developer talent for the future with purchases of Evolution Studios (MOTORSTORM) and BigBig Studios (PURSUIT FORCE). Survey responses gave Sony particularly high marks in our detailed survey, describing the company in particular as "honest and forthright in development contract negotiations."

4. UBISOFT

Year formed: 1986
Headquarters: Montreuil-sous-Bois, France
Studios: Annecy, France; Barcelona; Blue Byte (Düsseldorf, Germany); Bucharest; Casablanca; Chengdu, China; Digital Kids (Nagoya, Osaka, Japan); Hybride Technologies (Montreal); Milan; Montpellier, France; Montreal; Montreuil, France; Pune, India; Quebec City; Red Storm (Morrisville, N.C.); Reflections (Newcastle, U.K.); Sao Paulo, Brazil; Shanghai; Singapore; Kiev, Ukraine

UBISOFT EXPANDED OPERATIONS ALL THROUGH THE PAST YEAR, opening new studios across the globe and acquiring new talent in Japanese dev Digital Kids and effects house Studio Hybride. GRAW 2, ASSASSIN'S CREED, RAINBOW SIX: VEGAS 2, and the fruits of a successful casual-games venture drove sales up all year round.

Ubisoft's revenues were the fourth-highest in our study, just edging out Vivendi Games, and the company's 70 titles released during the year placed it in fourth for that category as well. The publisher's average review score fell slightly this year, but higher revenues and more releases made up for it. Our survey brought comments praising the company's quality and innovation, but noted that perhaps Ubisoft should "take the Wii core market more seriously."

3. ACTIVISION

Year formed: 1979
Headquarters: Santa Monica, Calif.
Studios: Beenox (Quebec City); Bizarre Creations (Liverpool, England); Infinity Ward (Encino, Calif.); Luxoflux (Santa Monica, Calif.); Neversoft (Encino, Woodland Hills, Calif.); Raven Software (Middleton, WI); RedOctane (Sunnyvale, Calif.); Shaba Games (San Francisco); Toys For Bob (Novato, Calif.); Treyarch (Santa Monica, Calif.); Vicarious Visions (Troy, N.Y.); Z-Axis (Foster City, Calif.)

ACTIVISION HAS JUST FINALIZED A MERGER WITH VIVENDI'S GAMES division, but for the period discussed here, Activision and Vivendi were considered separate entities. According to the NPD group, Activision was the top-selling publisher in the US for the calendar year of 2007, and during our study period the company's revenues doubled and profits tripled. But the publisher had the third-highest revenues this year, keeping it in the third-place spot for a third year in a row.

Several mega-smash releases powered those sales: CALL OF DUTY 4 sold over ten million copies, and GUITAR HERO III moved more than three million. Licensed titles were an important part of the company's strategy: movie-based titles SPIDER-MAN 3, TRANSFORMERS, and KUNG FU PANDA made strong contributions to Activision's bottom line.

To cap things off, the Vivendi merger will bring even more strength in intellectual property and development mojo—via Blizzard—under the Activision label.

Survey respondents gave somewhat mixed impressions of the publisher, offering no clear consensus. Some praised the company's franchise branding, marketing, Q/A, and management, and many readers were hopeful about the merger. But a few readers noted that innovation could be better at the publisher, and some unfavorably compared Activision's focus on sequels in a few key franchises to the approach used by "the old EA."

2. ELECTRONIC ARTS

Year formed: 1982
Headquarters: Redwood City, Calif.
Studios: Criterion (Guildford, U.K.); Digital Illusions CE (Stockholm) EA Black Box (Vancouver); EA Byrnest (Mout Sinai, NY); EA Canada (Burnaby, British Columbia); EA China (Shanghai); EA Los Angeles (Playa Vista, Calif.); EA Korea (Seoul, Korea); EA Mobile (Bucharest, Romania; Hyderabad, India); EA Mobile Korea (Seoul, Korea); EA Montreal; EA Mythic (Fairfax, Va.); EA Japan (Roppongi, Japan); EA Redwood Shores (Redwood City, Calif.); EA Singapore; Maxis (Emeryville, Calif.); EA Phenomic (Ingleheim, Ger.); EA Tiburon (Maitland, FL); EA Salt Lake (Bountiful, UT); BioWare Corp. (Edmonton, Alberta; Austin, Texas); Pandemic Studios (Los Angeles, Calif; Brisbane, Australia); EA North Carolina (Morrisville, NC)

NO OTHER PUBLISHER HAD A LINEUP THIS YEAR THAT CAME CLOSE to EA's bursting-at-the-seams schedule: EA released a total of 123 titles in the period considered by our study—seven more than last year. But with revenue and average review scores that didn't reach Nintendo's lofty heights, EA remained in second place for the second year in a row.

Still, EA was no slouch, sales-wise. Powerful franchises like MADDEN, ROCK BAND, FIFA, and MYSIMS—each of which sold over a million copies—gave EA the second-highest revenues this year. EA acquired developers and made deals with outside studios year round, adding variety to an already diverse and well-reviewed lineup. The company's quarterly results showed revenue that grew all year long, and meanwhile losses incurred by accounting changes decreased.

EA did well above average on our surveys. Many readers acknowledged EA's new direction and praised it for focusing on "original IPs and support for innovative concepts." Several commenters on the detailed survey had complaints about their time with the company: some noted an overabundance of crunch time at the company.

methodology

THE *GAME DEVELOPER* TOP 20 RANKS publishers using a score calculated from each publisher's performance in the following five measures: annual turnover, number of releases, average review score, an anonymous reputation survey, and detailed anonymous feedback from those who had worked directly with the publisher.

Annual turnover figures come from the publishers' annual accounts or, when these are not public, from our own estimates based on the sales of games they release. The number of releases, which counts the publication of the same game on different formats as separate releases, was obtained from information on the publishers' web sites and dedicated gaming web sites. The average review score ratings were based on information from Metacritic.com. A confidential online survey of developers provided the data for the reputational survey and the detailed comments.

The 28 larger publishers were ranked according to each of these five measures. The highest scoring publisher in a category was assigned a figure, and this figure was counted down from in regular intervals for each publisher on the list, in order. The totals were weighted and added to produce a final score, which determined the top 20.

Every effort has been made to ensure the accuracy of the information contained within this article. However, *Game Developer* does not guarantee its accuracy or completeness and does not accept liability for any direct, indirect, or consequential loss arising from its use.

1. NINTENDO

Year formed: 1933
Headquarters: Kyoto, Japan
Studios: Intelligent Systems (Kyoto); Nintendo Entertainment Analysis and Development (Tokyo); Nintendo Software Technology Corp. (Redmond, Wash.); Retro Studios (Austin); Systems Research & Development (Kyoto, Osaka); Brownie Brown (Tokyo); NDCUBE (Tokyo); Monolith Soft (Tokyo)

SURGING REVENUES GENERATED BY AN EXTREMELY STRONG STABLE OF first-party releases for Wii and DS have allowed Nintendo to maintain its hold on the top spot this year, following last year's upset over EA. The DS continued to dominate the portable market, and Nintendo's software for the platform consistently sold more than that of any other publisher.

Indeed, Nintendo's revenues were the highest of any publisher this year across all platforms, despite a relatively modest release schedule for the year. Software revenues were up 46 percent and profits up 48 percent this year compared with 2007, and sales were a good 43 percent higher than nearest competitor EA's revenues.

POKEMON DIAMOND/PEARL was Nintendo's biggest seller this year, having sold 15 million copies to date. BRAIN AGE 2, SUPER SMASH BROTHERS BRAWL, MARIO KART WII, and WII FIT also contributed to Nintendo's smashing success. And once again, Nintendo's games also found favor with critics, receiving the sixth-highest average review score this year.

The publisher garnered the highest average scores out of both our reputation survey and our detailed survey. Readers praised Nintendo for "doing a great job of expanding the market," and commenting developers called the publisher "a pleasure to work with" and "far more personable than the other manufacturers."

Nintendo's SUPER SMASH BROTHERS BRAWL.

This indicates that Nintendo is, at least somewhat, bucking the company's traditional "don't call us, we'll call you" approach to developer relations. As third party publishers continue to figure out Nintendo's hardware, future listings are anyone's guess. But for now, Nintendo rules the roost.

Nintendo's MARIO KART WII.

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Unreal Technology News

by Mark Rein, Epic Games, Inc.

Canadian-born Mark Rein is vice president and co-founder of Epic Games based in Cary, North Carolina.

Epic's Unreal Engine 3 has won Game Developer Magazine's Best Engine Front Line Award for the past three years, and "Gears of War," the 2006 Game of the Year, sold 5 million units on Xbox 360 and PC.

Epic recently shipped "Unreal Tournament 3" for PC, PlayStation 3 and Xbox 360. "Gears of War 2" for Xbox 360 is scheduled for release on November 7, 2008.

Upcoming Epic Attended Events:

Tokyo Game Show
Tokyo, Japan
October 9-12, 2008

IGDA Leadership Forum
San Francisco, CA
November 13-14, 2008

KGC/Gstar
Seoul, Korea
November 13-15, 2008

Please email:
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PSYONIX STUDIOS LICENSES UNREAL ENGINE 3

Psyonix, the studio behind *Monster Madness: Grave Danger*, has licensed Unreal Engine 3 to develop *Supersonic Acrobatic Rocket-Powered Battle-Cars*, an arena-based online vehicular sports game for PLAYSTATION®Network scheduled for release this fall.

Supersonic Acrobatic Rocket-Powered Battle-Cars

"We've been working with other studios using Unreal technology for years now," said Dave Hagewood, director of development, Psyonix. "I'm very proud to license the engine for our first title developed entirely in-house and am blown away by the fact that Epic goes out of its way to make its industry-leading technology affordable for developers of games like this."

Supersonic Acrobatic Rocket-Powered Battle-Cars features vehicles with physics-based maneuverability, including boosters for launching high into the air or accelerating at break-neck speeds on the ground.

Cars can roll, flip, jump, dodge and spin, and players can maneuver vehicles to perform breathtaking saves, awe-inspiring shots on goal, and gruesome demolishes of opponent cars in the BattleBall Arena team-based soccer game.

SKY GODS TAKES FLIGHT WITH UNREAL ENGINE 3

BlackFoot Studios has licensed Unreal Engine 3 for *Sky Gods*, a military tactical action game for PC, Xbox 360™ and PLAYSTATION®3.

BlackFoot chose Unreal Engine 3 because it is perfectly suited to the company's vision for its products, offering cutting edge technology, versatility and the ability to develop a multi-platform product.

"Epic supports the smaller studios, and they work hard to make the right things happen for all involved," said John Sonedecker, founder of BlackFoot Studios. "Epic is a great company to deal with, and we are proud to partner with them."

"A nicely proven engine solution makes it feasible for us to release our first title, *Sky Gods*, on multiple platforms. Unreal Engine 3 is proven on PC, Xbox 360™ and PLAYSTATION®3 with an art pipeline that allows for easy cross-platform development and drastically reduces the effort and costs involved with releasing a title on both PC and consoles," said Sonedecker.

Sky Gods will focus on a complete co-operative game experience centering on Special Forces operations, specifically HALO (High Altitude, Low Opening) and helicopter insertion missions. BlackFoot Studios plans a worldwide release of *Sky Gods* via digital distribution in the first quarter of 2009.

AMERICAN MCGEE'S *GRIMM* FOR PC

American McGee's unique perspective on the world of games is coming to life through GameTap with his first episodic endeavor, *Grimm*.

McGee, creative director of Shanghai-based Spicy Horse, turned to Unreal Engine 3 to tackle his new take on traditional fairy tales, which presents an accelerated production schedule for the game's 24 episodes. The model requires that McGee's team go from concept to shippable content in 12 months.

The *Grimm* development team, Spicy Horse

In that regard, McGee said that Unreal Engine 3 works ideally because it allows his studio to prototype an innovative game concept, establish a unique art style, and build large amounts of content in a rapid and efficient way.

"The funny thing is, because of my background with id Software, I always thought of Epic and their technology as 'the other side,'" said McGee. "In the early days, we'd play around with Epic's engine just to see how it might

Unreal Engine 3 Powers Downloadable Games

have solved problems with tools, interface, etc. Over the years, the change has been phenomenal. The toolset has evolved into a mature, robust, and flexible total solution. These days I feel confident we're working with the best total solution for our needs."

McGee's core team explored several engines before settling on Unreal Engine 3 and ultimately found that they were able to integrate content and achieve the visual results they wanted faster and easier with Unreal Engine 3.

"This was primarily attributable to the superior reference materials, tutorials, and content pipeline and tools. Once our decision was made, attracting other team members with UE3 experience and gaining critical knowledge on our own was easy," explained McGee.

American McGee's Grimm

"Because *Grimm* is such an experimental game concept, rapid prototyping was essential to proving our new ideas. Being able to quickly build a world from near-final content allowed us to focus on the challenges of implementing original ideas," he said.

Although the initial core team of 10 had little experience with the engine outside of what it gained during its evaluation, it had no problem meeting all of the game's deadlines throughout the development process, even as the team grew to over 35 internal employees, 20 external artists and a handful of people in the U.S.

When it came to the engine's toolset, McGee said Spicy Horse utilized every aspect of Unreal technology to some degree or another.

"And everything was useful," said McGee. "Because *Grimm* contains a large amount of narrative cinematic elements, we spent a lot of time editing content inside the FaceFX and Matinee tools.

"Custom modifications we made often had to do with 'old-schooling' something. Take the FaceFX tool for instance; we had to gut it in order to get the sort of simple animated faces we wanted. It's not easy to get 'South Park' style facial animation out of a next-gen game engine!"

Gameplay is wrapped around the idea of transforming things from light to dark; wherever the main character Grimm goes, darkness follows. He's like a dark paintbrush in a cute cartoon world. As he converts the world to dark, his power grows, and as his power grows, he's able to transform larger objects, move faster, and jump higher. Each episode focuses on a traditional Grimm fairy tale.

"There are standard 3D platform game elements layered on top of the transformation mechanic," explained McGee. "The end result, we think, is a visually compelling, compulsively addictive play experience with rich story, and a lot of humor. I think we can honestly say there's nothing else out there like *Grimm*."

McGee said Unreal Engine 3 provided his team with the ability to go from concept to playable concept in record time — something that the episodic game's development cycle required.

In simplest terms, the model has forced Spicy Horse to break 12 hours worth of game content into 24 smaller games. This means the development cycle for an individual "game" is measured in weeks, not years. Yet despite the accelerated cycle, the team has not had a single crunch time, missed milestone, or even a minor production mishap.

"The development process follows some standard schedule beats like design, concepting, first playable (alpha), beta (content lock), and final, but the whole process is accelerated—each major phase taking no more than six weeks," said McGee.

"The combined process takes 18 weeks for a single episode. Additionally, we have multiple development cycles running in parallel, with content moving from designer to designer, from concept to final. In many ways, it's a mini model of larger-scale development efforts."

The result of all this is that Spicy Horse will release its first *Grimm* episode about one year after its first pre-production meeting.

American McGee's Grimm

Subsequent episodes will be released weekly for eight weeks. The development team will then take a short break to make adjustments to content based on user feedback before embarking on the remaining episodes over another eight-week period.

"Episodic content, or whatever it evolves into, will continue to be interesting to us — and to our audience, I hope — for a long time to come," concluded McGee.

"There's definitely something worthwhile about the process and the result. *Grimm* is just another step in the evolution of the idea for how to build, distribute, and consume games in an episodic fashion."

This interview with American McGee was conducted by John Gaudiosi for www.unrealtechnology.com.

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SHOOT TO THRILL

A STUDY OF BIO-SENSORY REACTIONS TO 3D SHOOTING GAMES

BY 2007, THE NEXT-GEN ECOSYSTEM HAD COME OF AGE. The Xbox 360 had been out for more than a year, and both the PlayStation 3 and Nintendo's Wii had hit the market with a slew of new titles. The shooter genre, in particular, had pushed the envelope both in terms of graphics as well as new gameplay.

As part of our research activities at EmSense, a San Francisco-based company that uses proprietary brain monitoring EEG and bio-sensing technology to measure engagement and emotional and cognitive responses to content, we set out to understand exactly what defined the successful modern, next-gen shooter title. Where does it engage, and where doesn't it? How do players actually respond to new innovative gameplay (minus the hype)? We were also determined to identify broad trends that have occurred across all next-gen titles.

We started by looking at how players responded to then-new first- and third-person shooter video games on the market: BATTLEFIELD 2142, CALL OF DUTY 3, F.E.A.R., GEARS OF WAR, GHOST RECON ADVANCED WARFIGHTER 2, and RESISTANCE: FALL OF MAN. We added two "classics," HALO 2 and HALF-LIFE 2, to provide perspective from the previous generation of titles.

We measured players' responses to the first 90 minutes of those games, a time that we consider the most important for making a positive impression.

More than 300 hours of physiological and gameplay data were generated and analyzed to develop our findings.

We came in with no pre-conceptions, no prejudices, and let the response data demonstrate what worked and what didn't. The results are at times a confirmation of existing techniques that are timeless to good game design, and at other times, surprising and revealing about what gamers truly care about but often can't find a way to say.

WHAT WENT RIGHT

1 CUT SCENES WITH OVERARCHING EMOTIONAL THEMES. Uncovering the "perfect" cut scene, in terms of power of physiological emotional response, proved to have no formula. Just like their cinematic movie counterparts, game cut scenes

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BIOMETRIC DATA GATHERED

GAMES IN STUDY:

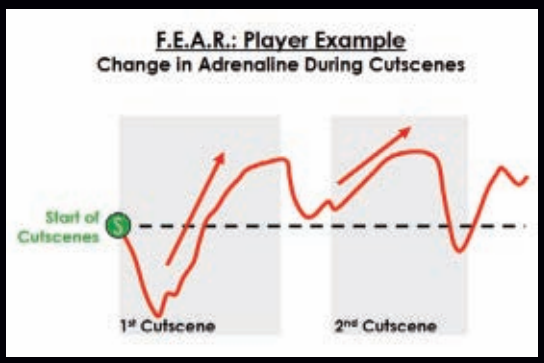
BATTLEFIELD 2142
CALL OF DUTY 3
F.E.A.R.
GEARS OF WAR
GHOST RECON AW 2
RESISTANCE: FALL OF MAN
HALO 2
HALF-LIFE 2

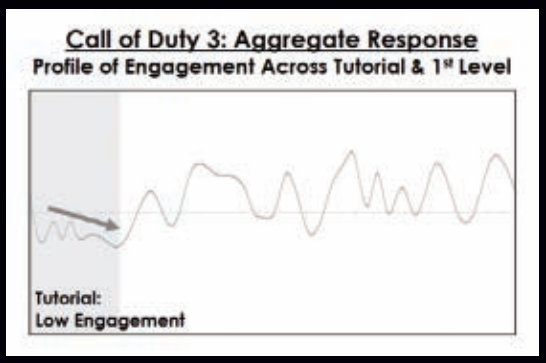
PLAYER RESPONSES MEASURED:

Brainwaves (through dry EEG sensors)
Heart Activity
Breathing
Blinking
Temperature
Motion

FACTORS OF ANALYSIS:

Engagement
Emotion
Adrenaline
Cognition





have no single creative blueprint. As you can imagine, a horror film evokes a different set of emotions than a comedy, but both may be powerful and effective pieces of art.

What we did find is that games like GEARS OF WAR, F.E.A.R., and CALL OF DUTY 3 consistently engage players by specializing in a particular thematic emotion.

In F.E.A.R., for example, dark themes and creepy music consistently translated to a high level of engagement. The introductory cut scene of F.E.A.R. was associated with a high level of adrenaline, even more so than much of the combat in the game. Creative elements like dialog, music, and blood-filled scenes combined to create this strong fear response about 73 percent of the time—significantly higher than the genre average we recorded for cut scenes.

CALL OF DUTY 3 used a different formula, albeit one that is just as effective. Its most engaging cut scenes came not from fear, but from a feeling of reward, as measured by our positive emotion vector. Each of the cut scenes at the end of a level in CALL OF DUTY 3, which naturally included NPC encouragement for a job well done, led to a strong positive reward response in up to 80 percent of players. It was a simple and effective way to link the intensity of gameplay with feelings of accomplishment.

Our big surprise came with GEARS OF WAR. We examined the 10 biggest events in GEARS OF WAR as defined by the highest levels of recorded player engagement. We weren't surprised when we saw fights against swarming Wretches or other epic battles. What we didn't expect to see was a cut scene: Lieutenant Kim, the protagonist's comrade, is killed suddenly and violently by enemy forces. Together, over 80 percent of players reacted with one of the 10 most intense engagement responses of the game, no small feat for a title with bloody chainsaws and huge courtyard battles. Consistently, GEARS OF WAR players showed high levels of engagement during action, battle sequences, and when in conversation with their comrades.

2 TUTORIALS INTEGRATED INTO COMBAT. As games (and controllers) become more and more complex, teaching players the mechanics of the game has become one of the big challenges for developers in general.

All our research indicates that male game players in the 18 to 34 year-old demographic are not receptive to being told what to do—and they learn most effectively by doing.

We've seen two side effects that reinforce the importance of having engaging tutorials. First, and most obviously, players who don't know how to play the game consistently have lower recorded engagement levels throughout their play session, as they continue to struggle to immerse themselves in gameplay, even after the introductory tutorials and levels have finished. Second, long and boring tutorials delay the first moment of engagement, that critical moment when players realize they can indeed be immersed in this game. In some games we've tested, the first strongly engaging event does not occur until 20 minutes into the experience, a lifetime for a gamer who just wants to have fun.

Treyarch's CALL OF DUTY 3.

The most important takeaway for developers regarding this finding is to not leave the creation of tutorials until the end of the production cycle. Tutorials can (and moving forward into future generations of hardware, will) be the first moment of true engagement in the game.

Two games that add new gameplay in this test sample were GEARS OF WAR and GHOST RECON ADVANCED WARFIGHTER 2. The former adds a cover mechanic. GHOST RECON has a cross-com remote camera heads-up display, squad-based combat, smoke grenades, unmanned aerial vehicles—the list goes on and on.

These games engaged users quickly with a simple strategy. Players were thrown into action and were threatened, and were expected to learn. The player learns to throw grenades not by tossing one into a dummy box target, but

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SHOOT TO THRILL

Insomniac Games' RESISTANCE: FALL OF MAN.

by utilizing them against enemies with real consequences on the line.

GEARS OF WAR not only forces players to learn gameplay mechanics under fire, but it gives them the option of skipping the tutorial altogether and being thrown directly into battle. Forty percent of subjects in our study did in fact skip the tutorial, but regardless of whether they did this, they engaged with the game strongly and quickly. In fact, average engagement during the first level was comparable to that in subsequent levels.

The entire first level of GHOST RECON ADVANCED WARFIGHTER 2 is a tutorial, a "simulation" that nonetheless has failure conditions and appears indistinguishable from standard combat. An emotional and adrenaline climax occurs when players utilize smoke grenades and explosive charges to take out a heavily outfitted, armored personnel carrier. In fact, the alternation between the calm of instruction and the intensity of trying new tactics against powerful enemies created a big emotional roller coaster that registered as one of the top two most engaging events out of the eight titles we studied.

3 BRING PLAYERS DOWN TO BRING THEM BACK UP. The roller coaster analogy is an apt one to describe players' engagement and physiological responses. The fun lies in going up and down on the ride. Staying at the same elevation is about as much fun as riding a monorail. Creating emotional drama, of course, is easier said than done in video games.

It seems counterintuitive, but the most intense points of engagement in the titles in our study were often the result of calm moments. Downtime, a period of lower engagement, is not always bad. Periodic but brief lulls in action allow for more intense action sequences and stronger reactions to climactic final battles. The emphasis is on "brief;" take too long, and players are truly disengaged and want (to continue the analogy) to get off the ride.

The most important thing for developers to understand is that the two elements—big intense events and brief lulls—must both occur. One doesn't function without the other.

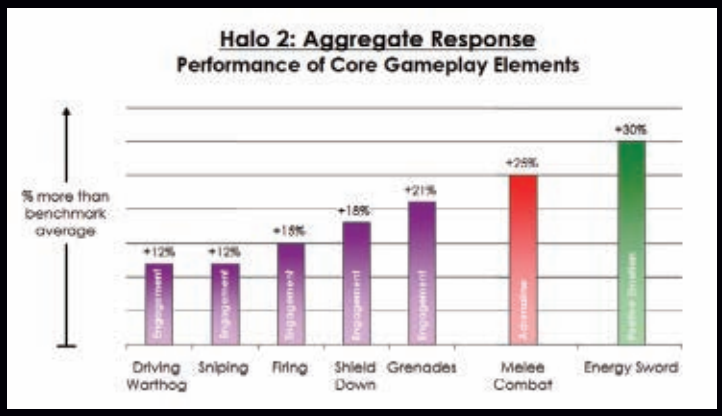
Examples of big, high-intensity moments included epic courtyard battles (CALL OF DUTY 3, RESISTANCE, GEARS OF WAR), powerful enemy bosses (GHOST RECON, GEARS OF WAR), and swarms of small ones (HALF-LIFE 2, RESISTANCE, and GEARS OF WAR).

Creating the calm before the storm is much trickier. We identified a few strategies. In GEARS OF WAR, there's a surprising amount of walking around, listening to the radio com—and these moments explicitly calm players just before hordes of Locusts appear from their emergence holes.

HALF-LIFE 2 used a different method. In between combat, puzzles provided an emotional break from action. As expected, these puzzles did not evoke adrenaline, but they did elicit engagement and more specifically, positive emotion in droves. Engagement was 17 percent higher than the benchmark, and the recorded level of positive emotion upon completion (the "reward" feeling of finishing) was additionally nearly 20 percent higher than the norm. It is HALF-LIFE 2's back and forth between the adrenaline of combat and the reward of puzzles that creates its roller coaster.

4 CLOSE COMBAT, CLOSE COMBAT, CLOSE COMBAT. Close combat was the most reliable method of creating engagement, adrenaline, reward, and all the emotions that make shooters so much fun. Certainly, this is nothing new to the genre, but the next-gen games that excelled in this area were exceptionally strong at creating high-paced close combat frequently.

It was no surprise to us that the three games in this study widely considered "game of the year" (GEARS OF WAR, HALO 2, and HALF-LIFE 2) all designed and executed exceptional melee weapons to encourage or force close combat.



The most successful FPS titles encourage close combat, dangling emotions of reward to compel players into high-risk, adrenaline-pumping scenarios that dramatically increased their level of engagement and feelings of reward.

For instance, in both HALO 2 and GEARS OF WAR, players were rewarded with an instant kill for using the energy sword and chainsaw. An energy sword kill in HALO 2, for instance, evoked 30 percent more recorded positive emotion and reward than the genre benchmark. In addition, GEARS OF WAR players recorded high emotional reward for the spray of enemy blood after they succeeded. Of course, we can't forget the ubiquitous HALF-LIFE 2 crowbar, the only weapon players initially have for fighting.

Other games don't only encourage close combat—they force it. In GHOST RECON, we've already mentioned how players are instructed to destroy an armored vehicle in the only way possible: planting a charge in close proximity to the vehicle. In CALL OF DUTY 3, players are thrown into a close-quarters mini-game struggle with a German soldier. Both events led to high measures of engagement, but these events occurred once or twice in a session, unlike the dozens and dozens of exhilarating moments found in the games that distinguished themselves.

It's not just the melee weapon itself that encourages close combat. Just listen to battles in GEARS OF WAR. Amidst the cacophony of bullets, players can hear their teammates tell them to flank the enemy. What the comrades forget to say is that narrow firefight areas and emergence holes can immediately make these flanking expeditions devolve into melee combat. Consistently, we measured increased engagement and intensity to these episodes.

The takeaway for developers is that creating next-gen experiences is about exhilaration. Nowhere did these shooters distinguish themselves more than in the ability to consistently throw gamers into close combat.

5 LITTLE THINGS MAKE A BIG DIFFERENCE. Games with proven multiplayer popularity were fast-paced with consistently engaging core elements. These elements, like melee weapons, vehicles, and grenades, easily translated from a single player experience to multiplayer.

A look at our pacing metrics—measuring how frequently players respond to gameplay events physiologically—reveals a familiar top two for fastest pacing: GEARS OF WAR (pacing was 51 percent above the average) and HALO 2 (35 percent above average).

Our system utilizes time-coded tags when a key event occurs (for example, when a HALO 2 player's shield drops) and correlates it with the corresponding emotional data. Many titles have a standout feature that always engages, but for games like HALO 2 and GEARS OF WAR, every little element of gameplay engages. In HALO 2, "shield down" correlates with an engagement response 18 percent above average, and grenades show engagement at 21 percent above average. These supposedly little elements add up simply because they occur so often in a play session.

The result is an inherently fun gameplay experience that doesn't rely on big scripted events to create engagement. However, there's also a huge cursory benefit. All these engagement systems translate easily and directly into multiplayer gameplay. All GEARS OF WAR and HALO 2 need to do to give players a fun time is throw them into a death match and watch the mayhem.

WHAT WENT WRONG

1 CUT SCENES THAT INFORM, RATHER THAN ENTERTAIN. Cut scenes open up a big opportunity for creating a cinematic experience. Games like CALL OF DUTY 3, F.E.A.R., and GEARS OF WAR leverage them successfully to stimulate emotion in players.

However, other titles in this study struggled with maintaining engagement during cut scenes more than any other element. Players say they want them, but cut scenes in general are not as engaging as combat or other interactive gameplay. All too often, cut scenes simply served as the cursory bridge between two levels.

Underperforming cut scenes showed a distinct pattern. Most were highly informational and involved "talking heads" or narration. Briefing-style cut scenes often fall into this category. For instance, GHOST RECON ADVANCED WARFIGHTER 2 evoked an incoherent response during cut scenes across players. Its scripted briefings did not consistently engage players. Players did not even strongly think about the information in the briefings, a clear sign that these cut scenes were not grabbing players' attentions.

In RESISTANCE, engagement dropped significantly in 57 percent of cases during cinematics. Cut scenes here recount the Chimeran attack and Nathan Hale's journey, leading to long sections of emotional disengagement. Dynamic scenes of action and conversation between characters, on the other hand, demonstrated a stronger ability to engage and influence emotions.

Even extremely high-performing games suffer from disengaging cut scenes. HALO 2's cut scenes disengaged players 64 percent of the time, in stark contrast to its extremely engaging core gameplay. Results like this confirm that HALO 2 single player is fun more for the joy of combat than

methodology

EmSense utilizes a next-generation, bio-sensory headset to measure consumers' responses to media. The headset measures brainwaves (through dry EEG sensors), heart activity, breathing, blinking, temperature, motion, and other physiological signals as gamers play.

Proprietary algorithms built on decades of research literature and empirically verified with EmSense's testing of thousands of test participants, process physiological signals to develop models of engagement, emotion, adrenaline, and cognition. Each represents a different dimension of the game experience.

EmSense also utilizes analytic and data mining methods designed to be completely blind and objective. "Event tags" identify when and where events, like player deaths, occur. This is correlated with physiological data, then aggregated and benchmarked against other titles. The result is an objective, detailed view into what does and doesn't work to engage players.

SHOOT TO THRILL

Ubisoft's GHOST RECON ADVANCED WARFIGHTER 2.

any cut scene or storyline element. It also suggests that, given the tight timeframes inherent in every production schedule, knowing how to allocate production efforts is as important as game design itself.

The proper use of cut scenes is certainly one area we feel has broad applicability across genres, particularly as next-gen, triple-A titles are increasingly expected to deliver big cinematic experiences. Indeed, it raises questions about the role of cut scenes: to inform or entertain.

Predictably, GEARS OF WAR seems to get it right. Its cut scenes are filled with action, while information is largely communicated via radio and conversations during lulls in gameplay, in between firefights. Our data demonstrates that entertaining cut scenes engage and connect with players at the emotional level.

2 BOOT CAMPS AND TRAINING AREAS. We've all seen the classic boot camp in war movies, televisions shows, and video games. Pushed on by staff sergeants, recruits are put through the paces and come out stronger and ready to fight.

There's only one problem: The act of learning to shoot a gun, throw grenades, and perform hand-to-hand combat against dummy targets isn't very engaging. In the critical first minutes of the game, when players' first impressions are made, tutorials isolated from the action and storyline leave players emotionally disengaged.

Nowhere was this more apparent than in CALL OF DUTY 3. Its training area, where players are taught how to fight without danger or penalty for failure, led to below average emotional engagement for the first seven minutes of gameplay—that's seven long minutes when players are not immersed and not entertained. Only when players were thrust into battle did engagement rise again.

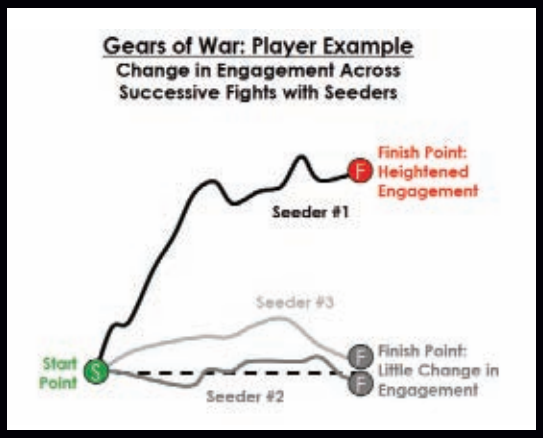
Through our years of testing and analyzing video games, we've found very few absolute rules in game design, but this one seems to come close. Titles that do not make its tutorials a "game," with their own sets of rewards and failure conditions, are not as engaging as those that do.

3 BROKEN ROLLER COASTERS. There's only so much intensity players can handle. Games that try to keep intensity continuously high created (counter-intuitively) an experience that was actually less intense, less cinematic, and less "epic."

This problem occurred in two ways. First, games that do not vary the intensity of events ultimately began to lose players. Over time, we measured what amounted to attenuation. These games actually led to smaller and smaller responses to each repetitive event. HALO 2 excelled in fast-paced action, but one side effect was a single player experience that was less intense. In the first level of HALO 2, players only faced a mix of smaller threats. As a result, the intensity of that level was up to 40 percent lower than in other games.

Second, level designs that begin with an intense firefight may have captured players' attention, but often they overshadow subsequent events. Players' engagement across the rest of the level, by comparison, was significantly lower in these circumstances. It amounts to an emotional letdown. For example, the second level of CALL OF DUTY 3 starts with an extremely intense battle, but players' emotional engagement for the rest of the level was comparably lower. This was not the climactic finish that we've heard so many developers want to try to shoot for.

4 REPETITION AND ASSURED OUTCOMES. We also discovered how important novelty and its close cousin, the unknown, are to engaging players. The Seeder in GEARS OF WAR provides a nice case study of this phenomenon. In the first 90 minutes of gameplay, players encounter three Seeders, one at a time. Killing them can only be done with the Hammer of Dawn weapon, and taking them down is crucial to restoring radio communications.



The result is that the novelty of the first encounter with this enemy makes the gameplay intensely engaging. However, the second and third encounters with Seeders do not engage players at nearly the same level of intensity. In some sense, emotion data demonstrated that players only went through the motions with the second and third Seeders.

Do exceptions exist? Sure they do, even in the same game. The wretches in GEARS OF WAR, fast-moving, crawling, and with swarms of Locust enemies, consistently engaged players in part because players were often pinned to the only thing that could save them, a Troika machine gun turret.

We think the important distinction here is not repetition, but the unknown outcome. Once players locked onto the Seeder

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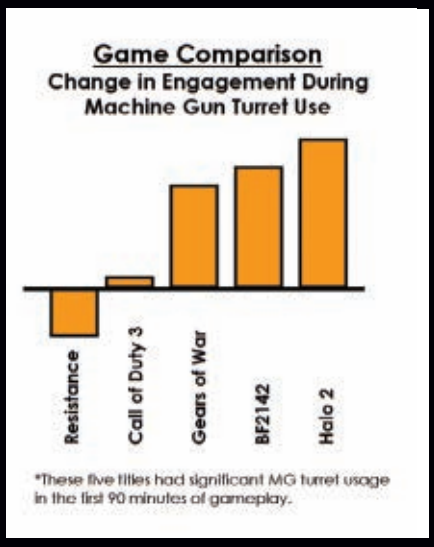
with the Hammer of Dawn, it was fairly clear that it was going down pretty quickly. However, for each wave of Wretches, the player had no idea if he would be able to fight them off in time.

5 GAMEPLAY INNOVATION THROUGH NOVEL WEAPONS. Results demonstrate that novel weapons can have a huge payout, but also a big downside if not executed well.

First, a definition: "Novel weapons" is a term we use for unique and powerful weapons beyond the standard pistol and machine gun. This includes high-powered sniper rifles, machine gun turrets, battle walkers, tanks, and other vehicles. Introducing these differentiating gameplay elements has increasingly become a focus of innovation (and risk) to game developers and marketers.

What separates the engaging from the disengaging—and why these weapons are such double-edged swords—is a consequence of their power. When players are protected and not getting harmed, utilizing these weapons led to low engagement levels. When players were consistently damaged, unprotected, or challenged by equally powerful enemies, the payoff was huge: engagement rose often to off-the-charts levels.

We looked at two high-powered weapons, sniper rifles and machine gun turrets, two frequently implemented elements in most shooters. Machine gun turrets, on average, have long been superior engagement performers in our database of elements. However, some games, including some in this test group, continued to fail to engage, leading to huge missed opportunities. For instance, engagement to RESISTANCE's machine gun turrets was a full 19 percent below leader HALO 2. That's the difference between an exciting experience and one that, frankly, is a disappointment.



The failure lies in how protected the players are. In RESISTANCE, one of the players' experiences with turrets in the first 90 minutes is from within a huge tank. In HALO 2, players utilize small, unprotected turrets that nearly ensure that they will be harmed, if not killed, if they remain on the turret for long.

The difference between engaging sniping and disengaging sniping also lies in the threats posed to the shooter. HALO 2, BATTLEFIELD 2142, and GHOST RECON all performed exceptionally here, scoring 12 percent, 18 percent, and 16 percent above benchmark averages, respectively. The level design ensures that players move forward as they snipe, frequently putting them in harm's way.

CALL OF DUTY 3 was an exception. The game gives players an opportunity to distance themselves from the battlefield and locate themselves in a position where they can snipe unthreatened. The result is not only disengagement during sniping, but also during the period where players get into position, knowing full well that enemies are far away.

Digital Illusions CE's BATTLEFIELD 2142.

The pattern continues with the use of vehicles. BATTLEFIELD 2142's battle walkers failed to engage players until an equally powerful enemy approached, typically another battle walker. The majority of the time that players are in battle walkers, they are not strongly engaged in the game. Similarly, in RESISTANCE, players emotionally disengage when driving the tank. Tank combat, without comparable threats, is not exciting or adrenaline-pumping.

What's interesting is that these threats don't always have to take the shape of enemies to engage players. HALO 2's Warthog is able to evoke sustained engagement and adrenaline, 17 percent above most vehicle benchmarks. The key difference we noticed is that Warthogs are never driven sensibly. Sure enough, high-speed driving, flying off jumps, and other generally reckless behavior consistently raised the level of engagement. In this case, players (and the vehicle physics) generated the threats, the challenge, and the entertainment of this novel gameplay.

KEYS TO ENGAGEMENT

Clients (and family members) always ask us if there's a single formula to compelling, engaging media, whether it's a video game, advertisement, or a movie. The truth is, there isn't.

But there are definite trends in what makes engaging and successful gameplay. At the end of the day, each of these successful games relies on superior execution and creativity to craft a uniquely engaging experience. Our big surprise is just how important the little things, like throwing a grenade, can be—even more engaging than that epic and highly-scripted plot events.

Little things add up to more enjoyable experiences, higher Metacritic scores, and higher sales. In short, more fun. As we've seen, there are definitely some "rules of fun" that hold across these titles, and in some cases, across games in general. More interestingly, though, we're looking forward to seeing how future titles innovate and break these rules. As players expect more and more from their game experience, smart risk-taking in game design may be the only way to truly stand out in the crowd.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IT'S BACK, BADDER THAN EVER: Bionic Commando*

BY LEE PURCELL

STRETCHING THE BOUNDARIES OF EXTREME

From the retro archives of gaming history, a popular Nintendo title, *Bionic Commando**, has been resurrected in richly detailed, 3-D glory by GRIN, a Swedish development firm, and showcased on a multi-core gaming machine monster, Skulltrail. More formally known as the Intel® Dual Socket Extreme Desktop platform, Skulltrail is an eight-core system featuring two four-core Intel® Core™2 Extreme processors. This is the configuration that showcased the pre-release version of *Bionic Commando* at the 2008 Game Developers Conference (GDC) to an enthusiastic audience. The extra processing muscle delivers greater detail, better physics, and exceptional effects, or as Intel applications engineer Orion Granatir noted, "Basically, it allows them to turn the dial all the way up on the game." Turning up the dial—always a worthy endeavor—is something best accomplished through a well-calibrated blend of hardware and software.

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Parallelization was integral to the game development. "The nice thing about this title," Granatir said, "is that it takes advantage of multiple cores, so as we start getting these machines out there with more and more cores, eight cores, we're actually seeing titles that take advantage of it. Intel can help developers on multi-core in a number of ways. One of our main goals, through online resources, training sessions, and university courses, is to show developers how they can do multi-core, how they can design multi-core techniques into their games. There were a lot of titles early on where they were just trying to patch in multi-core with Intel, just saying, this is the future. Now we're doing sessions with companies, we're teaching them, we're doing literature, showing them how they can start taking advatage of our multi-core from the ground up."

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David Potages, a Senior Engine Architect at GRIN, was heavily involved in threading *Bionic Commando*. "I have been at GRIN for three years," Potages said. "I'm working with the engine, improving the way it works. Threading the renderer is the first thing to do and it takes some time. Because it is quite tricky, it is really important to start very early. With eight cores we're getting better physics and effects, as you can see, like explosions, like effects with particles. I used Intel® VTune™ Performance Analyzer. You get pretty good interaction with your engine, as well." GRIN was also working with Intel on GRAW2, taking advantage of multi-core to enhance multi-player interactivity and responsiveness.

Messing with a Classic

Bionic Commando, the Nintendo classic released in 1988, equipped the hero with a useful grappling hook for swinging through the 2-D, side-scrolling game space. Though the latest iteration, published by Capcom, takes place in a far more interesting 3-D environment, the grappling hook is back with additional capabilities. Not only is the mechanical appendage handy for swinging across menacing abysses, but the bionically modified agent, Nathan Spencer, can use it to toss heavy objects around, traverse vertical inclines, and dissuade opponents from getting too close. Agent Spencer has an attitude in this new release. Having been framed for a number of crimes, he has been sentenced for execution when a mammoth explosion turns the city into rubble and Spencer is freed by his captors to help out the government in the post-apocalyptic world. With the terrain in ruins and the city's air defense grid now in the control of a massive terrorist force whose goal remains unclear, the FSA have only one option left: a behind-the-lines assault—the perfect job for a *Bionic Commando*.

GRIN kept enough of the flavor of the game to make it recognizable to those who may have played the original, but the current 3-D renderings are a vast improvement over the earlier 2-D artwork. It's a richly detailed world of towering buildings, suspended roadways and monorails, deep canyons, and sheer rock faces, where every environment is scalable using swinging, scaling, climbing, and wall-walking techniques. Moving all of these pixels, textures, models, and shadows around a complicated, rubble-strewn world takes massive amounts of processing power. The game certainly doesn't require an eight-core system for a satisfying experience, but it knows how to use those cores when available and the result is a visual delight to game aficionados.

Tuning, More Tuning, and Optimization

The development team at GRIN focused their optimization efforts for the game on platforms powered by Intel® Core™ microarchitecture, tailoring the code to take maximum advantage of the available cores in a system as well as the presence of features, such as Intel® Streaming SIMD Extensions 3 and 4.1. "We also think that Direct X* 10 support is important and that it requires some optimizations," Potages said. "The good thing is that DX and drivers are also starting to use the available cores in an efficient way."

"Our main objective with the game engine was to give the player a good frame rate, even in high workload circumstances," Potages continued. "I think we all hate it when you get a huge drop in the frames per second (FPS)

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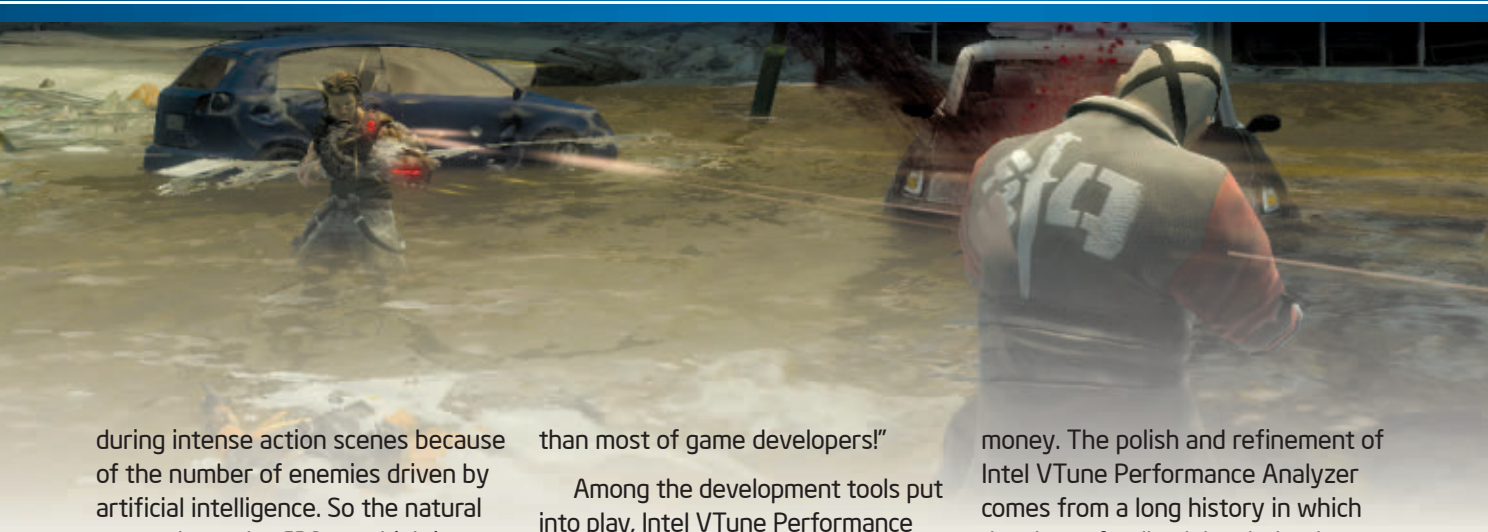

during intense action scenes because of the number of enemies driven by artificial intelligence. So the natural way to keep the FPS rate high is to ensure we take advantage of all the cores. This is definitely not an easy task and requires a lot of refactoring when working on an existing game engine. During development, we also wanted to fully support DX10 and its new features."

GRIN took advantage of support from Intel to craft the latest version of *Bionic Commando*, working to target the hardware platforms that would be in the market at the projected time for the software release. "The support from Intel is definitely excellent," Potages said. "We received some development systems and tools to experiment and benchmark our new features, which is extremely important when you try to develop for next-generation hardware. Game development takes a long time and if you want to fully support hardware that will be out when your game will be released, you need this kind of support very early on."

"Another thing we really appreciate with Intel," Potages added, "is the constant dialogue we have with them. This includes advice and best practices, but they also analyze and benchmark our engine; it is very useful to have comments from very experienced developers that know the hardware much better than most of game developers!"

Among the development tools put into play, Intel VTune Performance Analyzer took center stage, but the GRIN team also took advantage of two threading analysis tools: Intel® Thread Checker and Intel® Thread Profiler. Much of the code optimization took place on Intel-based development systems. GRIN used a wide range of configurations to ensure solid platform support and optimized code that worked well for all of them.

"When it comes to benchmarking and optimization," Potages said, "VTune is definitely the most useful tool we have. We were able to pinpoint several design issues (for instance, we reduced the data flow and redesigned the engine in some areas that were causing far too many cache misses), but we also optimized very specific areas of the code by examining how different implementations behaved. Also, Thread Checker found several possible data races that would have been extremely hard to track otherwise, so this was a very nice time saver." Potages commented that game developers want to minimize the time spent debugging, implementing tools, benchmarking, and optimizing, in order to focus on new features. It's difficult to create custom tools from the ground up, so using existing applications saves both tool development time and money. The polish and refinement of Intel VTune Performance Analyzer comes from a long history in which developer feedback has helped improve each successive release. Isolating bugs and design issues early in the development process offers big advantages when scrambling to complete a complex game on schedule.

The performance benefits of all of the tuning and optimization work were noteworthy. As Potages said, "Basically we managed to get to a point where the bottleneck on quad-core machines is the GPU; we're now able to add features such as additional effects that are only enabled when you get such architectures. But, we didn't forget dual-cores. The speed increase is big, and we keep optimizing it. For instance, the benchmarks we did for Intel's presentation at GDC 2008, "Optimizing DirectX on Multi-core Architectures", showed a 1.76x FPS scale-up between one and two cores."

Take It to the Limits: Skulltrail

Extreme gaming offers a trial-by-fire test bed for the most advanced hardware, and with that in mind, Intel's latest irrepressible gaming machine, Skulltrail, enters the fray like a monster truck rolling over the bleacher barriers and every other obstacle to enter the stadium. The Skulltrail platform includes the first

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desktop board from Intel with dual processor sockets: the Intel® Desktop Board D5400XS. Fill those sockets with a pair of Intel Core 2 Extreme processors QX9775 and you have full-tilt boogie eight-core processing, as well as support for up to four PCI Express* graphics cards (both NVIDIA SLI* Technology and ATI CrossFireX* Technology components can be used). The platform also handles up to 8 GB FBE DIMM 800 memory and supports Dolby* Home Theater 7.1-channel audio. To keep the on-screen action flowing smoothly, the Skulltrail data throughput benefits from a 3.2 GHz clock, up to 12 MB of cache, and a 1600 MHz Front Side Bus.

The gaming potential is not only hot, but dedicated gamers who rely on overclocking to push the processor performance have found a friend in Blastflow, a subsidiary of the British boutique PC manufacturer Vadim Computers. The Blastflow Tidal Skulltrail SB Block brings watercooling to the platform with a unique copper and acrylic waterblock. Intel has deliberately removed overspeed protection from the platform components, as befits a machine targeting the speed demons of extreme gaming. For those bad boys who go beyond the prescribed limits, however, the Intel disclaimers are unmistakably stern.[1]

Systems based on the Intel Core 2 Extreme processor QX9775 and Intel Desktop Board D5400X will be offered by several PC manufacturers, including Armari, Boxx Technologies, Digital Storm, Falcon Northwest, Maingear Computers, Puget Custom Computers, Scan Computers, Velocity Micro, Vigor Gaming Computer, Voodoo Computers, @Xi Computer, and others.

Only the most devoted gaming enthusiast is likely to plunk down the dollars for a Skulltrail system, but there are other options available for those whose budgets are on a more terrestrial scale. Intel® GMA X3000 technology advances are narrowing the boundaries between discrete game acceleration cards and integrated graphics chipsets. While there will be a certain percentage of high-end games that will require a discrete card for a satisfying gaming experience, many top-tier games perform very respectably on systems equipped with the latest generation integrated graphics architecture from Intel. ■

[1] Warning: altering clock frequency or voltage may (1) reduce system stability and useful life of the system and processor, (2) cause the processor and other components to fail, (3) cause reductions in system performance, (4) cause additional damage, and (5) affect system data integrity. Intel has not tested, and does not warranty, the operation of the processor beyond its specifications.

About Capcom

Capcom began in Japan in 1979 as a manufacturer and distributor of electronic game machines. In 1983 Capcom Co., Ltd was founded and soon built a reputation for introducing cutting-edge technology and software to the video game market. Now an industry leader in the video game industry for 25 years, Capcom's legacy of historic franchises in home and arcade gaming are testaments to an unparalleled commitment to excellence.

Building on its origins as a game machine manufacturer, Capcom is now involved in all areas of the video game industry and has offices in California, England, Germany, France, Hong Kong, Osaka, and Tokyo.

To learn more about Capcom, visit www.capcom.com

To learn more about *Bionic Commando**, visit www.bioniccommando.com

About GRIN

GRIN is located in the heart of Stockholm, Sweden, where 115 staff members take game development to the next level. GRIN also has offices in Gothenburg and Barcelona, and a quality assurance studio in Indonesia. All totaled, 220 hard-working and creative individuals are developing games for the major next-generation platforms: Xbox* 360, Playstation* 3 and the PC.

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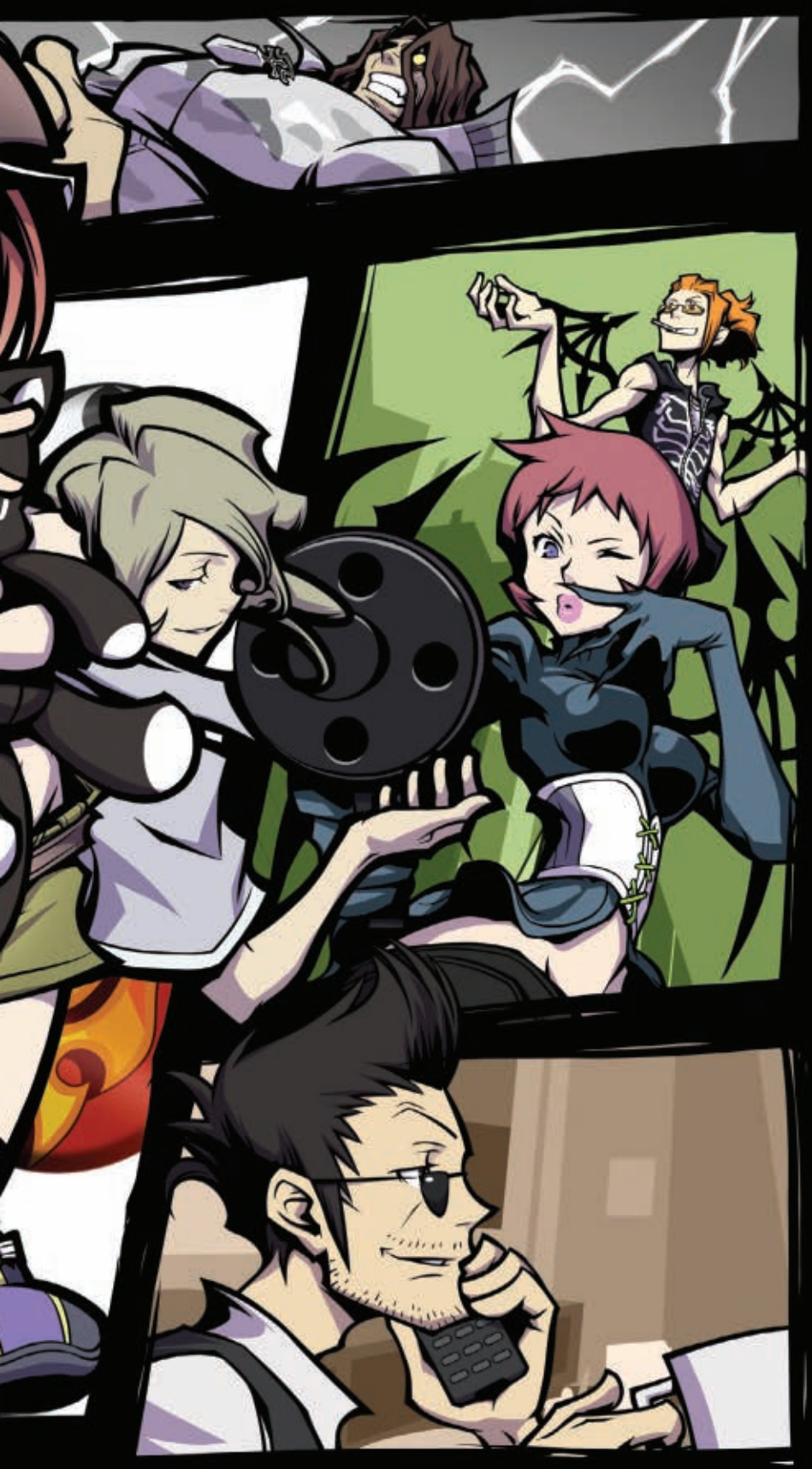

SQUARE ENIX'S THE WORLD ENDS WITH YOU

THE WORLD ENDS WITH YOU WAS OUR TEAM'S first game for the Nintendo DS—a platform that we felt had limitless possibilities. The three of us who were primarily responsible for the game had previously worked as artists for the FINAL FANTASY and KINGDOM HEARTS series, but had never directed a game before. The game wound up taking two years to develop, which is a considerable amount of time for a portable game, and was a continual trial-and-error process throughout. We feel that the resulting project was eclectic and ambitious, but not different just for the sake of being different.

WHAT WENT RIGHT

1 **GETTING TO GO WILD WITH ORIGINAL IP AND GAMEPLAY CONCEPTS.** The project began with constant brainstorming and idea-sharing between the three of us. As this was our first game as directors, a healthy dose of paranoia prompted daily brainstorming meetings. These sessions established a strong sense of camaraderie and led for better overall communication, allowing us to constantly meet our deadlines without any serious delays.

From the beginning we were determined to create an original IP—something that wasn't another FINAL FANTASY or KINGDOM HEARTS. This

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TAKESHI ARAKAWA *worked on FINAL FANTASY VIII and FINAL FANTASY X, and was the art director for the KINGDOM HEARTS series.* **TOMOHIRO HASEGAWA** *was a graphic designer on FINAL FANTASY VIII, IX, X, the KINGDOM HEARTS series, and SAGA FRONTIER.* **TATSUYA KANDO** *worked on FINAL FANTASY VII and VIII, and was the animation director for the KINGDOM HEARTS series. Send comments about this article to* **editors@gdmag.com.**

THE WORLD ENDS WITH YOU incorporated many real-world locations from the Shibuya district of Tokyo into its game setting.

led us to choose the Shibuya district in Tokyo as the game's setting. At first we thought the Shibuya locale would be a turnoff to overseas players, but the district's uniqueness adds a certain reality and depth that we couldn't have recreated in a fantasy setting, and it lets players identify more with their in-game counterparts, who are fighting for their lives in the "real world." It turns out we were successful—even a year after the game's Japanese release, hardcore fans are still organizing tours of the real Shibuya to compare it to the game world.

GAME DATA

PUBLISHER:
Square Enix

RELEASE DATE:
April 22, 2008

DEVELOPER:
Jupiter, Square Enix

PLATFORM:
Nintendo DS

2 A STORY CREATED BY COMMITTEE (AND FREE OF THOSE PESKY RPG PLOT HOLES)! Like all other aspects of development, story development was done by committee. Each director was given his own writing team, which brainstormed over the general story background, plot, and other elements. Because the over arching story has the player trapped in Shibuya, the story needed an air of mystery about it, so the team was determined to avoid any plot holes.

One contradiction in a story like ours could bring down the house of cards, so the team worked carefully to keep the storyline locked down. The game's designers took part in the writing process as well, ensuring that as many eyes as possible went over the plot, searching for holes and offering input from every conceivable angle. After the final story was in place, we had our Q/A department go over everything as a final failsafe. To our surprise (and horror), they tracked down several inconsistencies we had managed to miss during our multiple checks. Their diligence reminded us of how critical it is to view the game from the player's perspective—and these extensive preliminary story checks are becoming a standard at the company.

3 IMPLEMENTING A PLAYER-CONTROLLED RISK VS. REWARD SYSTEM. Many agree that the standard JRPG formula of walking around the field and grinding (or running away from monsters that aren't worth your time) can get monotonous and build up player stress. Another issue on the development side is that tuning combat difficulty takes excessive amounts of time, and there's no guarantee that a designer's ideal difficulty is the same as the player's.

Our solution was the "Active Encounter" system, where players can choose how many enemies they wish to fight and when. This removes mandatory battles with "trash mobs," and allows the player to control the risks and rewards of battle. Harder battles yield better loot and more experience points. This let players of varying skill levels enjoy the game beginning to end—at the cost of some game balance.

4 GOING FULL-BORE 2D. Modern settings are rare for Square Enix titles, so we had to make sure our art style would stand out from other titles—and to keep the entire game in 2D. Most games go for the 3D approach, but we felt we couldn't fully express ourselves on the DS if we went the polygonal route. 2D graphics can really "pop" on the DS's small screen, and we wanted to have lots of wildly shifting and morphing monsters. The game's "Noise" creatures have colorful tattoos that dynamically change shape and attack the player.

We also made an effort to make the backgrounds as faithful to the real city as possible. The entire staff went on location to Shibuya and walked its streets constantly, taking note of interesting areas where battles could go down, and what specific landmarks to highlight. Background artists spent extensive time on location, making sure not just to trace what was there, but more actively capture the overall look and style of the city. (See accompanying photolog, pgs 38 and 39.)

5 WORKING CLOSELY WITH OUR MIDDLEWARE PROVIDER TO CRAM A FULL VOCAL SOUNDTRACK INTO THE GAME. From the very beginning, we wanted to include a variety of musical genres that fit the mood of walking around Shibuya. Given the limitations of DS game cards, we initially hadn't even thought of using vocal tracks, but we wound up implementing CRI's Kyuseishu Sound Streamer. This middleware had only been used for voice compression in the past, and this was the first time anyone had used it for music. We were blown away when we heard the first vocal track coming out of the DS, and realized we'd be able to include a full digital soundtrack. We


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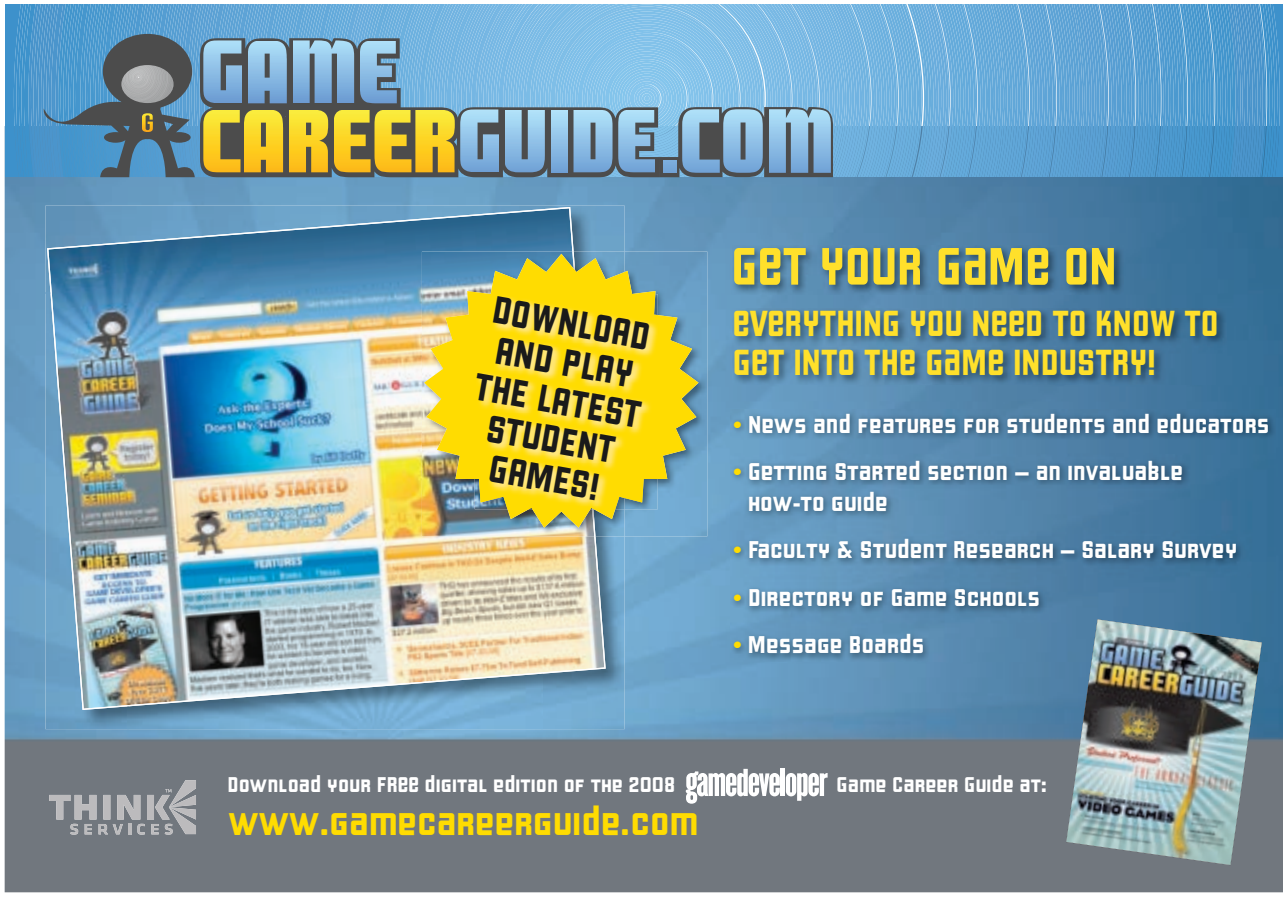
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removed the pre-rendered movies and replaced them with Flash-style sequences, which freed up cartridge space to include over 30 songs. In the end, about 1/4th of the game ROM consists of compressed music data. This was an example of how trying something new really paid off.




Photo references for Shibuya district landmarks, which translate to the below in-game locations.

WHAT WENT WRONG

1 **TIME MANAGEMENT AND DEVELOPMENT CULTURE CLASH.** The game was developed by Square Enix in Tokyo and Jupiter in Kyoto. While we originally commissioned Jupiter as the developer, we wound up with more creative crossover than we thought. The Square-side directors got involved in the gameplay design elements, while Jupiter went beyond the call of duty and assisted with the game planning. The cooperative endeavor resulted in a fantastic product, but it came at a price. Square and Jupiter have very different development cultures, but it took us a while to realize it. We assumed all companies' development processes were the same—that our way was the standard. Once we met up and reached a consensus on how to do things, work proceeded much more smoothly.

Geographically, we were very distant as well—it takes about two hours to get between Tokyo and Kyoto via bullet train. It was critical that we met in person, but this ended up costing us time, and it hurt the schedule at every step. We had weekly telephone conferences, but it was hard for us to "read"

THE WORLD ENDS WITH YOU'S dual screen battle system.





PHOTO LEFT BY GAME DEVELOPER STAFF

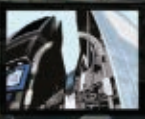
WELCOME TO SHIBUYA

Shibuya is one of Tokyo's three major subcenters, along with Shinjuku and Ikebukuro. From the statue of the dog Hachiko that serves as the area's symbol, to the tangle of streets and stores that call out to a sea of young people, Shibuya pulls together music, recreation, fashion, food, and sports from far and wide—from within Japan and beyond its borders—and spins the hordes of people and scores of ideas into a chaotic broadcast of culture. These scenes were marked, analyzed, and photographed by the staff of The World Ends With You, in order to re-create an authentic approximation of Shibuya. The following are some of the important sights and feelings of the region.

10. DOGENZAKA
This sloping street is flanked by shops which tend toward the eccentric. This hill was once a popular setting for novels.

11. A-EAST
This is one of Shibuya's shadier neighborhoods. The street winds past concert spaces (known as live houses) and gothic-lolita boutiques.

12. MOLCO
Molco is a series of department store buildings centered around teen and twenty-something fashion. Don't miss the exhibition space for a dose of pop culture.



13. CENTER STREET ENTRANCE
A stomping ground for Shibuya youth. In the 80s, it gave birth to the "Shibu-Kaji" (Shibuya Casuals) fashion movement.

14. AMX
AMX is a major Japanese CD store on Center Street. Nearby you can find shoe stores, lingerie shops, and other clothing boutiques.

15. TIPSY TOSE HALL
This is a popular corner where arcades and karaoke boxes draw crowds. There's even a store specializing in American comics.

16. SHIBU-Q HEADS
A chain store that sells pretty much anything, including seasonal and party goods as well as collector's items. They even have a drugstore.

17. SHIBUKYU MAIN STORE
This department store targets the family demographic. The secret of its popularity is a wide range of tenants.

18. SPAIN HILL
A narrow, Mediterranean street lined with eateries, bookshops, and more. As you climb the stone-paved steps, you'll want to veer off and explore.

19. WEST EXIT BUS TERMINAL
This terminal is served by most Tokyo bus lines. Normally, this is your ticket all over the city.

20. STATION UNDERPASS
A tunnel beneath the train tracks. The eerie graffiti and gloomy atmosphere keep people away despite its proximity to the station.

each other over the line. Sadly, we were unable to do video conferencing, which I believe would have resulted in a more open, jam-session sort of feel.

2 STORY CREATION SCHEDULING. Even though we were happy with how the story turned out, the process started going smoothly only halfway through the project. When we started, we were plagued by confused direction and constant rewrites by the scenario staff. Changing plot elements mid-project is risky business, and we were making tweaks to the scenario all the way up until just before master submission! We were able to pull it off because the game didn't contain a lot of voice—if it had been voice-heavy, we would have had to lock down the scenario far earlier.

Although it's obvious that the scenario should be put together early on in the development process, it also takes time to create something that's truly interesting. Maintaining this balance is extremely important.

3 OVERLOADING THE PLAYER WITH NEW CONCEPTS AND GAME SYSTEMS. We made three big mistakes with some of the gameplay concepts we implemented. The first issue was how the player could "scan" the thoughts of NPCs. We should have integrated this into the story more, because it never really related to solving puzzles. I can't say the whole system was unnecessary, but it could have been integrated much better. If there is a sequel, this is something we'll need to work on.

Another stumbling block was the special attacks in the dual-screen battles. To activate the special attack, you play a card-based minigame on the top screen. We wanted to drop the system in lieu of a gauge that fills up as the player uses normal attacks. We were hoping to fix it for the North American release, but we ended up not having enough time and went with the same system (with reduced difficulty).

The last issue was partially fixed for the North American version. Anyone playing the Japanese version was forced to wade through pages of tutorials. With all the new systems, the players had a lot to learn, and "the wall of text" was hard for people to absorb all at once. I think the chaotic state of all these new systems confused the heck out of Japanese gamers. In the North American version, we trimmed down the text as much as possible, and made the tutorials skippable.

4 DUAL-SCREEN BATTLES, OR "WHAT'S GOING ON HERE?" The original concept of dual-screen battles came from creative producer Tetsuya Nomura, but it was easier said than done. Fighting battles on the lower screen using the touch panel was our original concept, and turned out as well as we expected. But our biggest headache stemmed from the battles in the upper screen.

We threw a number of ideas at the wall to see what stuck, like command-based battles or even music games. At first, we were determined that the player would have to fight on

both screens at once, but after trying out a few systems we realized the error of our ways.

Why did we have to make the user do anything in the upper screen at all? Once we left our creative egos at the door and looked at things through the player's eyes, we realized what was wrong. We had to make the user want to fight on both screens, but still provide the automatic combat if they elected to avoid it. This sped things up and we arrived at the battle system we have today, where the player can simply let the battle progress in the upper screen by itself, or actively fight using the control pad. I regret that we hadn't come up with this solution earlier.

5 ANIMATION QUANTITY AND QUALITY. The biggest problem with going fully 2D is the animation costs, and heavy amounts of animation were required for our battle sequences. To reduce our workload, we created a polygon-based template for the main character Neku and some of the larger monsters. We rendered out some simple animated models, and rotoscoped the 2D pixel art on top of it.

The tattoos on the "Noise" monsters were another headache, since the sprites moved and shifted with each frame of animation. It took a while for the whole team to agree on how each tattoo should change and lock down the data set.

Additionally, with so many people on staff, we had difficulties maintaining a quality standard for the animation. We naturally wanted everything to look cool and modern, but "cool" is subjective, so strong direction was a necessity—so, as the animation director, Tatsuya Kando had to take a trip to Kyoto to visit Jupiter every week to check on how things were going.

LESSONS LEARNED

The main challenges in our project were trying out new ways of expressing ourselves, and maintaining quality while keeping an eye on costs—an always daunting task. Given the opportunity to do it again, we'd be able to work faster while keeping a high standard of quality. The hardest aspect is determining the staff's skill level and planning for it to allow for accurate time and cost estimates.

THE WORLD ENDS WITH YOU directors from left to right: Tomohiro Hasegawa (co-director), Tatsuya Kondo (director), and Takeshi Arakawa (planning director).

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Doxygen Essentials

Nicholas Olsen

DOCUMENTATION. THE WORD STRIKES TERROR IN THE programmer's soul. And for anyone who has inherited someone else's code, a lack of documentation (apart from the source itself) can make getting productive a painful chore.

Few game studios can divert precious resources exclusively to the creation and maintenance of documentation, especially when they are the sole clients for internal engine and tool development. One way to reduce the effort required for documentation is to use a documentation generator, a program that uses the source itself along with specially formatted comments to automate typesetting and page layout, which results in a final document.

Assuming interfaces will be commented (and why wouldn't they be?), using a documentation generator allows documentation to become a part of the development process rather than a process unto itself. I've found Doxygen to be a good, free solution.

GETTING STARTED WITH DOXYGEN

Doxygen, created by Dimitri van Heesch, is a documentation system for code written in C, C++, C#, Java, Objective-C, Python, IDL (CORBA and Microsoft flavors), Fortran, VHDL, PHP, and to some extent D—or so says the official literature. The commenting extensions supported by Doxygen are relatively low on programmer overhead but can scale from simple API references to comprehensive manuals.

To get started, the user must first download and install binaries for his platform, available from www.stack.nl/ffdimitri/doxygen/download.html#latestsrc. For the sake of the following examples, I will assume the user has the Doxygen executable in his PATH and available from a command-prompt, which will be the case for a default Windows installation (OS X and other *nix users may need to add Doxygen to their PATH).

The Doxywizard GUI front-end is also available to assist in configuring and running Doxygen, and is perhaps better for day-to-day tweaking of configuration files and building documentation. I recommend playing around with Doxywizard to figure out how to use it for building the examples; descriptions of how to navigate the UI widgets would add too much clutter for a quick introduction.

Your first documented class in Doxygen's Class List.

YOUR FIRST DOCUMENTED CLASS

The programmer informs Doxygen of his or her intent to document something via special documentation blocks and commands. A special documentation block is a comment that is extended to inform Doxygen that it will be used for generating output.

Doxygen supports several comment styles to accommodate the various languages it understands, which can lead to confusion for beginners, as the samples in the manual bounce between styles seemingly at random. I will use C++ for the examples here, along with the triple-slash (///) to denote documentation comments and @ to denote commands.

Create a source file named DoxygenEssentials.h and insert the following comment and class declaration:

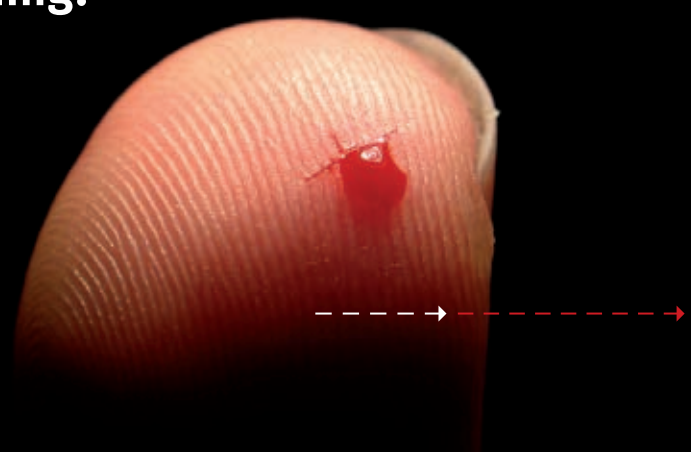
```
/// @brief A documented C++ class!
class Doxygenized {
};
```

From a command prompt, cd to the directory that contains DoxygenEssentials.h and issue the following commands:

```
>doxygen -g
>doxygen
```

CONTINUED ON NEXT PAGE

A minor issue in the beginning.



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The first command tells Doxygen to generate a default configuration file, which will be named Doxyfile. The second command builds the documentation and places html and latex output in `./html` and `./latex`, respectively (I will ignore the LaTeX output).

Opening ./html/index.html in a web browser will enable you to navigate to the Classes page and find the entry for Doxygenized along with the text that followed `@brief`. `@brief` is a command that instructs Doxygen to use the next paragraph of comment text as a short description for display in the class list.

ADDING A DETAILED DESCRIPTION

Now that I've given a brief description for the class list, it would be nice to have a more comprehensive description so the next poor programmer who gets stuck in this code can figure out what the class does. A detailed description can be added by using an empty documentation comment followed by a documentation block containing an arbitrary amount of descriptive text:

```
/// @brief A documented C++ class!
///
/// The Doxygenized class serves as a demonstration
/// of how to document C++ code using Doxygen
class Doxygenized {
};
```

Upon re-running Doxygen, the user can follow the Doxygenized link in the class list to a class reference page that includes the detailed description.

DOCUMENTING METHODS AND FUNCTIONS

Now that I've shown a reference page for Doxygenized, let's see what happens when a method with its own brief and detailed descriptions is added.

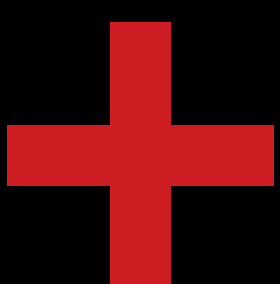
Add the following to the body of Doxygenized and rebuild:

```
public:
        /// @brief A documented method
        ///
        /// The isDocumented method serves as an
        /// example of how to document methods,
        /// along with their parameters and
        /// return value.
        bool isDocumented(int aParameter) {
                return true;
        }
```

The Doxygenized class reference now contains a Public Member Functions section where the method and brief description appear. There is also a Member Function Documentation section with a verbose entry for `isDocumented` that includes the detailed description.

In order to make the documentation more descriptive, the return type and parameter(s) can be documented explicitly, expanding the documentation block for `isDocumented` as such:

```
        /// @brief A documented method
        ///
        /// The isDocumented method serves as an
        /// example of how to document methods,
        /// along with their parameters and
        /// return value.
        /// @return Always returns true, because this
        /// is a contrived example
        /// @param aParameter A documented method
        /// parameter. This parameter is not actually
        /// used. Its only purpose in life is to be
        ///documented
        bool isDocumented(int aParameter) {
                return true;
        }
```



Launching an MMO is a complex process. It requires skill and great fortitude, sprinkled with optimism. Each decision is dependent on the next. Before your MMO hits the crowd, the work begins to make sure your big idea is both well designed and well coded. It also has to be technically capable of coping with several thousands of concurrent players – if not, something that appears to be a minor technical issue in the beginning, can lead to a catastrophe once your game is launched.

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Because you only get one chance.

When the documentation is rebuilt, the Returns and Parameters sections can be found in isDocumented's detailed description which, predictably, includes the descriptions provided for the parameter and return value.

DOCUMENTING FIELDS AND ENUMERATIONS

When documenting class fields and enumerators, the brief/detailed description pattern used in the previous examples works perfectly fine. However, Doxygen also offers shorthand for placing a brief description on the same line as a declaration.

Add the following to the body of Doxygenized:

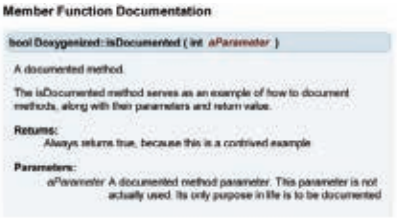
```
/// @brief A documented enumeration!
///
/// An example of documenting an enumeration
/// and its members using the shorthand for
/// placing documentation inline with
/// declarations
enum eNumbers {
        kOne,     ///< The number One
        kTwo,     ///< The number Two
        kThree    ///< The Number Three
};

int aField; ///< An example documented field
```

Rebuilding now will produce Public Types and Public Attributes sections in the Doxygenized class reference, plus a detailed documentation section for eNumbers that contains the descriptions of the enumerators. This method of providing documentation on the same line as declarations keeps headers streamlined, and comes in handy when developers don't feel the need to write a treatise.

Also note that by default Doxygen only includes public and protected members in the documentation, although editing the Doxyfile or using Doxywizard can override this behavior.

A WORD ABOUT DOXYGEN COMMANDS

Now that I've shown several Doxygen commands, using commands and their parameters will be straightforward and even obvious from here on out. For the sake of completeness, I will briefly describe the conventions used by Doxygen's manual, which I will use when introducing additional commands.

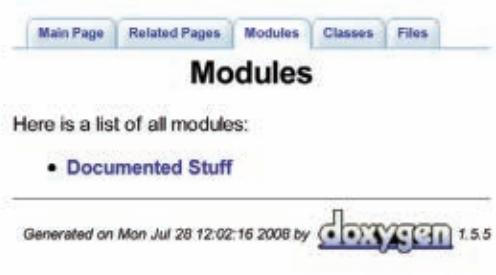


A detailed function description.

As I've already shown, commands begin with @ and have one or more parameters. In Doxygen's manual, the following conventions are used to describe parameters:

- If the parameter is enclosed in angle brackets ("<parameter>") it consumes a single word.
- If the parameter is enclosed in parenthesis ("(parameter)") it consumes text until the end of the line.
- If the parameter is enclosed in curly brackets ("{parameter}") it consumes text until the end of the next paragraph, paragraphs being delimited by a blank comment line.
- If square brackets are used as a modifier ("[{parameter}]"), the parameter is optional.

Note that these conventions only apply to how parameters are described in Doxygen's manual, not to the arguments supplied by the developer when commenting. In the preceding example, I used the @parameter command, which has the description @parameter <parameter-name> { parameter description }, to tell Doxygen which function parameter is being documented and provide a paragraph of descriptive text. Similarly, the @return command has the form @return { description of return value } and uses the paragraph that follows it as a description of possible return values.



A Doxygen Modules group with related classes and functions.

GROUPS

Getting back to the code, a problem with the current documentation is that class Doxygenized only appears in an alphabetical list that will grow to include every other documented class and structure. As the codebase grows, such a list will only become less useful and more uninviting.

Fortunately, Doxygen provides commands that allow classes and functions to be grouped and referenced as a unit. Wrap the existing class definition with the following documentation blocks:

```
/// @addtogroup documentedStuff Documented Stuff
/// A group used to demonstrate Doxygen's grouping
/// capabilities
/// @{
        /// (Insert the code to add to group.
        /// In this case the definition of
        /// Doxygenized).
/// @}
```

When the documentation is rebuilt, it will produce a Modules tab on the page header whose associated list includes our freshly minted group. The `@addtogroup <name> [(title)]` command takes a single-word name used to uniquely identify the group internally and create links to the group's documentation, while title is an optional descriptive title used in the output. `@addtogroup` can be used repeatedly throughout a project to add various entities in different source files, but if more than one title is provided, Doxygen uses the first one it processes.

Related Pages are automatically generated for some Doxygen commands.

CREATING A TO-DO LIST, BUG LIST, AND DEPRECATED LIST

You can use the `@todo`, `@bug`, or `@deprecated {paragraph}` commands in a documentation block to mark pieces of code as unfinished, buggy or deprecated and provide a description of the problem. Add the following definitions to DoxygenEssentials.h, inside the group created in the previous example:

```
/// @brief An unfinished class
/// @todo Figure out what this class
/// is supposed to do and implement it
class UnfinishedClass {
};

/// @brief A buggy function
/// @return num divided by zero
/// @param num number to divide by zero
/// @bug This function always crashes for some reason
int Boom(int num) {
        int divisor = 0;
        return num / divisor;
}

/// @brief A washed up, useless class
/// @deprecated Please don´t ever use this code again
class Retired {
};
```

The new documentation set contains a Related Pages navigation tab with links to project-wide Todo, Bug, and Deprecated Lists. There will also be a class-specific Todo: item in the UnfinishedClass reference page, along with a Bug: in the Boom function reference and a Deprecated: item in the Retired class reference. Additionally, the Documented Stuff module now contains the new classes and function.

DECORATING FILES

Doxygen also enables the user to document files explicitly and has a few commands that lend themselves to the task. Boilerplates can be incorporated into a documentation block. Add this example file header to the top of DoxygenEssentials.h:

```
/// @file
/// @brief A documented file provided for Doxygen Essentials
///
/// Copyright 2008, Nicholas Olsen
///
/// Feel free to do whatever you want with this software
///
/// @author Nicholas Olsen
/// @version 0.0001
/// @date 2008
```

The File List entry for DoxygenEssentials.h now contains a brief comment and a link to a file reference page. This page contains entries for the classes and function in the file, while the detailed description is complete with author and date information. Note that the `@author`, `@date`, and `@version {`

description } commands can be used to document anything, but a file header is a common case where this information is used in practice.

ADDING MAIN PAGE DOCUMENTATION

While it's nice to have all this documentation, what's been created is still just a manual that is not particularly inviting to someone who does not already know where to find things. Fortunately Doxygen allows the contents of the main page to be modified, and even allows such documentation to be placed in dedicated files outside the source.

Create a file named mainpage.dox in the same directory as DoxygenEssentials.h with the following contents:

```
/// @mainpage Manual For Doxygen Essentials
///
/// @section introSection Introduction
///
/// This is the programming manual for Doxygen Essentials
///
/// @section moduleSection Modules
///
/// Doxygen Essentials contains the following modules:
/// @li @ref documentedStuff
///
/// @section additionalSection Additional Points of Interest
///
/// These may also come in handy:
/// @li @ref todo
/// @li @ref deprecated
/// @li @ref bug
```

The main page now includes Introduction, Modules, and Additional Points of Interest sections that direct readers to some of the highlights of the manual. `@mainpage [(title)]` instructs Doxygen to use the following documentation block as the contents of the main page, while `@section <name> (title)` creates a page section using name as the internal identifier and title as a descriptive heading. `@li` is also used to create bulleted list items that use `@ref <name> ["(text)"]` to link to the page or section identified by name.

WRAPPING UP

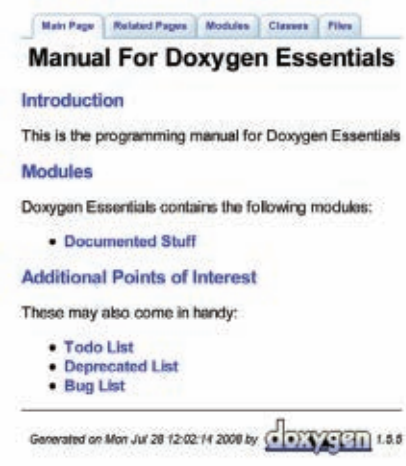
Using only brief and detailed descriptions, as outlined in this article, will result in more documentation than much of the world's code enjoys currently. By documenting parameters and return types and taking advantage of grouping commands, developers can create something that might be useful to the next programmer tasked with maintaining the code.

Add a nice main page with a fancy introduction and readers might even believe the coder knows what he is doing. Doxygen has many additional commands and capabilities that are beyond the scope of this article, the previously mentioned Doxywizard being a good place to start experimenting.

To give some examples, with the Ghostscript interpreter and a TeX distribution (I have used the TeX and Postscript tools provided by Cygwin), it's possible to create PDF reference manuals and embed LaTeX formulas in comments; install the AT&T GraphViz package and it becomes possible to embed Dot diagrams in your comments.

Another useful practice is to add Doxygen to an existing build or continuous integration process and publish the results on the local network, thus ensuring current documentation is always available to every developer.

Hopefully this article has inspired some game developers to consider turning their usual commenting into documenting. The next programmer who has to go through their code will thank them for it. Maybe someday you'll be pleasantly surprised to discover you wrote a manual for that code you never expected to see again.



The Main Page tells readers where to find things.

Doxygen's home page is located at www.stack.nl/ffdimitri/doxygen. More code examples for this article can be found at www.gdmag.com/resources/code.htm.

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NOEL LLOPIS

THE INNER PRODUCT

DELICIOUS DATA BAKING

WHO DOESN'T LIKE A WARM COOKIE, straight out of the oven? Cookies are created from their raw ingredients (flour, butter, sugar, eggs), which are mixed together, portioned into bite-sized pieces, and baked in the oven until everything comes together just so. The baking process transforms a set of ingredients that are rather unappealing by themselves, into a delicious and irresistible treat.

Data baking (also called conditioning) is very similar. It's a process that takes raw data and transforms it into something that is ready to be consumed by the game. Data baking can range from being a complex and involved process that totally transforms the data, to a lightweight process that leaves the data in almost its original format.

Since it's an internal process, totally invisible to the player, data baking rarely gets the attention it deserves. As it turns out, the way data is baked and loaded in the game can have a profound impact not just in your game architecture, but in the development process and even the player experience.

The main goal of data baking is to achieve very fast loading times. The player will have a much smoother experience by being able to start the game right away, and team members will be able to iterate and try different options if the game loads in two seconds rather than if it takes a full minute.

There are also some secondary goals achieved by good data baking: data validation, minimizing memory fragmentation, fast level restarts, and simpler data streaming.

Loading times for a game are determined by two things: disk I/O time and processing time. Inefficient disk I/O patterns can dominate loading times, taking close to 100 percent of the full load time. It's important to make sure your disk I/O operations are efficient and streamlined before we start thinking about gaining performance from baking data. Make sure to minimize seeks, avoid unnecessary blocking, lay out data sequentially, and the rest of the usual best practices for efficient disk I/O.

DATA BAKING AND LOADING

What follows is a summary of an ideal baking process from a high level.

These steps happen offline:

1. Exporting from content creation tool
2. Transforming into final format
3. Combining into a memory image
4. Updating data references.

Which leaves only the following steps at runtime:

1. Loading memory image
2. Pointer fixup
3. Extra processing (optional).

Notice that we've done all the heavy lifting during the baking process offline, and the steps performed at runtime are very simple and very fast.

This illustrates what I used to call the Fundamental Rule of Data Loading: *Don't do anything at runtime that you can do offline.* Can you generate mipmaps offline? Can you generate pathfinding information offline? Can you fix up data references offline? You know the drill.

This rule reflects the fact that it is often much faster to load data than it is to do processing on it.

However, that has changed to a certain extent with the current generation of hardware. Disk bandwidth hasn't increased much, but the amount of memory and the available CPU power has gone up significantly. So we can amend the previous rule to allow for the possibility of trading some CPU computations for a reduction in data size when possible. For example, you might want to decompress data at load time, or even generate some data procedurally while other data is being loaded.

This process is an ideal one to shoot for, but it's not always possible. On a PC for example, we might not be able to know the exact memory layout of our data or how the compiled version of our graphics shaders will be, so we might have to do some processing at load time.

Also, with an established code base, it might be impractical to take the rule to an extreme because it could take a large amount of manpower to precompute everything possible. In that case, we're trading some amount of optimal data loading for faster development. Just don't overdo it because if the hit on loading times is significant, your whole development will suffer from slow iteration times.

TRANSFORMING DATA

The goal of data transformation is to take some data in raw format (the way it was exported), to the exact format it will be in memory in the game. For example, the game will never read XML files, parse them, and create new data at runtime. Rather, all that will happen during the transformation step, and the game will just load a small binary set of data into memory and start using it right away.

The actual data transformation is pretty straightforward.

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1. *Load raw data.* Raw data can be either in the original format the artist created it in (such as a Maya file, PSD Photoshop file), or in an intermediate file format that was exported from the content creation tool. Using an intermediate file format has many advantages. The file can be text-based and easy to read by a human. It can be versioned more easily. The format is stable, and, most importantly, the original tool doesn't have to be involved to transform it into the final data format. This last point is particularly important because we want to keep this step relatively fast to allow for fast iteration, so avoiding launching heavyweight applications is a big win.

2. *Parse and validate data.* Once the data is in memory, we parse it and at the same time validate that everything makes sense. Are all the particle system parameters within the ranges that you expect? Does the animation skeleton have the correct number of bones? If not, this is the time to raise an error, before the bad data makes it to the game.

3. *Fill out the data.* This step is just a matter of filling out the data we collected during parsing in the correct structure fields. Because this step needs to create the exact same memory layout as the game, it's easier to write it in the same language as your game runtime (most often C or C++).

4. *Write data to disk.* In order to be able to write to disk the exact data structure that will be used at runtime, we should limit ourselves to C structs and C++ classes without virtual functions. That way we can reliably save the data and reload it without having to worry about vtable pointers. Using structs will also encourage the type of architecture that allows us to use the data right after loading instead of having to process it by calling constructors or other member functions.

This data transformation happens as part of a larger data build, so it needs to run fully automated. It's usually best to implement the program that transforms the data as a command-line application that takes inputs and outputs through the command line. It can also be implemented as a DLL or .NET assembly as part of a larger framework, but never as a GUI program that requires user interaction.

Even though this is an offline process, you still want it to happen as fast as possible so data can get in the game quickly and you can iterate as much as possible. There will be some types of data that have thousands of files that need to be transformed, and the overhead of calling the same program repeatedly can be very noticeable. To improve performance in that case, it is beneficial to have the program take a list of files to transform and process them all at the same time, rather than invoking the program once for each file.

COMBINING INTO A MEMORY IMAGE

So far, we've transformed isolated data files, some models, some textures, some AI parameters. The next step is to combine them all into one large file containing the full memory image of all the data that will be loaded.

Combining all the data in a large memory image has many advantages. The main one is that it simplifies and speeds up loading significantly. We can load a single file in memory and start using the data right away. Also, loading all the data as one large block will keep memory fragmentation and allocation overhead down to a minimum.

One way to combine all the files is to create a packfile: A single file that contains all the other files inside along with a catalog that associates each file with the offset where they reside within the packfile.

The catalog can be implemented as a hash table of file names and offsets into the packfile. Whenever the runtime asks for a particular filename, we run the filename through a hash function and access the hash table with the result.

Hashes are not guaranteed to be unique, but with a good hash function, they'll be extremely unlikely to clash. If it ever does, we can detect it during this step and we can adapt (either by changing the hash function, adding more bits, or even changing the filename in a pinch!). Make sure you always normalize filenames before computing the hash by setting them to a consistent case and extending paths to start from a specific root.

You will often want more than a single memory image. Some platforms have different memory areas with different uses, whereby each area could get its own memory image (for example, all the textures and other video memory in one, and all your other game data in another). Also, sometimes you'll need several memory images to be able to load and unload blocks of data independently. For example, the front end could be a memory image, and the level data another one, so the front end can be unloaded when the game starts. Or you can take it as far as making each screen in the front end a different memory image. It's a tradeoff between memory usage and simplicity.

Since this memory image is the smallest unit of data that is going to be loaded in memory, now is the time to apply compression if you're going to use it. Choose a compression scheme that allows you to decompress it incrementally, as the file is loaded, that way you don't need a loading buffer almost twice the size of your data.

POINTER FIXUP

The packfile approach is a big improvement over having loose files in disk that need to be accessed separately, but we can take things further by doing even more pre-processing on the data offline. The reason we need to have a catalog is because the game will create some data associations at runtime: draw the right textures with the right model, point to the correct game entity definitions from the level, and so on.

Since we have a global view of this data, we can precompute most of those associations during this step. As we create this memory image, we can change all the places where data has references to other data (usually in the form of filenames at this point) into pointers or offsets.

If you're lucky enough to have a memory management system for your game that gives you control over the location of your data, then you can fully resolve data references into an exact memory address. You know the start

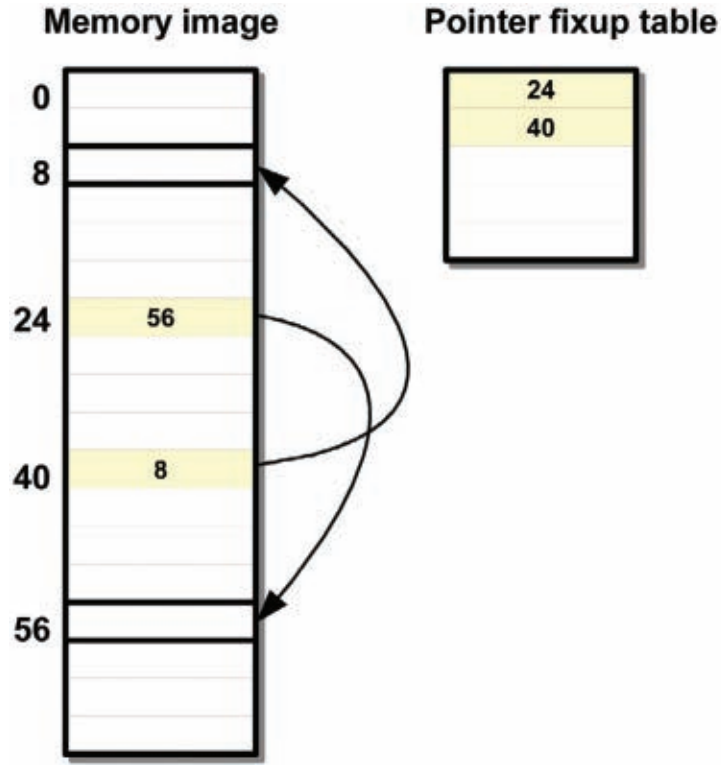

FIGURE 1 Pointer Fix-up table.

address where the memory image will be loaded, so you just need to add the appropriate offset to that memory address. You can then simply load the data in the game and be ready to go.

For most games, you don't know the exact location in memory where your data will live, but you can still do most of the work offline and then do a quick pointer fix-up at load time. The idea is to look for all data references and convert them to an offset into the memory image, not the full address. At the same time, the address of each of those offsets is added to the pointer fix-up table so it can be updated later (see Figure 1). This fix-up table is saved along with the rest of the data.

At load time, once all the data has been loaded, we make a very fast pass through the pointer fix-up table and add the address of the start location of the memory image to all offsets. Using the pointer fix-up table is a totally generic step and works on any type of data without the code having any idea what kind of data it is fixing up. We have done dynamic linking of our data, just like a dll, by relocating it at load time.

Another benefit of computing the references at bake time is that we can detect global data errors. During data transformation, we were able to verify that each piece of data was correct, but we had no idea if a model was pointing to invalid textures. Now we have a global view of all the data, allowing us to detect missing or invalid files and raise errors.

STREAMING

Most games today need to do some type of data streaming during gameplay. Fortunately, the approach to data baking presented in this article fits very well with streaming.

The most straightforward way to stream game data is to break it up into blocks containing data that need to be loaded together. For example, a level could be broken up into blocks containing rooms or sectors. Then each block can be baked separately, each in a different memory image with its own pointer fix-up table. The game logic decides what data needs to be present and initiates asynchronous loads for the desired blocks.

Because this approach requires no complex operations at load time, it is very well suited for background loading without affecting the game. It also minimizes memory fragmentation, and, if you manage to keep each block the same size, then it simplifies memory management tremendously and you know you will never run out of memory.

It's important to hit the right balance between number of blocks and block size. If each block contains just a texture, then we're back to having thousands of separate files and very poor loading performance. If blocks are very large, they won't fit in memory at once. Finding the sweet spot will depend mostly on your game behavior, what areas are visible, and what actions the player can perform.

To keep streaming even simpler, make sure to make each streaming block fully standalone. In other words, it should contain all the data it needs, independent of what the blocks around it have. That means that you'll sometimes have to duplicate a texture or a mesh that is present in several blocks. That's a small price to pay to keep streaming simpler. It also serves to give artists and designers a very specific memory budget, and it can even encourage them to create unique textures for each area if they want to.

DESSERT IS SERVED

What we covered on data baking should be enough to get you started in the right direction.

One important topic I avoided here is the problems introduced by different target platforms, which deserves coverage of its own next month. Until then, enjoy the fruits of your baking.

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Evaleen Jaager Roy,
Vice President, EA

STEVE THEODORE

CLONE WARS

The conquest of file referencing

SIGH ...

There was a time when *Star Wars: The Clone Wars* was a tantalizing hint of rich, star-spanning backstory. Now, alas, we know it was just the world's longest-running product placement. We've seen the *Clone Wars* from every angle, in live action and animation, and we know the truth: The Clones won, and it's been downhill ever since.

Still, the desire to produce hordes of perfect duplicates isn't just for Sith Lords—it's also one of the staples of the video game business. But, as a somewhat better popcorn movie reminds us, great power comes with great responsibility. The power of cloning is very difficult to use responsibly.

Let's take a look at the ups and downs of the quintessential form of cloning: file references (or xRefs as they're known in Max-land), an important, powerful, and much maligned tool for sharing art assets.

I'VE GOT A BAD FEELING ABOUT THIS

Creating a library of identical copies is obviously useful, whether you're aiming at speedy construction, visual consistency, or runtime memory savings. Knowing that every object you place will automatically be up to date seems like an obvious win.

And what a great way to split up the work! Instead of having a squad of artists queued up waiting for a turn to check out that one special file, you can assign everybody an individual unit, from an architectural library to a city block, knowing that references will keep the team up to date on each other's work. Fix that fire_hydrant.max file, and every fire hydrant in the level is magically updated to match. It's great—like getting to see Yoda in his glory days.

The cynical veterans among us are already reviewing their list of referencing horror stories, and with good reason. Referencing is a great idea, but it has a pretty checkered past. Not many features are both so useful and so problematic that dozens of studios (including, I might add, Industrial Light & Magic) have resorted to rewriting them from scratch. File referencing generates about the same level of enthusiasm from artists as a visit to the dentist: No matter how badly you need it, it's not much fun.

Including a copy of file A inside file B isn't particularly tricky. That much, at least, works pretty reliably in all the major packages. The problems arise as soon as we try to put referencing to real use, because the elegant simplicity of the concept turns out to be a bit of an illusion. There's always more to the problem than just "insert file here."

Referencing can go wrong in a number of different ways, from simple tech glitches to serious organizational conundrums.

INTO THE GARBAGE CHUTE, FLYBOY

Most 3D files of are full of junk.

Every file includes some stuff that the original author cares about but other people don't. Whether it's hoarding bits of backup geometry, objects brought in for reference, construction history, or works-in-progress, the average file in your source tree is full of potential confusions. Computers, alas, are perversely literal, and they can't tell the difference between the ready-for-prime-time side of a file and the junk drawer, so a reference-heavy pipeline demands a certain commitment on the part of the owning artists to leave their files in a presentable state.

Reference-heavy pipelines really need tools to sweep the rogue elements under the rug. Saving a file to go out for coffee should not trigger a wave of updates across the rest of the studio. Instead, you should treat updates to your references more like an export process. Making a distinction between artists' work files and cleaned-up, properly tested files that get published to the team is definitely the safest strategy.

Explicit exports encourage less frequent updates (which is usually a good thing for performance and stability) and forces artists to make clear decisions about what's share-able and what isn't. A simple "exporting" script can formalize the procedure and cut down on the clerical work. Routine and easily forgettable tasks, like locking the transforms on things that shouldn't get moved and resetting pivot points, can be automated so they don't get skipped or shortchanged. As a bonus, you can handle check-ins and maybe even notification emails automatically. Adding a blessing step to your references may be a minor annoyance, but it's the single best antidote to the queasy feeling so many artists get about referenced files.

GENERAL ORDER 66

The biggest plus—and the worst drawback—of referencing is the automatic flow of changes from the source file to all the files where it's referenced. That's the point, right? We want a clone of the original.

Or do we?

Sometimes we do want an exact clone, and when we do, out-of-the-box referencing tools are generally pretty good. Most of the time, though, we want to make some changes to the local copy. Some of these are simple and non-destructive, like posing a character model or rescaling a placed object. But they can be complex and invasive, like replacing a material or editing a referenced mesh.

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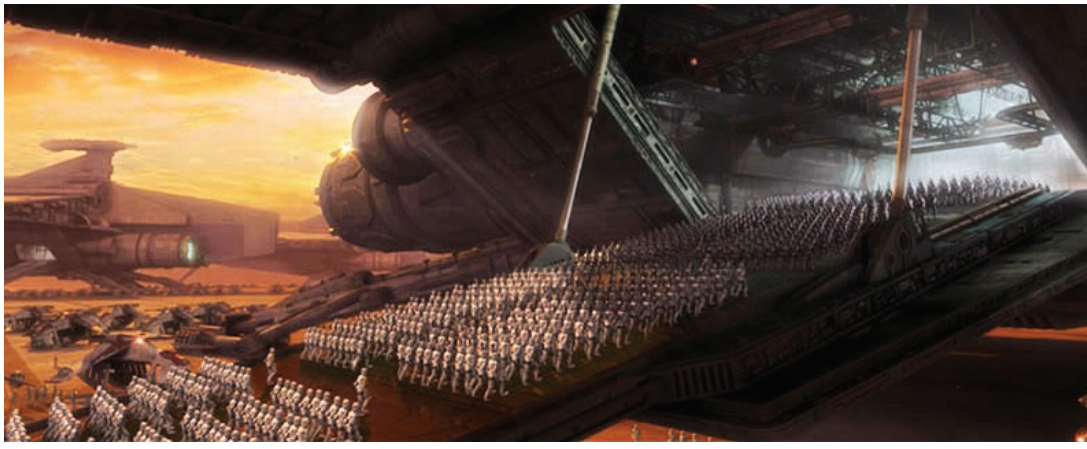

IMAGE © LUCASFILM LTD.

Once you start making edits on the referenced objects, things get confusing very fast. When do you want model updates to override your local edits? When don't you? How can you know which behavior goes with which kind of change?

The multiplication of these choices is the main reason artists grumble about referencing. 3D app vendors have the unenviable task of supporting every imaginable combination of options, from blanket replacement to selective updates to porting local edits back to the master file. It should hardly be surprising that confusion and unpleasant surprises abound. Much of the time, when we complain that referencing is "broken," it's actually doing exactly what we asked it to—it's just that we didn't realize what all those obscurely named checkboxes really do. Especially when most packages contain 10 years or more of legacy options to support, the confusion piles up pretty fast.

If you're planning on making use of references, you've absolutely got to put in the legwork and really learn what all the options in your package mean. When you've got a set of features that meets your needs, get your friendly neighborhood scripter to make you a foolproof one-button version that won't let you set the wrong options. Referencing is not a private matter and it offers no creative leeway, so order up some tech-art help to ensure your files are set up well and behave predictably. Relying on a memo isn't going to cut it.

THE DARK SIDE

If things sound grim so far, it gets more complicated when you consider that trivial little detail of the pipeline known as the game. If you're using references to maintain style guidance or just standardize construction across your levels, things are almost manageable with generic referencing tools. If nothing else, you're still seeing what you get. But if your pipeline uses references as proxies for placing actual game objects too, things get pretty non-linear.

Companies that use Max or Maya as a level editor often use references as stand-ins for game objects. The logic is fair enough: placing an actual model crate or monster or whatnot into your level gives better feedback than placing an enigmatically named marker or (Force be with us!) editing some text file somewhere.

This is all true enough, but the feedback can become misleading unless you're careful. An artist might move the pieces of a multipart object, or fiddle with pivots, or rescale the object in a way the engine can't. Deformers, animations, or altered materials can create a misleading picture. And even if the visible model does match the game object, your scene will be cluttered with a whole hierarchy of transforms that shouldn't be edited, a permanent temptation to do something wrong, and an annoying burden when managing the scene.

A safer and less confusing alternative is to place a collapsed proxy object instead of a complete copy. If my job as a level artist is to populate a street, it's much easier and faster to work with a single object that represents the game's idea of a car or a lamppost than a complex hierarchy with a lot of pieces and transforms. My life is also simpler without the chance to, say, open a car door in Max that doesn't actually move in game—or worse, to move the pivots and sink the whole car two feet into the asphalt in the game. Plus, if I have a street with a dozen cars, I only have a dozen objects to manage instead of a dozen complete hierarchies with parts.

Of course, getting that nice, simple, proxy object means somebody has to make one for me. As I've already said, a formal "export" of references is indispensable for keeping references under control. When the references in question are really proxies for in-game objects, the case is even stronger—you want to make sure it's impossible for a dicey pivot or a bad scale transform to confuse your teammates. Ideally, you can piggyback your reference export onto a regular export-to-game, and get all the benefits for free. Or, if your model exports are in a readable format like FBX or Collada, you can even suck the game model right back in as a proxy.

NOOOOOO!

The biggest annoyance of working with references is the fact that referencing inserts an extra step into the artist's workflow. It's just plain annoying to have to go to a separate file every time you want to fix something in a referenced object.

Unfortunately, all the various schemes that have been tried for allowing in-place edits on referenced objects share the same, inevitable drawback: it's hard to manage the complex web of sharing relationships if you also allow every artist who has a copy of your object to start noodling with it at will.

If you make it easy, you'll get a lot of conflicts and breaking, as happens in

references that have been so heavily modified that changes in the original object cause them to break when the original gets touched. On the other hand, if you force your artists to close the scene they're working on to make changes on the base object, they'll lose the visual context for their fix, and they'll have a built-in incentive to avoid the hassle by using local copies instead of references, thus missing the whole point. It's a real catch-22, but unfortunately, it's not a solvable technological problem. It's a logical conundrum you can't get around.

The only thing you can do is to make sure you're clear about what you're using references for. If you're using references as a workflow shortcut (as a quick way of distributing objects that match your art direction or building up levels fast) then a certain amount of breakage might be an acceptable cost. If, on the other hand, your references are closely tied to your runtime budget (if you are placing references to tell the game engine where to put game entities at runtime), then you'll have to live with the clumsiness of bailing out to a separate file to make changes. Sorry.

IT PAINS ME TO CLONE YOU

For something so dry and technical, referencing is a surprisingly emotional issue for artists. Game artists hate it for being quirky and unreliable, which it certainly can be when used without a little bit of care. On a deeper level, it rubs artists the wrong way because it's symbolic of how the games business has grown up to industrial scale.

The artistic conscience rebels at the amount of management and the level of centralized control that come with using other people's work inside our own. This is why the logical problem of balancing shared assets and local edits is so damnable. It's hard for artists to relinquish control; but that's what referencing does. It's what it's supposed to do—make it easy for you to work with other people's stuff.

This is not an issue we can dance around. We work in a complex, collaborative medium, and the days when every artist ran a private fiefdom are receding into memory. The technical side of referencing is a pain in the butt, but it's manageable if you put in some simple spadework.

The productivity benefits of rationalizing your reference pipeline are enough to justify a serious investment. But the important issue isn't bugs or quirky behavior. It's finding a comfortable and satisfying way of getting artists to work together without squashing individual artistry and ownership. That's a little trickier than just writing a few scripts, but if you don't think it through you'll wish everything could be as simple as just updating your Xrefs.

DAMION SCHUBERT

DESIGNING CHOICE

SID MEIER ONCE SAID THAT GAMES ARE A "series of interesting choices." I've always liked this definition. It speaks well to what is unique about our craft. For all the progress we've made in graphics, audio, physics, AI, and storytelling, interactivity remains the defining feature of our genre. And interactivity, when you think about it, just means your decisions matter.

In this light, the true job definition of the game designer becomes clear: creating interesting choices. So what makes decisions engaging? Understanding this has the capacity to turn a shallow game experience into a deep and engaging one.

OPPORTUNITY COSTS

Businesses and economists use the term "opportunity cost" to describe what any given business opportunity will prevent them from pursuing. By putting your money in the stock market, you sacrifice guaranteed interest you could earn from the bank. By promoting the iPod, Apple committed resources that could otherwise have spent selling Apple computers. By nominating Obama, the Democrats chose not to run Hillary.

Whether these were the right decisions is almost impossible to tell at the moment the decision is made. The iPod decision seems like a no-brainer now, but at the time, it represented a significant shift for Apple, and there were doubtlessly some sleepless nights over it.

What's lost is that some of these decisions are equally as hard to examine in retrospect. If Obama loses his presidential bid, we'll never know if a Clinton run would have done better. Whenever this kind of second-guessing after the fact occurs, you're almost guaranteed that the original decision was at the very least interesting.

Games make players factor in all manner of resources as costs. The most obvious are direct analogs: wood or steel in an RTS. But the most common resource used is time. In CIVILIZATION, when you use your turn to build archers in your city, that's time not spend building a temple. In MORTAL KOMBAT, the time a player spends doing a leg sweep is time when he cannot do a flying kick. The two options are mutually exclusive, and in certain situations, either could be the better choice.

Designers of mature game properties tend to have extremely sophisticated ideas of what is a resource in their games. WORLD OF WARCRAFT's designers now treat each party slot as a resource. If your raid needs a healer, you can bring either a shaman for great group healing or a paladin for optimal single-target healing—or you can bring both, at the sacrifice of one player that can deal damage.

Magic: The Gathering's designers are perhaps the best in the industry at this kind of analysis, adding new ways to consider cards resources. Not satisfied with the resources found in the original game (turns, mana, cards in hand), the designers have, over time, experimented with cards which manipulated resources, like the graveyard pile, and accentuated other key resources such as turn tempo. One game mechanic called "madness" makes cards cheaper to cast if they are in the process of being discarded. Normally, discarding is a negative, but "madness" turns discard opportunities into a valuable resource to build whole decks around.

MEANINGFUL CHOICES

An interesting choice is a meaningful one, which means that there must be some appreciable differences between the two. If, in a boxing game, the left jab and the right cross have the same timing and do the same damage, the difference between the two is negligible, and the choice is immediately uninteresting.

Dozens of games ship without many meaningful choices. These games may be fun short-term diversions, but they are rarely considered deep or interesting. Most stories in games are extremely linear; some may let players make dialogue options, but in most cases the conversation will end in the same place.

At BioWare, we take great pride in our interactive storytelling. We work hard to make sure that the choices a player makes has an impact on her character, her companions, and the world around them. To us, that choice and its consequences are what interactive means.

BAD CHOICES

It would be nice if, in all cases, you could have two equally valid but strongly different choices, but in most cases, offering meaningful choices implies the player can make a bad one. That's okay. That chance is what makes the choice meaningful. On the other hand, if a given play is always a bad choice—that is, there are no circumstances where it's the best choice—the game design team is probably looking at something it can cut.

But factor in the hidden payoffs. Throwing someone in SOUL CALIBER is slow and leaves you exposed (mathematically, it's almost always a bad move), but it is deliciously humiliatingly if you manage to pull it off. Killing someone with a chainsaw in DOOM before you get run down yourself often seems nigh

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impossible, but pulling it off even one time in ten is immensely satisfying.

SITUATIONAL CHOICES AND THE ROLE OF INFORMATION

In most cases, choices should be situational. Whether a decision is the right choice is based on the game environment and the opponent's actions. If there is an opposing city nearby, a CIVILIZATION player should lean more toward defensive tech advances than cultural ones. If the opponent has the capability for a big and heavy attack, the player should keep a fast interrupt or knockback in reserve. With this mentality, optimal gameplay comes from choosing the correct response to the current situation.

The Umezawa's Jitte card was so powerful that all decks had to either include it, or include cards specifically to deal with it. Because it reduced choice, it was broken.

But this way of thinking puts a premium on information, since only that will allow players to make correct decisions rather than randomly stumble upon the optimal strategy. If you know your opponent is susceptible to fire damage, you can sling fireballs at him instead of magic missiles. Most designers are surprised as to how smart this completely transparent tactical choice can make the player feel.

How much information a designer should expose varies from game to game. Chess is a good example of a game that offers perfect information. Both players are completely aware of the capabilities of the other player. The game is highly tactical—in fact, it's all tactics. Other multiplayer games tend to offer imperfect information to give players tactical clues. A SOUL CALIBER players judges her opponents' capabilities based on their chosen characters, and *Magic: The Gathering* players judge it based on untapped land.

In the endless debate of class versus skill-based systems in MMOs, one advantage of classes that's rarely mentioned is that, in PvP, the player is given some idea of his opponent's capabilities, allowing him to form a strategy. Skill-based fans argue that the surprise factor is part of the allure of the system, but I'd argue that this does not make for a better game. When players have no information on which to base a decision on, they revert to what works the majority of the time. Lack of information tends to narrow tactics, not expand them.

Most designers try too hard to hide information. Poker's recent popularity can be tied pretty firmly to the rise of Texas Hold'Em, a variant that exposes enough information for players to make tactical choices. This was enough to create a mass-market phenomenon.

CHOOSING TO ABSTAIN

Sometimes, the right move is not to play. Examples include blocking and waiting to apply countermoves in a fighting game, keeping your first Warrior in your CIVILIZATION city rather than exploring, or leaving mana untapped in *Magic: The Gathering* for a counterspell. In WORLD OF WARCRAFT, rogues have the option of going all-out on damage, or leaving just a little energy in reserve in order to interrupt a spell cast. Choosing to not play is usually a defensive move, an act of biding one's time and being opportunistic.

These decisions are often interesting, but the designer needs to be careful with them. As Mark Rosewater, head designer of *Magic: The Gathering* observed in a recent column on Magicthegathering.com, it's always more fun to play cards than not play cards. Designers also need to be wary of making defensive measures too narrow. If a counterspell only works one time in 20, most players will simply blast through with strategies that are more universal.

SACRIFICIAL CHOICES

In the game show *Deal or No Deal*, contestants decide between taking a cash amount that the banker offers or opening another suitcase, which may cause that cash amount to (hopefully) go up or (more likely) go down. Academic economists love this show, and so should game designers. The bird-in-hand choices are mesmerizing, and yet statistically, the contestants so often make the wrong choice, which, of course, makes great TV.

Consider five-card draw. To attempt to improve your hand, you must first discard. There is no guarantee that your new card will be an improvement, and in some cases, you may be bluffed into breaking up a pair to chase an unlikely straight.

Such mechanics are very powerful, but are tough to balance. Casual players typically love the idea of them but need to be lured to take the risk. Hardcore players learn quickly how to play the odds. If the payoff isn't worth the odds, the mechanic will rarely be used. If it's too advantageous or easy to manipulate into happening, the hardcore players will dominate with it.

BROKEN MECHANICS

With this choice-centric view of design, identifying broken mechanics becomes easy. They are the ones that effectively reduce choice. In *Magic*'s "Betrayers of Kamigawa" expansion, one card, Umezawa's Jitte, was so overpowered that nearly every tournament deck either used it or packed cards to deal with it. In a game that normally encourages creative deck-building, the environment suddenly became frustrating and confining. The card was broken.

Sometimes, it's hard to tell. In MMOs, players constantly complain about classes being broken, that certain classes are the best PvPers (and therefore everyone must react to them) or the best healer to bring to a raid (so why would you need anything else?). It can be hard for designers to tell when a mechanic is actually broken and what is overblown. Sometimes, it just takes time for good counter strategies to emerge. Sometimes, it's best just to wait. But you'd better not be wrong.

I've heard some designers and producers try to argue that games should have no bad choices, that players should always feel rewarded no matter what, that the whole experience should lead players down a safe, candy-coated path of guaranteed success.

I disagree. Certainly, bad choices should not be humiliating or irrevocable, and no choice should make the player quit. But choice is the very essence of interactive gameplay. While bad choices may frustrate the player, good choices will reward him, making him feel clever and engaged. And interesting choices will leave him talking and make him want to replay the game.

To me, the choice is simple.

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JESSE HARLIN

AHEAD OF THE CURVE

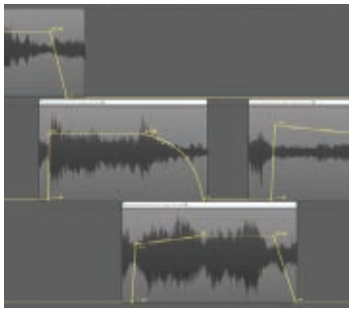
FIGURE 1 A string instrument's decay envelope is shown.

FIGURE 2 A brass instrument's decay envelope is shown.

RARELY IN THE WORLD OF GAME SCORING do pieces of music appear as they were originally written. Whether edited to loop, or for interactivity or content, a big part of preparing music for implementation is the process of additive or subtractive music editing. There isn't much middle ground with music editing. Bad edits are glaringly obvious and unmusical while good edits are completely undetectable.

THE BASICS OF BLENDING

The simplest way to edit two pieces of music together is by using a basic crossfade at the join. Music which uses the same time signature and at the same tempo (which is the case for most pop/rock music as well as most game scores) is the easiest to tackle with basic crossfades. Simple crossfades have a number of benefits. All digital audio workstations (DAWs) such as Pro Tools or Logic make authoring crossfades easy with click-and-drag crossfade tools. These tools offer a limited ability to edit the shape of the fades, though editing one part of the fade will affect the entire crossfade curve. Additionally, simple crossfades lack the dangers of radical changes in amplitude that come from more advanced edits such as layering multiple tracks together and summing their outputs.



Crossfading of multiple tracks in Logic is shown.

The size of a crossfade depends on what's going on musically at the join. If you're simply editing out a verse from a pop tune, the crossfade will most likely be fairly short and centered on a moment of identical orchestration, such as a repeated guitar riff, or you may splice together a syncopated drum accent. Crossfading between arrhythmic pads or long decay tails will most likely benefit from longer crossfades that approximate the dovetailing of one completed musical thought and the beginning of a second thought.

Simple crossfades can have their problems, as melodies that don't begin on barlines or long cymbal swells are more difficult to tackle with a simplified crossfade tool. In these cases, the join of your edit will probably not be the center point of the crossfade. Rather, you may find the fade beginning a few beats before or ending a few beats after the join in order to ease into or out of sections with troublesome instrumentation or lingering high frequency noise.

THE SCIENCE OF SHAPING

A simple crossfade can only do so much, though. More advanced music editing necessitates a complex understanding of orchestration, acoustics, and studio mixing techniques. Though more involved, these methods can turn an impossible crossfade into a successfully indistinguishable edit.

You can move beyond basic crossfades by layering multiple tracks. Layering tracks allows for the combination of multiple source sounds, each of which can have its own fade properties. This kind of editing is extremely helpful when working with orchestral material that changes its tempo or time signature repeatedly. Editing in layers allows the music editor to introduce new material without fading out the original. This can be done to add musical elements that weren't present in the original piece such as dissonant brass clusters, rhythmic ostinatos, or simply percussion sweeteners like timpani rolls or cymbal swells that can smooth over edit joins.

Editing on separate layers also allows for the creation of individual fade curves. A brass line may be made to taper out musically or a string glissando can crescendo independent of the rest of the musical material. Doing so necessitates an understanding of natural acoustic amplitude envelopes. Strings, for instance, fade in and fade out very naturally through the use of a basic linear fade (see Figure 1). Woodwinds and brass, however, sound extremely unnatural with a linear decay. Breath-based instruments are much better served with logarithmic amplitude decay envelopes (see Figure 2).

Another thing to keep in mind when layering multiple tracks is the relative volume of your layers. Sometimes simply raising or lowering the volume of the target piece of music so that it better matches what came before can fix an awkward edit. Likewise, individual volume curves can be edited to create melodic crescendos or decrescendos that feel as if they are a natural part of the original composition. However, overall volume levels can become an issue when layering tracks together. Unlike crossfading on a single track, layering means that the amplitudes of multiple source files are being summed together out of the main output. The result is often a spike in volume that can clip and send your meters into the red. To combat this, the music editor can either lower all of the individual volume levels for the separate layers or rely on the addition of a limiter into the signal chain to help keep the track from peaking.

THE LOGIC OF LOOPING

One last point about music editing for games: always keep in mind that the beginning of a piece of music becomes arbitrary when it becomes an in-game loop. Once a track is edited and stitched together from end to end, reverb tails, cymbal swells, or nuances in production work might mean that what once was the beginning of the track now isn't actually the best place to edit the loop's start point. Don't discount starting loops with a melodic pickup or a glissando. Frequently, these starting points go unnoticed as loop points once the end of the file has been reached.

JESSE HARLIN *has been composing music for games since 1999. He is currently the staff composer for LucasArts. You can email him at* **jharlin@gdmag.com**.

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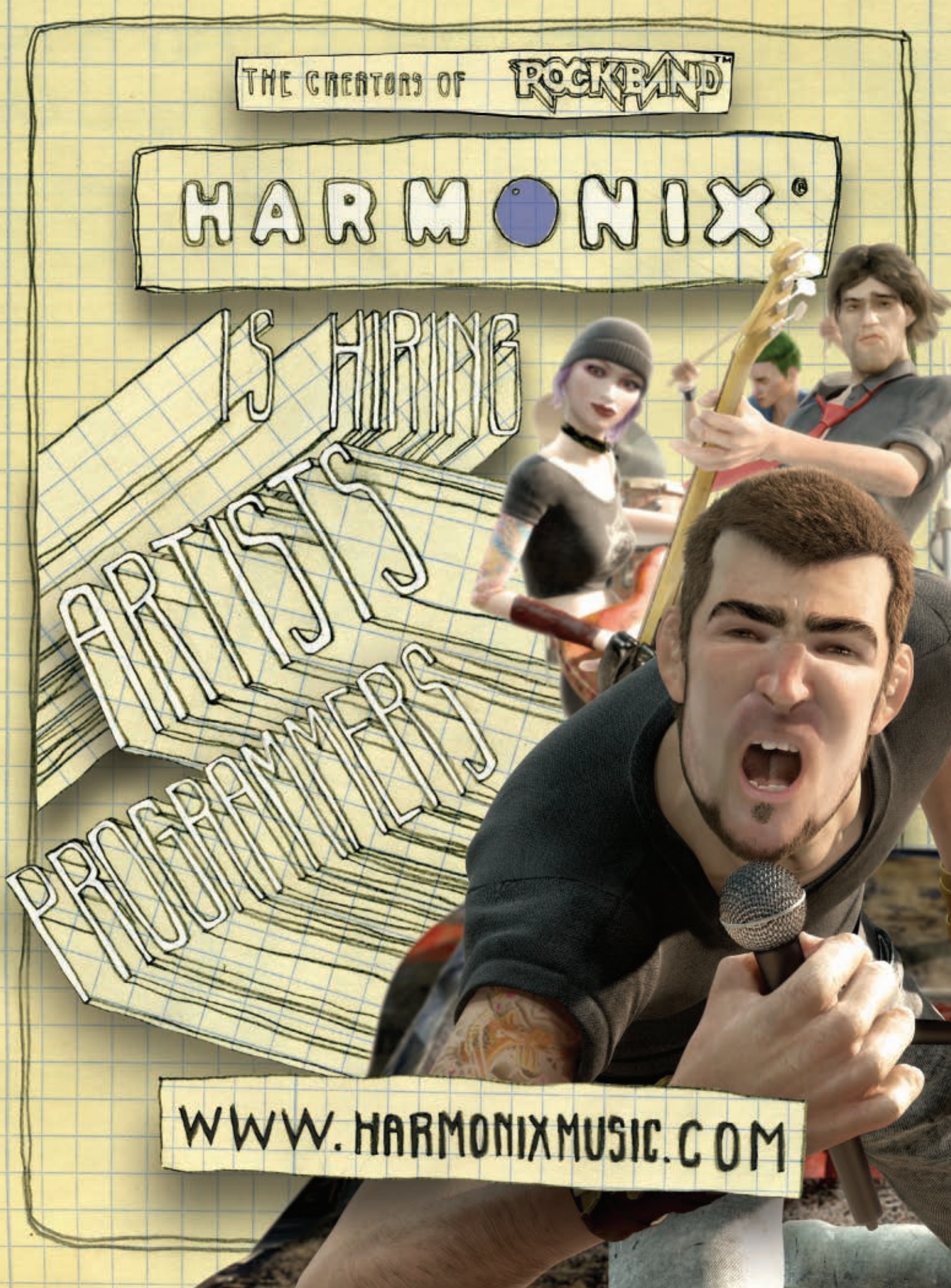
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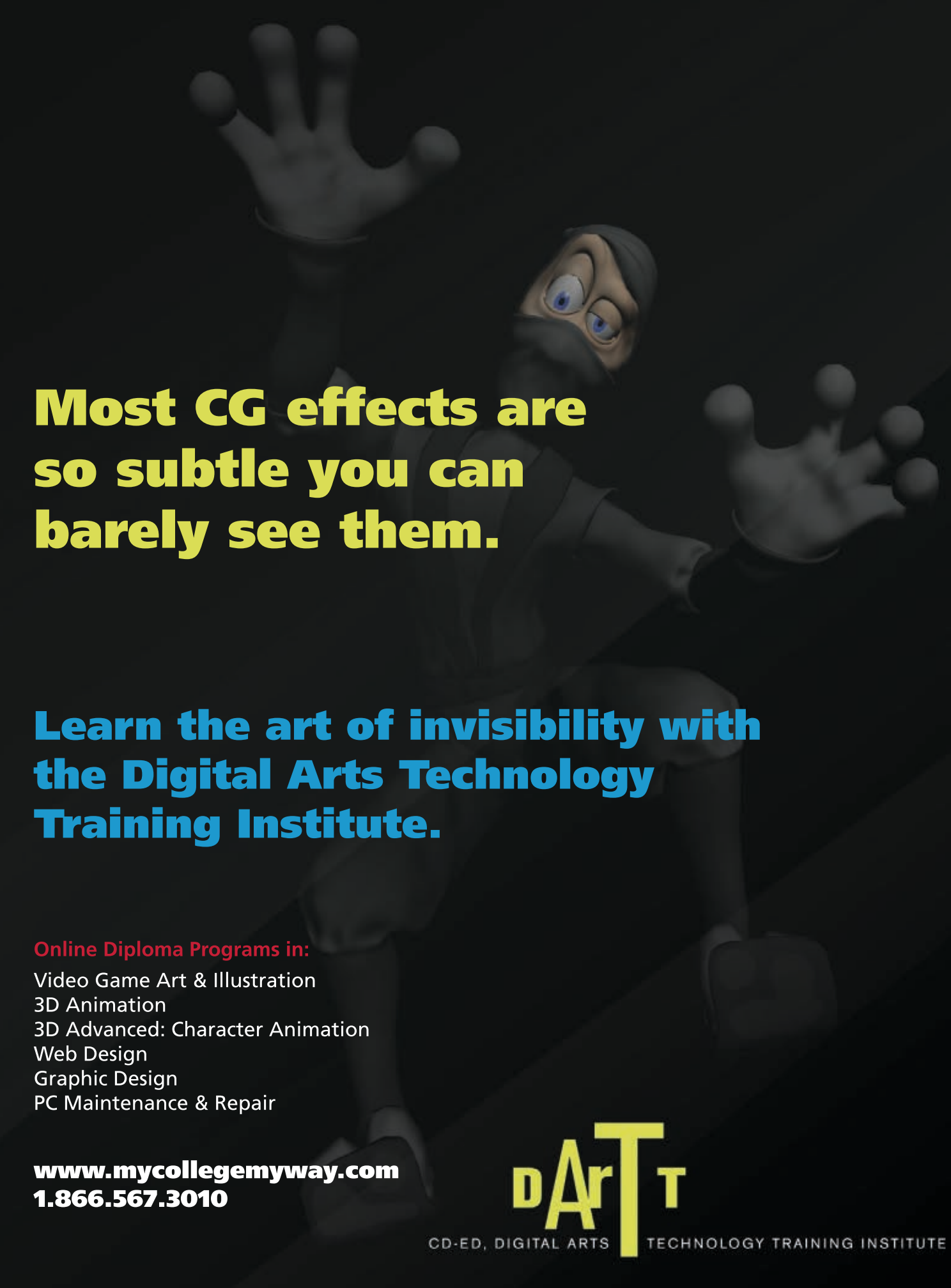
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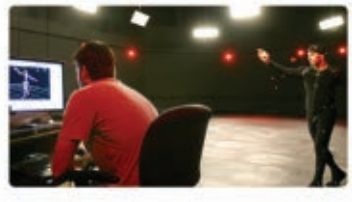

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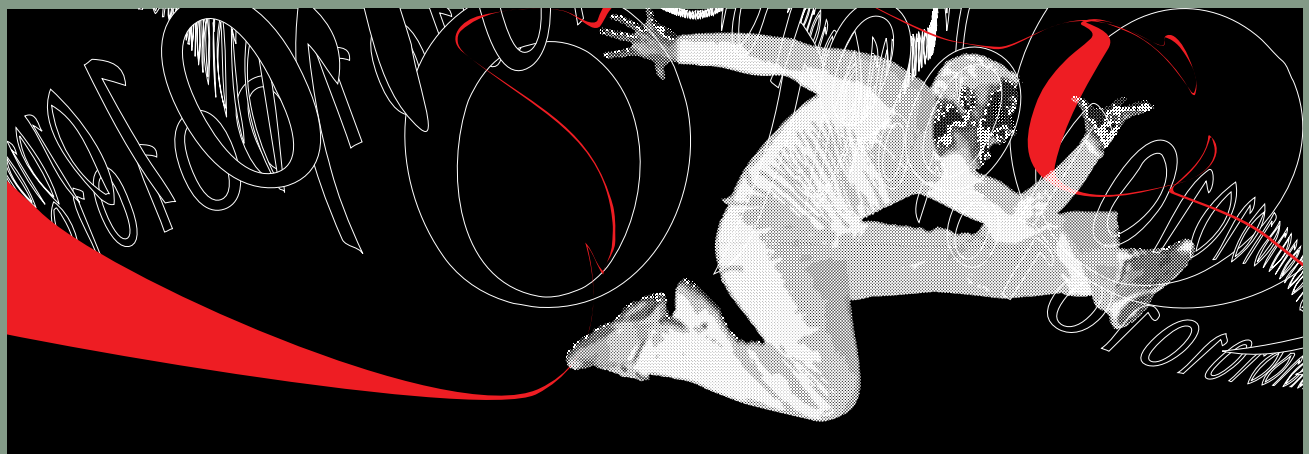

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(1) Outside County Paid/Requested Mail Subscriptions Stated on Form 3541.	27,740	24,604
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18 MONTHS BEFORE CERT:
Hey, thanks for the build! Everyone thought it was a blast to play and we're really excited for the game. We are looking forward to working with you to build a successful new product!

I should also mention that there was some concern here over the graphics. Sad to say, a lot of the game just doesn't look very good, especially when compared to games that are on the shelf now—in fact, it almost looks like a game that's not finished! When do you think we could see some graphics that are completely and totally representative of the final product? If you could put something together for next Tuesday's marketing review that would be great! Thanks!

12 MONTHS BEFORE CERT:
Hi guys, so we're done with the internal design review here. All in all, I'd say it went really well! One big takeaway is that the game is currently much too focused on adventure-y, "fetch quest" style stuff, which is distracting from the "fast, nonstop action" message that we want for the title. If you could cut all the slow and boring adventure elements and focus on making a great, pure action game, that would be great. Thanks!

Also, we're still concerned about the graphics. I know you explained to me that many of the assets are what you called "placeholder," but we can't show marketing a "placeholder"! Haha!

9 MONTHS BEFORE CERT:
Hey there. Results from our focus test are back, and the game did pretty good! The game's action elements scored very high marks. However, one point all of the testers agreed on is that there was very little "breathing room" between all of the frantic combat. We had some discussions about it afterwards and thought that maybe some other game mechanics besides just action are called for—like make some kind of "adventure mode" where you find objects, examine them for clues, etc. We aren't sure exactly what it should be but we know you will come up with something great! Thanks!

P.S. Do you think we could get some mocked-up screenshots of what the final game will look like? Like, soon? It seems that marketing promised a bunch of exclusive screenshots to an enthusiast magazine without any of us knowing! Haha!

6 MONTHS BEFORE CERT:
Hey guys. Continuing our quest to help you guys out with the graphics, I'm forwarding some comments and feedback from our Group Art Director:

[Begin Forwarded Message]

- Some really noticeable edges ... they should increase the poly counts for all of models in the game.
- Lots of textures are scaled up too big, too. They should increase the texture resolution of everything in the game by a factor of at least 2, maybe 4.
- The framerate was dropping, so they should fix that as well.
- They should be pushing the action part of their game, IMO. The adventure part just bores me to tears. Why not cut that stuff?

[End Forwarded Message]

Let me know when you can do all that stuff. Thanks!

3 MONTHS BEFORE CERT:
Hey guys, the CEO was looking at the game today, and he really loved it! In fact, he even said the action was the most amazing he'd ever seen in a video game! He did make one comment I felt I should pass on, though. There's a part at the beginning of Mission 1 where the hero says something like, "Those bastards are the ones who killed my parents," and the CEO said he thought that was kind of cheesy and cliché. I think I may just have to agree with him! If you could maybe take that line and punch it up a little with some more modern language? "Those dipwads," maybe? Basically whatever the kids are saying these days. Thanks!

P.S. Also, I looked at the bug database today. Wow, there are a ton of bugs! When are you going to start fixing them? Thanks!

1 MONTH BEFORE CERT:
Hey guys, it's getting close to 6 PM, I was wondering if the build is ready yet? Thanks.

1 DAY BEFORE CERT:
hey guys ... its getting close to 6 in the A.M. ... i was wongerinf is build yet

3 MONTHS AFTER SHIP:
Hey guys, just wanted to let you in on the great news— we're one of *Game Developer Magazine*'s Top 20 Publishers! I am sure your positive experience with us was one of the deciding factors! We are looking forward to working with you again! Thanks!

MATTHEW WASTELAND *is a pseudonymous game developer who has a fairly common first name. Email him at* ***mwasteland@gdmag.com****.*

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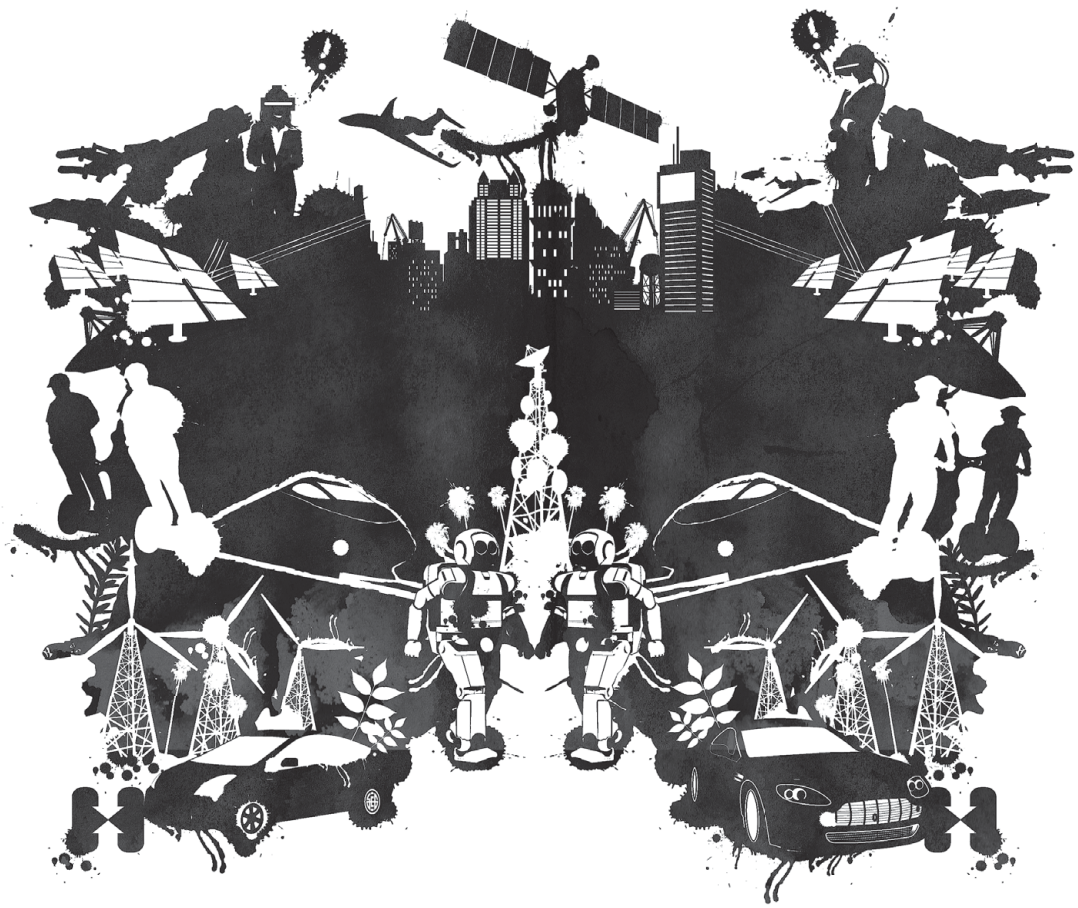

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