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Opening the Valve: From Software to Hardware (A)

Manager—The kind of people we don't have any of. So if you see one, tell somebody, because it's probably the ghost of whoever was in this building before us.

—Valve Handbook for New Employees

After dropping out of Harvard in 1983 to join Microsoft, Gabe Newell, Co-Founder of Valve Software, spent the next thirteen years as "producer" for the first three releases of Windows, becoming a Microsoft millionaire in the process.

> Like a lot of people in my cohort at Microsoft, I hit the lottery—I reached the point financially where I could do anything I wanted. I could retire and sail around the world. But the thing I enjoyed the most was working with smart people who liked building products that affected lots and lots of people. That's what I'd gotten hooked on at Microsoft, and that's what I created Valve to do. So the question was why would Valve be an interesting company? We had to think both about the design of our products and the design of the company.

By offering unheard of levels of autonomy, Gabe intended to attract talent and allow it to flourish. By choosing an industry in which flourishing talent translated into high returns, he hoped to afford commensurately high pay and rewards.

As Gabe looked out on the horizon in 1996, the video games industry seemed poised to offer the increasing returns to talent required to power such a model. Therefore, he and co-founder Mike Harrington, both with experience in operating systems and productivity software but not in video games, created Valve Software. Valve was established as a radically open, non-hierarchical company where job titles and org charts were non-existent, employee time was 100% self-allocated, and every desk was on wheels so that employees could physically relocate themselves anytime they wished.

By mid-2013, Valve's unmanaged 400 employees had created many of PC gaming's leading titles, supported by Valve's digital distribution system, "Steam," which helped transform the business of selling video games. But Valve saw a plateau ahead. Through Steam, Valve's games could be played on PC, Mac, and Linux—but without accessible living room and mobile hardware, Valve's growth opportunities were limited. Innovations in hardware would be essential to Valve's ongoing success. Could a "boss-free" company designed to build gaming software create hardware too?

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Generational Warfare: A Short History of Video Games

We were convinced in 1996 that video games had an inherent advantage over passive, couch-potato entertainment: consumers could participate in the experience. We could point to many psychological studies as to why agency makes video games a more valuable experience.

— Gabe Newell, Co-Founder of Valve

In 2012, consumers spent an estimated $20.77 billion on video games worldwide, or roughly two-thirds of the global movie box office sales.[1] 58% of Americans played video games, in one medium or another, and 51% of U.S. households owned at least one dedicated game console.[2] Major releases, known in the industry as AAA ("triple-A") titles, could attract millions of concurrent users and regularly competed with more 'passive' entertainment forms (like movies) for audiences.

Yet all this success had not been preordained, as video games had risen from humble beginnings and endured a roller coaster ride along the way (see **Exhibits 1** and **2**).

Building the House of Atari

In 1971, Nolan Bushnell developed the first mass produced coin-operated arcade video game, *Computer Space*. It was a commercial failure. Undeterred, Bushnell founded Atari in 1972.[3] Atari's first project was arcade classic *Pong*. By 1974, the company had already earned $3.2 million, largely from Pong.[4] However, the company failed to successfully protect its intellectual property ("IP"). Of 100,000 *Pong*-type games shipped in 1974, Atari was responsible for just one tenth.[5]

Meanwhile, electronics company Magnavox had released the first retail video game console in 1972. The Odyssey eventually sold 300,000 units. Atari followed Magnavox into the console business in 1975 with a home version of Pong, which sold 150,000 units in that holiday season alone.[6] Four years after the debut of video game consoles, the marketplace was already crowded by feuding platforms and in-house developed games.

In the midst of a market flooded by competing game consoles featuring copycat games (particularly *Pong* clones), two Atari innovations in the late 1970s changed the game console market forever. First, the advent of the plug-in cartridge, first introduced in 1977 with the Atari *2600 VCS,* transformed the industry and remained the standard until the 1990s. Second, in an effort to survive a market crash in 1977 and 1978,[7] Atari decided to license the popular arcade game *Space Invaders*, the first third party game licensed by a console maker for the home market.

At first, that pair of innovations benefitted Atari, giving it two-thirds of the market by the end of the decade.[8] But the disaggregation of software from hardware ultimately caused Atari significant heartburn. In 1979, four former Atari employees founded game developer Activision. By 1981, Activision had sold $65.9 million of cartridges for the 2600 VCS.[9] Atari's profitability depended on software rather than hardware, and so they filed suit against Activision. A resulting deal required independent developers to pay Atari a royalty if the game cartridge was Atari-compatible. This partially-open, royalty-based model would serve as the basis for industry practice in the console sector for years to come.

The new royalty-based model made Atari a strategic partner in the industry. In the early 1980s, Atari was approached by a Japanese game developer eager to bring its hit arcade game *Donkey Kong* to consoles in North America. Atari turned down the partnership offer in a move much regretted later. The developer was Nintendo.

Atari is Dead, Long Live Nintendo

From revenues of $3 billion in 1982, console hardware and software sales plummeted to just $100 million in 1985.[10] Unsustainable competition between too many hardware platforms and a glut of poorly made games caused the industry to crash.[11] Atari and several of its competitors flirted with bankruptcy.

Enter Nintendo. Back in the 1970s, Nintendo licensed Magnavox's technology to release a version of the Odyssey in Japan. Nintendo subsequently developed its own "Famicom" console for the Japanese market in the early 1980s, which could be manufactured at a much lower price by increasing chip efficiency and 'outsourcing' some core system operations to processors embedded in the game cartridges. Known as the Nintendo Entertainment System ("NES") outside of Japan, it was a surprise hit when released in North America in 1985.[12] Recognizing that software drove console sales, Nintendo paired proprietary development of marquis titles with a carefully curated marketplace of third-party licensed titles. Nintendo quickly established a strict licensing regimen for game developers including initial exclusivity periods, a 20% royalty on sales, and a Nintendo approval process designed to prevent a repeated glut of poor software.

By 1990, the NES had sold 30 million units in the United States, representing 90% of the market. There was an NES in 30% of US households[13], compared to 23% for all personal computers.

The Japanese Civil War

By the mid-1990s, the American pioneers of console gaming had faded to irrelevance. The market became dominated by three Japanese companies: Nintendo, Sega, and Sony.

Witnessing Nintendo's entry into the market, Sega—Japan's largest arcade operator—entered the console market in Japan in 1983 in an attempt to duplicate its arcade-based success. Although initially unsuccessful, Sega pushed forward with successful releases of the 16-bit Genesis in 1988 and the 32-bit Saturn in 1995.

Sony, the consumer electronics giant, first entered the console market in partnership with Nintendo to create a 32-bit system with both CD and cartridge input. The partnership failed, but Sony continued the project and debuted the CD-based PlayStation in 1995. Sony leveraged its existing electronics operations to forge relationships with developers, leading to a stronger software ecosystem despite Sega's first-mover advantage. Within two months of its North America release, the PlayStation had doubled the installed base of the Saturn.[14]

After the failure of its partnership with Sony, Nintendo decided to leapfrog the 32-bit competition and develop the first successful 64-bit cartridge system, the Nintendo 64 ("N64"), which was released in North America in September 1996. However, high development costs dissuaded game developers from working with the system. Nintendo had to develop 57% of N64 titles in-house, against just 23% of titles for the PlayStation. Although Nintendo achieved strong sales, Sony's large software ecosystem and utilization of CDs enabled it to take leadership of the console market.

In November 1998, Sega released the Dreamcast in Japan. Anxious to get ahead of the curve technologically and re-orient towards casual gaming audiences, the Dreamcast included comprehensive online functionality and support for HD displays. But the product was too costly for Sega and its customers, and the advanced features often relied on other systems, such as fast internet and HD televisions, then uncommon in the consumer market.[15] By 1999, Sega had decided to shift focus to software, and in 2001 discontinued Dreamcast support and exited hardware altogether.[16]

Reaching Stability in the Console Market

The console market was not without a third player for long: Microsoft released the *Xbox* in 2001, two months after Nintendo's GameCube and a year after the PlayStation 2. It was an early foray into hardware for software giant Microsoft. The Xbox enjoyed exclusive access to the popular *Halo* series, the first title of which set a new record by selling over a million copies in five months after its Christmas 2001 release.[17] The Xbox ultimately sold 24 million units, more than the Nintendo GameCube that inherited its predecessor's difficulties with developers.[18]

However, despite Microsoft's successes, Sony was the clear winner at the beginning of the twenty-first century. The PlayStation 2 sold over 150 million units and remained in 2013 the most popular console ever.[19] Sony had successfully repeated its prior strategy with a competitive entry date and a strong content ecosystem.

Sony and Microsoft returned to the ring later in the decade, with the Xbox360 and PlayStation 3. Microsoft appeared to have learned from its competition and focused on the development of tools to aid development of games.[20] Meanwhile, Sony appeared to be flirting with mistakes of the past: investing heavily in high-end chip technology but at the cost of longer development cycles and higher production costs. The Xbox360 launched at the end of 2005, a year before the PS3, and at a lower price point. Microsoft reaped the benefits and sold 78 million Xbox360s. Sony was humbled but not defeated, and the PS3 eventually overcame Microsoft's sales numbers, even if only barely, by the end of 2012.[21]

The real surprise of the generation was the Nintendo Wii, released in late 2006. Nintendo designed the Wii to appeal to women, older people, and other traditionally undervalued segments.[22] The Wii also featured new technology: a motion capture system that enabled players to act out real life activities. Wii therefore sidestepped its competitors and sold over 100 million units.[23] After the Wii, input devices became a new basis for competition, with Sony and Microsoft both releasing competing technology (Move and Kinect) for their existing systems.

In 2013, the console sector prepared for another triangular battle for dominance, even as the thinning walls between PCs and consoles threatened to transform the market at the hands of a fourth player focused to-date only on PC gaming—Valve.

The Rise of PC Gaming

In the shadows of that console gaming history, the market for PC-based games had developed in parallel. In the 1970s, the high cost of early PCs prevented the emergence of a large gaming market. But by 1983, this had begun to change. New PCs, like the Commodore 64 and the Apple II, were price-accessible for many families. The market for PC games boomed. PC makers marketed their products as capable of both gaming and productive work.[24] Early game developers took advantage of keyboard and mouse input to build games that would be difficult to play on a console, like text-entry Role-Playing Games, and city simulator, *SimCity*.

Like consoles, PC gaming was initially dominated by feuding platforms. This changed rapidly in the late 1980s with the consolidation of operating systems (OS). By 1995, over 80% of PCs ran a Microsoft OS.[25] Unlike the temporary dominance achieved among consoles, Microsoft's advantage was long-lasting. The dominance of a single, ubiquitous OS provided a fundamental contrast with console gaming. Unlike console developers, PC game developers only had to consider one platform.

The Death and Life of "Open" PC Gaming

Despite frequent doomsday stories of PC games being unable to compete on price, graphics, or other criteria, the "open architecture" of PC games offered sufficiently crucial advantages to keep it alive across generations. For programmers, it was easier to develop software for the PC and fast software innovation became more common. For consumers, the flexible, modular nature of the PC's hardware architecture, as compared to the fixed architecture of consoles, meant that even if PCs technically lagged behind consoles at the time of the latter's release, the PC could incorporate new technology in order to catch-up while consoles awaited the next generation.[26] For game developers, PC gaming availed itself of a sunk cost: as more households purchased PCs, prospective customers only had to be convinced to buy the game, not an expensive (yet low-margin) machine to play it.

A handful of PC games produced sky-high sales figures. *The Sims* and its sequel *The Sims 2* sold 16 million and 20 million copies respectively, while also showcasing the differences between the console and PC audiences. The popularity of different genres differed markedly between platforms. Strategy and Role-Playing Games made up 53% of the PC market in 2012, compared to just 8.9% for consoles.[27]

Because of its openness, the PC gaming environment represented the leading-edge of several new emerging trends, including "free-to-play" and digital/mobile distribution (**Exhibit 3** and **4**).

The Creation of Valve

When Gabe Newell and fellow ex-Microsoft employee Mike Harrington started Valve in 1996, they had a very specific strategy in mind. As Gabe recalled,

> We were pretty sure that video games were going to continue to increase as a percentage of total entertainment spend. We were also pretty sure that making video games was hard—that the design of video games was, and still is, folk art and changing very rapidly. Most projects would fail, but a few blockbusters would be extremely profitable. The question was: are blockbusters randomly distributed, in which case you just want to have a lot of irons in the fire, cast your net as wide as you can, and then hope that one will hit? We didn't think so. To us, there was something at work other than just random chance. It seemed certain people who were successful creating a blockbuster game tended to be consistently successful. Predictable success was all about attracting and retaining the specific individuals on each team who seemed to predict success.
>
> But it was not just about recruiting stars. One of the lessons we had taken away from Microsoft was that no matter how good you are as a set of individuals, after you've worked together through multiple shipping iterations, you're adding more value to the underlying capabilities of the people on the team. The more stable you can keep those high-performing teams, the better. To this day, we're startled by how Hollywood creates and destroys their production teams multiple times over the course of making a film, which to us just seems like madness when we know that working together only improves over time. So the key question was how to find these incredibly talented people, convince them to come, and then convince them to stay together over time.

The answer to that question was written in the Valve Handbook for New Employees, which was released to the public in 2012.

Spontaneous Order: Valve's Amorphous Corporate Structure

Michael Abrash, a fellow Microsoft veteran whom Gabe had been trying to recruit for years and finally joined Valve in 2011, recounted how Gabe set about organizing Valve:

> When Gabe was at Microsoft in the early 1990s, he commissioned a study to find out what was on customers' hard disks; Windows was number two and *Doom* was number one. The idea that a ten-person company of twenty-somethings in Mesquite, Texas could have gotten software distributed more widely than the biggest software company in the world made him think that the world had changed. So he did some research. He found that the hierarchical management worked very well during the industrial revolution because people basically had to be components of a machine and do the same thing over and over. What *Doom* made him realize, among other things, was that the true value today is in that first creative task and that doing it a second time has far less value. I always tell other programmers that any of us could now write the initial Google search engine or Facebook or *Doom*. It's not really that hard to write software. What's really hard is to know what software to write. So, Valve was constructed around the idea of enabling those extremely high value events to occur. This means that you need creative people and you need to let them create.

Consistent with that view, when Gabe left Microsoft in 1996, he set out to create a company focused on generating and nurturing new ideas, rather than reproducing the same product. As Gabe noted, "repeatability is the enemy of what Valve does. Things that were the winning recipe five years ago are disastrous today."

Valve lacked most of the hallmarks of classic business hierarchies: dedicated management tiers, codified reporting channels, and even job descriptions. It was a company almost entirely without titles. "Valve does not have distinct sets of decision-makers and doers—those of us that are doing all own the fundamental decisions that Valve is making," explained Greg Coomer. One long-time employee observed, "I think Gabe is technically the CEO, but it's funny that I'm not even sure of that." Those few employees that possessed titles chiefly did so to meet Washington State regulatory requirements or mollify outside partners. But there is a boss—the customer—and "no red tape stopping you from figuring out for yourself what customers want, and then giving it to them."

Valve's organizational structures were developed on an ad hoc and temporary basis—what some inside Valve referred to as 'spontaneous order'. While other tech companies were lauded for directing their employees to spend 10 or 20 percent of their time on their own projects, at Valve employees had full freedom to choose what projects to work on. As Abrash noted,

> There's no status, there's no money associated with a title. There are de facto leads, but titles carry no formal authority. It's just that people agree that things will be more productive if these people are de facto leads for a certain period of time.

As stated in the *Handbook*, "although people at Valve don't have fixed job descriptions, they can and often do have clarity around the definition of their 'job' on any given day."

Valve did subject new projects to rigorous testing. This process took place across the company's business, from game development to hiring or selling games. Project teams, known as Cabals, developed organization as necessary. Cabals could be as simple and fluid as a set of individuals rolling their desks together for a few hours to address a customer need—or as complex as a group of individuals strategically taking Valve Software into hardware.

All About Cabals

The formation of new projects at Valve was neither centrally planned nor centrally managed. As stated in the *Handbook*, "There is no secret decision-making cabal."[28] Coomer recounted his experience of building a team for a major project:

> When I started that project, I had to build consensus because I needed to convince a lot of people who already work here that we should go build this piece of software instead of that one. It wasn't so much a team's consensus as convincing several individuals that the best way to spend their own time was to come sit with me and work on the thing that I thought was really important.

For employees, deciding which cabal to start working with could be a harrowing process. As the *Handbook* stated, deciding what to work on "can be the hardest part of your job," with one employee sharing that at Valve you never have "the luxury of having someone tell you what to do." Employees were encouraged to take on new challenges, remembering that "at the end of a project, you may end up well outside what you thought was the core area of your expertise."[29]

Hiring the Right People, and Keeping Them Forever

Hiring is the single most important thing you will ever do at Valve.

— Valve Handbook for New Employees

Because of its' participatory management model, Valve evaluated candidates not only for their expertise and experience, but also for their suitability for engaging with major strategic decisions.

Valve described its ideal employees as fundamentally "T-Shaped": "People who are both generalists (highly skilled at a broad set of valuable things – the top of the T) and also experts (among the best in their field within a narrow discipline – the vertical leg of the T)."[30] The combination, paired with a requirement that successful recruits have the ability to talk through issues out loud in a collaborative way, helped make Valve's multidisciplinary cabals work. As Abrash noted,

> In terms of finding people, generally what we have to do is we have to find people who have deep skills that we need but who also could go work on the next game or theme, for example, and have value. We can't go out and hire somebody who's good at image processing but can't actually write code.

Gabe admitted he "gets freaked out any time one person leaves… it seems like a bug in the system."[31] Valve offered its employees an array of attractive perks including an annual expenses-paid company vacation. Valve also tried to engage its employees' families, believing that, as Gabe noted, "the company does not hire people; it actually hires their families." The key aspect of Valve's ability to retain its employees, however, was the system itself.

Old Management's Antiques: Stack Ranking

Although it eschewed most hierarchical structures, Valve stack-ranked its employees for compensation purposes. Employees were first ranked internally within projects, based on their technical ability, productivity, contribution to the operation of the group and the successful development of resulting product. The group rankings were then collated to produce a company-wide ranking upon which compensation was based.

Valve's Path

Half Life and the Mod Community

When Valve was established in Kirkland, WA in 1996, one of its first acts was to acquire a license to the *Quake* game engine. This enabled Valve to make *Half-Life*. The game combined suspenseful combat with puzzle solving. The game won over 50 game-of-the-year awards from industry publications and went on to sell 9.3 million copies.[32] In 1998, Valve hired the developers of the popular game *Team Fortress*, who then created an updated version for Valve.[33]

Ever since the video game market crashes of the 1970s and 1980s, video game companies had closely guarded their IP and feared that a failure to do so would lead to severe brand damage. Yet with the spread of the internet, there was a growing market for online-distributed modifications ("mods") for existing games—essentially hacked versions of existing games. In a departure from the mainstream, Valve embraced that trend and even used it as a recruiting technique. In 1999, college students Minh "Gooseman" Lee and Jess "Cliffe" Cliff developed the *Counter-Strike* mod for *Half-Life*, which transformed the game into a multiplayer arena where teams of players fought over a fixed map to complete mission objectives.[34] Rather than enter an IP battle, Valve opted to hire the two, bringing *Counter-Strike* development in-house in the process. A full retail version was released in November 2000.[35] *Counter-Strike* was the first step in establishing a pattern at Valve of crowdsourcing mod development and bringing particularly notable mods in-house along with their creators.

From First-Person Shooter (FPS) to Digital Download: The Rise of Steam

In 2002, Valve announced the release of their Steam platform. Steam's original purpose was to form an integrated system for auto-delivering and installing software patches for Valve's games, especially online multiplayer games like *Counter-Strike* which required all players to be running the latest patch. Valve also announced that it would use the Steam platform to make a variety of the tools it had created available to outside developers and "modders".[36]

Valve began using Steam to retail its own games in 2004, opening the platform to other games in 2005. Steam rapidly dominated digital distribution of PC games. Although Valve did not disclose exact numbers, industry observers believed 50-70% of the PC digital distribution market in 2012 ran through Steam.[37] As of 2013, the platform offered over 2000 games, had 75 million active user accounts, and had set a new record of over 6 million concurrent users online.[38]

The Source of All Things

Having utilized the *Quake* engine to develop its early games, Valve eventually sought to bring design entirely in-house. The result was the Source Engine. The engine enabled Valve not only to deliver superior graphics, but also to increase the modularity of development and thus the capacity for rapid adaptation. The first game to be made with the new engine was *Half-Life 2*, which was very positively received in the industry, selling over 12 million copies by 2011 while winning numerous awards.[39]

While the first use of the new engine was a sequel, the company had broader ambitions to use the engine to build novel experiences for gamers. Chief among the results of this strategy was *Portal*, a game that shared the camera perspective and control schema of *Half-Life* but required the player to kill only once and at great cost.[40] The player's 'gun' created portals around each level, allowing the solving of puzzles and navigation around obstacles. The game was also known for its humor. Other games created using the Source engine including zombie survival game *Left 4 Dead*, the long awaited

Team Fortress 2, and third party titles like the gothic role-playing game (RPG) *Vampire: The Masquerade – Bloodlines*.

Valve Versus The Brave New World

Valve was increasingly striving to move beyond the PC ecosystem in which it had grown up. Valve released a *PlayStation 3* compatible version of Steam (with its retail features inoperable as mandated by Sony) that allowed players of Valve games such as *Portal 2* to access extra content and other Steam features.[41]

Meanwhile, Valve continued to add functionality to Steam, including a streamlined support system for mods and the capability to allow users to directly support other users of Indie games. Steam Greenlight allowed smaller developers seeking to sell their games on Steam to post information, video, and screenshots of their games and build community support.[42] Steam users could then vote on whether or not they wanted a game to be available on Steam. The Steam Workshop leveraged Steam's existing systems to allow for the centralized uploading, promotion, and dissemination of mods or other user-created content for games. While the rules differed by title, Steam made these customizations easily accessible to PC gamers unwilling to perform complicated installations and configurations.[43]

As it opened its own platforms, Valve carefully monitored the growth of closed-shop platforms. In 2011, top PC game publisher Electronics Arts established its own digital distribution platform called Origin for EA-developed games.[44] When Microsoft released Windows 8 with an integrated, closed Windows Store, Gabe vocally expressed concern that it could decrease the open character of PC gaming.[45] In part in response to those fears, he stated Valve would deepen its involvement with the Linux platform as a hedge against similar future developments in Windows.[46]

Towards Hardware?

Any decrease in the open architecture of PCs was concerning to Valve. Coomer explained that Valve's "success story as a medium-sized company is entirely based on the existence of that openness in PCs." Even so, open architecture had limitations since Valve had no control over the hardware on which its games were running. Abrash echoed a common frustration at Valve when he noted that "Valve was increasingly concerned that taking advantage of advanced opportunities in software can't happen until the hardware changes." Meanwhile, Valve viewed market data such as that in **Exhibit 4** as a call to action by its customers.

So, spontaneously yet slowly, a cabal emerged at Valve committed to exploring hardware:

> A group of us started to believe that it was important to actually respond to customers' requests about not having to abandon either their games or their friends because each was in a different room. We started to scope the work required to actually connect the dots for customers to help them get the games out of their computer stations and into the living room.

As a first step, in 2013, Valve developed Big Picture, which adapted the Steam platform for use on wide-screen TVs.[47] Big Picture was conceived as part of a general strategy of integrating PCs into the living room and allowing PC gaming to compete more directly with consoles.[48] The team behind it understood that Big Picture itself could not accomplish this goal. Instead, Big Picture was seen as both a smaller, software-based first step in that direction as well as an effort to generate internal

credibility for the project and support the accretion of resources for further work. One of the early cabal members, Anna Sweet, commented:

> I think it became clear to everybody that the other pieces—input devices and dedicated console-like hardware—needed to be developed by Valve in order to solve our customers' problem of wanting to move into the living room.

Building internal and external support for the project was particularly important because the PC had failed repeatedly to make its debut in the living room, and there was a risk that Valve's effort could meet a similar end or at least be tarred by that memory.

The hardware cabal was tiny at first, but then, like other successful Valve projects, it accreted people and effort and arms for the work. The cabal began to attract software engineers who were accomplished enough hardware hobbyists to get basic work done. They experimented with things like biometrics—collecting data from the user's body through sensors about arousal state through heart rate, blood volume measurement, skin galvanic response, etc.—along with eye tracking and, to a limited extent, virtual reality. They built 'Frankenstein' prototypes in-house, cobbled together out of low-tech solutions but sufficient to gather data and iterate. As one hardware cabal member reflected, "in hindsight, we were just competent enough to be dangerous, but we did learn a fair amount."

To produce higher-fidelity prototypes which could be used in robust gameplay testing, the cabal enlisted the help of outside contract firms, including a local firm full of experts in industrial design, electrical engineering, and manufacturing. For example, that firm helped Valve create a mouse which was covered in metallic contact points to collect skin galvanic electric responses with which the user's arousal state could be inferred and correlated with game events. With that mouse, Valve conducted game design experiments to see if changes to game design could meaningfully affect arousal state of an individual playing games like Left 4 Dead.

Yet even as the cabal grew, it also became increasingly clear that entering the hardware field could be challenging for Valve. These early experiments were rich with learning but also, as one cabal member put it, "messy," "unreliable," and "glacially slow." Valve was also "uncomfortable with outsourcing product development to outside contract firms, having long ago come to believe that it's exactly the kind of work which ultimately must be done in house." There was a growing view that, if Valve were going to make a meaningful dent in the hardware space, they needed to make a significant commitment to hire hardware experts as full-time employees.

But the nature of hardware development posed a potential disconnect with Valve's open team staffing and T-shaped skill preferences. Abrash noted, "Hardware tends to be more an interaction of a team of specialists whose skills interlock, and generally requires far more planning and upfront investment." Coomer noted that producing hardware required the writing of "really large checks that other parts of the organization don't need to write." And perhaps most importantly, hardware production was marked by long lead times, resulting in a requirement that things be fixed long in advance of a particular release day. As Coomer reflected, "in our model, it's really hard for us to have things fixed. We don't think that way. Why would we stop designing if we can continue to improve it? But in hardware, it's much harder to have something be fluid." Valve had begun thinking about hardware in an organic way, but the next steps seemed to be demanding far more deliberate planning and constrained activity.

While irregular corporate organization was not necessarily unusual in software firms, would the Valve operating system be compatible with hardware production?

Does Anybody Have a Walkthrough[a]?

Valve faced three key decisions as it considered entering the hardware field.

First, was entry into hardware a good and feasible option for Valve, particularly given its unique structure and the competing demands of hardware development? For example, Coomer observed that "one of the most difficult challenges for us is that in the software model, what we like to do is put something out there and get real-time feedback and then constantly iterate on it…," but putting an unfinished hardware product into the hands of consumers was not possible with the long lead-times, up-front investments, legal and regulatory challenges, and complex ecosystems involved in producing hardware.

Second, if Valve did step into the hardware segment, how should they do so? Should Valve mass-manufacture its own input and console devices for sale to end consumers? There were certainly those at Valve who found the idea appealing. As Frank Taylor explained, "it's an interesting question because I think we have a lot of faith that, for the things we choose to do, we can do a better job than almost any other organization."

But such a major intervention could potentially strain Valve's flat structure. Others in the hardware cabal wondered whether it might make sense for Valve to instead adopt a more hands-off approach, working with partners and external parties:

> Perhaps Valve should engage in hardware as a company that exclusively innovates and produces prototypes and reference designs, which other companies take as guidance from us and essentially become engaged in the production process using the invention and innovation that we have pushed forward.

But if Valve decided to outsource the manufacture of hardware to partners and external parties, it would need to carve out a productive role within the existing, interdependent hardware ecosystem—from retailers to component manufacturers to existing PC manufacturers and the software content producers already working with Valve via Steam (see **Exhibit 5** for a visual map of the ecosystem). Valve was uncertain how to choose among potential partners and uncomfortable being too dependent on any of them. There was also a growing concern that partnering closely with outside organizations, all of which operated as more traditional, bureaucratic structures, might result in more pressure on Valve's unique structure rather than less.

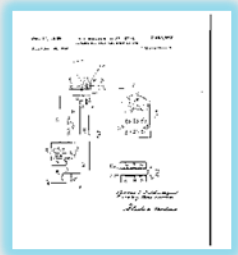
Third, should Valve adopt the same or different approaches to manufacturing the various components necessary to bring PC gaming into the living room? In addition to a PC console, users were also demanding a new kind of controller to serve as an input device to serve the wide variety of PC games, many of which had not traditionally been well-served by existing controllers.

The plethora of competing factors and questions made it all the more difficult for the hardware cabal as they wondered how Valve could best participate in pushing hardware forward, and how it could do so without compromising its unique organizational structure.

[a] Note: In PC gaming, a "walkthrough" is a series of steps (solution manual) through which a level or game can be solved.

Exhibit 1 A Short History of Video Games

VIDEOGAME PREHISTORY



1947 - Thomas Goldsmith and Estle Mann file a patent for a "Cathode Ray Tube Amusement Device." It is never commercialized.

1950s and 1960s – The first video games were developed for mainframe computers during this period. Many were computerized versions of existing games. Examples include A.S. Douglass's OXO, a variant of tic-tac-toe, and William Higinbotham's Tennis for Two. The technical limitations of mainframe computers and their enormous size and cost limited early games to a development and use by a hobbyist community.

1972 – Nolan Bushnell and Ted Dabny created Atari to develop and market arcade games, starting with the classic *Pong*.

1975-1977– Atari entered the console market with a home-pong version in 1975. It was followed by the *VCS 2600* in 1977, which could play multiple game cartridges.

1979– Following the 1977 crash, Atari's fortunes rebound after the company licenses popular arcade game *Space Invaders* for home use. Combined with in-house hit *Asteroids*, it helped power Atari to control of 2/3s of the market by the decade's end.

1972 - A team led by Ralph Baer had developed the first console in 1968, Which was commercialized as The Magnavox Odyssey for release in 1972.

ACTIVISION

1979- A group of former Atari employees leave to form a third party game developer.

GAME OVER

1977- By the mid 1970s, the market for consoles was crowded by too many platforms and starved by insufficient demand. The industry crashed with a terrible holiday season in 1977 and a lackluster 1978. Several companies flirted with bankruptcy and collapse, though market leader Atari limped through.

The Early PC– Over the course of the 1970s, the Personal Computer (PC) gradually emerged from the shadow of it's monumental cousin, the mainframe. The first recognizably modern PC, the Xerox Alto, was released in 1973, and others followed. Steve Wozniak developed the Apple I in 1976, forming a company with friend Steve Jobs to market it the next year. From their earliest days, PCs were a platform for gaming, even if initially for a small audience of early adopters.

1980s

1981– Following the 1977 crash, new competition for Atari gradually emerged. ColecoVision was released in 1982, and came with a copy of *Donkey Kong*, a popular arcade game developed by Nintendo.

1983-1985– Nintendo had entered the console business as the Japanese licensor of the Odyssey platform in the 1970s, and Nintendo-developed games had been sold in the US for other platforms. Nintendo decided to develop its own console, The Famicom/NES, which was released in Japan in 1983 and North America in 1985. The console had advanced graphics and lower unit costs. It was a smash hit, eventually reaching 90% market share in the United States.

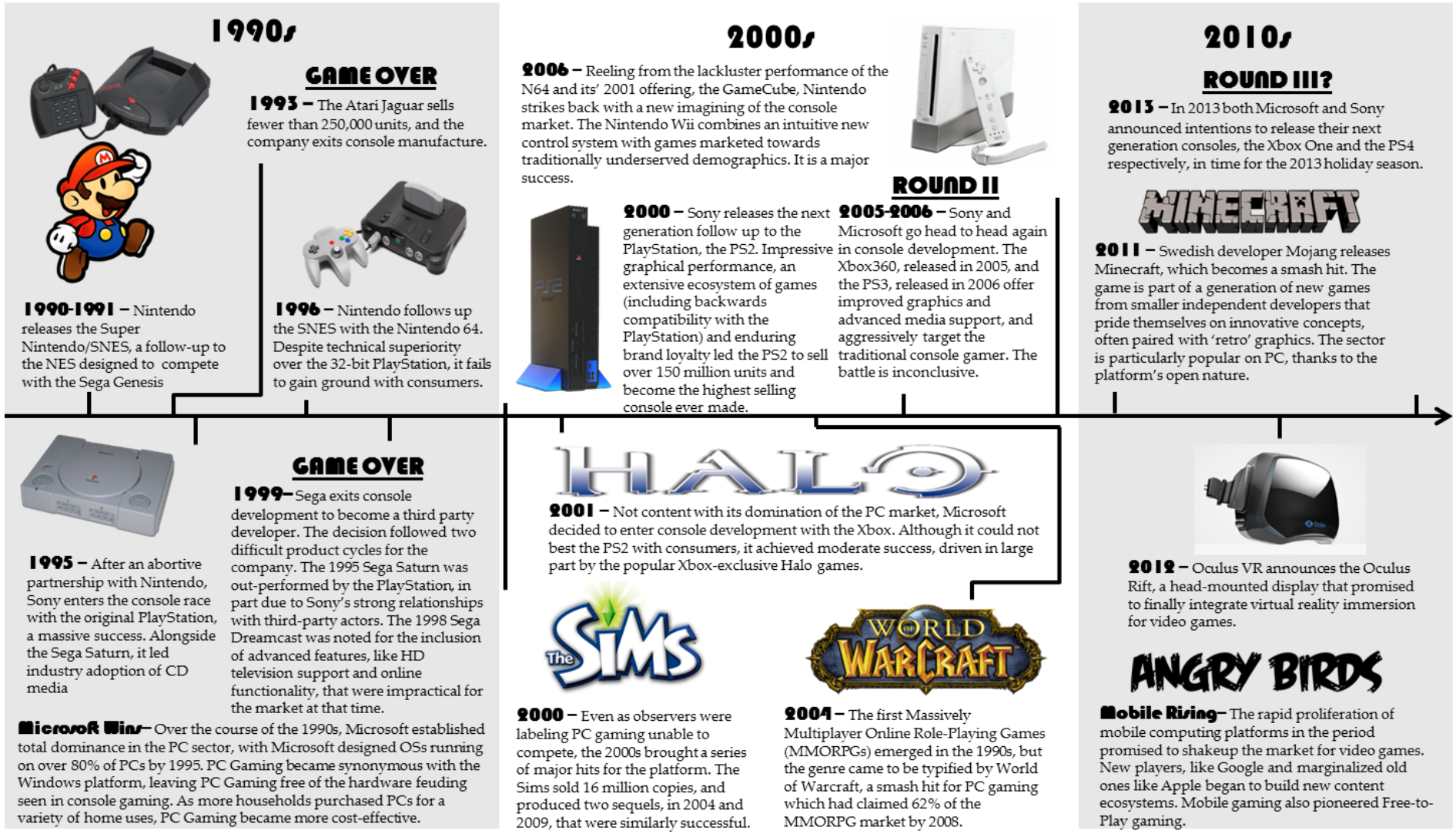
GAME OVER

1983- Just six years after the crash of 1977, console gaming threatened to collapse again in 1983. From a high of $3 billion in 1982, the North American console market had collapsed to just $100 million by 1985. The crash was driven by unsustainable competition between too many hardware platforms, and a glut of poorly made games, particularly from rapidly growing third-party developers. Unlike in 1977, the 1983 crash hit market leader Atari hard.

1985 – The fragmented PC market began to unify over the 1980s, with the release of Windows 1.0 the beginning of Microsoft's eventual domination of the OS market for PCs.

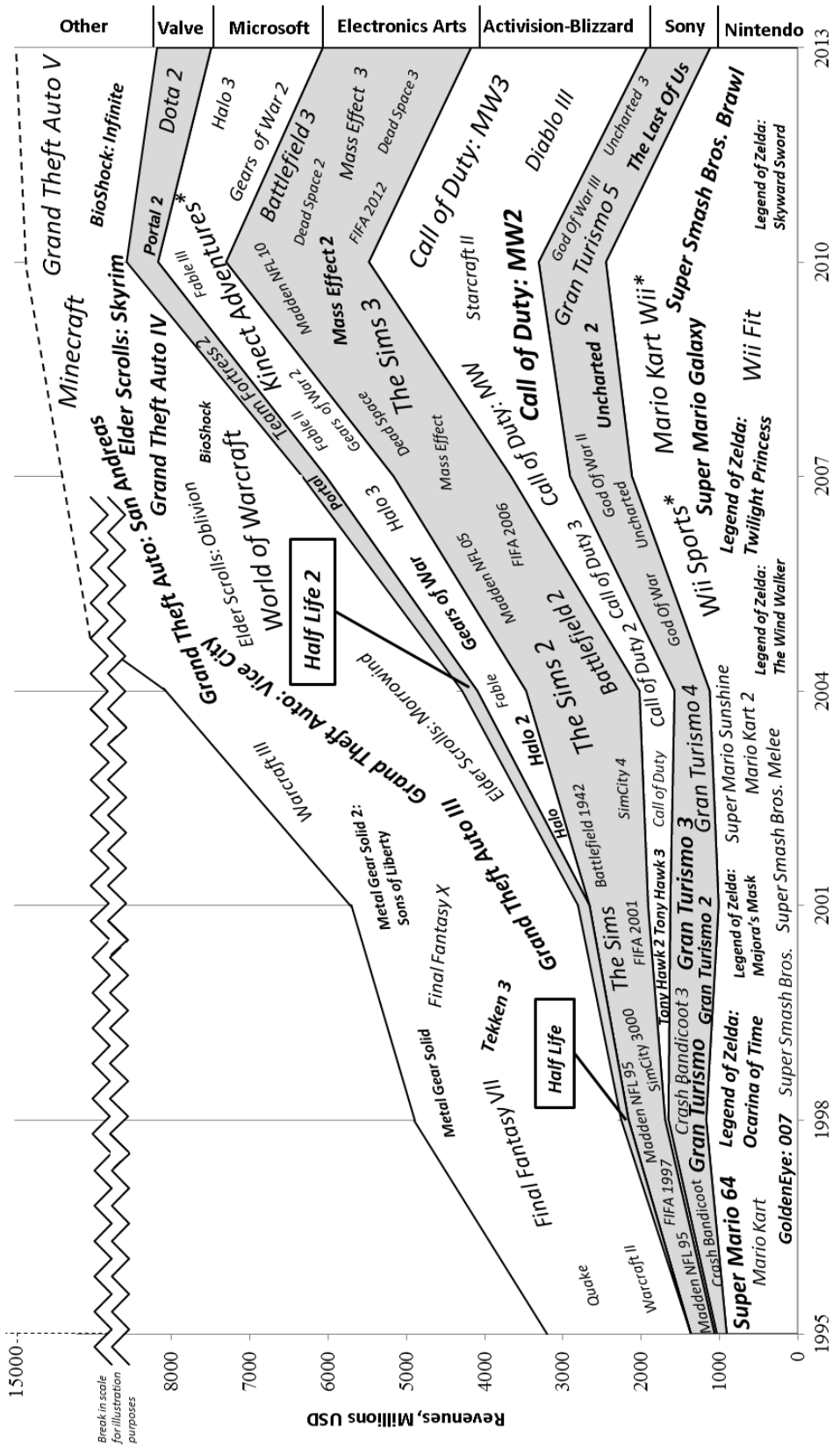
1985-1989 – Japanese arcade giant Sega followed Nintendo into the console market, with the release of the poorly performing Master System in 1985, followed by the Genesis in 1988/1989. Although unable to dethrone Nintendo, the Genesis was still very successful.

PC Gaming Emerges– The crash that shook console gaming in 1983 spared the PC. By the mid-1980s a number of PC sub-platforms had emerged that were increasingly affordable and accessible to families, including the Commodore 64, released in 1982. Game developers often took advantage of keyboard and mouse input to build games for the PC that would not easily work on consoles.



Source: Compiled by casewriter based on company annual reports and other public data

Exhibit 2 Game Publishing Reviews for Major Companies (1995-2013)



Notes:

1. *Games in **bold** were listed in the top 10 games for their platform by Metacritic.*
2. *Some data in this chart has been estimated.*
3. *Games with an asterisk* were bundled for sale with underlying hardware, contribution to higher sales revenue for that game*

Source: Compiled by casewriter based on company annual reports and other public data

Exhibit 3 Selection of Leading-Edge, Emerging Trends in PC Gaming

Independent ("Indie") Games: These games were made outside major development and publishing companies. *Minecraft* was the prototypical example: started as the personal project of Swedish programmer Markus "Notch" Persson, it became one of the highest selling PC games of all time.

Digital (Internet) Distribution: Online purchase and downloading replaced conventional retail distribution. These platforms rapidly dominated PC gaming, led by Valve's Steam and with other services often filling specific market niches, such as GOG ("Good Old Games"), which specialized in offering classic video games re-optimized to run on modern machines.

Free-to-Play: With digital distribution, games could be offered without charge, with the developer recouping costs through other mechanisms such as paid, in-game, premium content (such as new stages, avatars, tools, etc.). Many of these games became highly profitable. Indeed, some originally pay-to-play games had been converted to free-to-play. One game, *Lord of the Rings Online*, tripled revenues after making this transition, an in-game store compensating for lost up-front revenues.[49]

Frequent Updates: Sequels of popular games have always been highly profitable for games manufacturers—in 2012, of games purchased from physical retail locations, the top 20 PC games and top 20 console games were all either sequels or otherwise related to existing intellectual property.[50] Not surprisingly, the most likely purchasers of a sequel title were owners of the previous title. With digital distribution, game manufacturers could get closer to these prospective buyers. It even allowed game manufacturers to release early versions of games to this community, following up with updates later. For example, according to Valve staff, Valve had updated *Team Fortress* about 800 times.

Mobile: The emergence of mobile computing impacted the video game industry as well. It allowed new players to enter the market, with Apple and Google building major software ecosystems (iOS and Android respectively). Apple customers, who once had to wait months for new PC games to reach them, had instead become the first consumers to receive the latest mobile game. In 2013, growth in these platforms appeared to be driving stagnation in PC sales, which had the potential to further impact the future of platform leader Microsoft.[51]

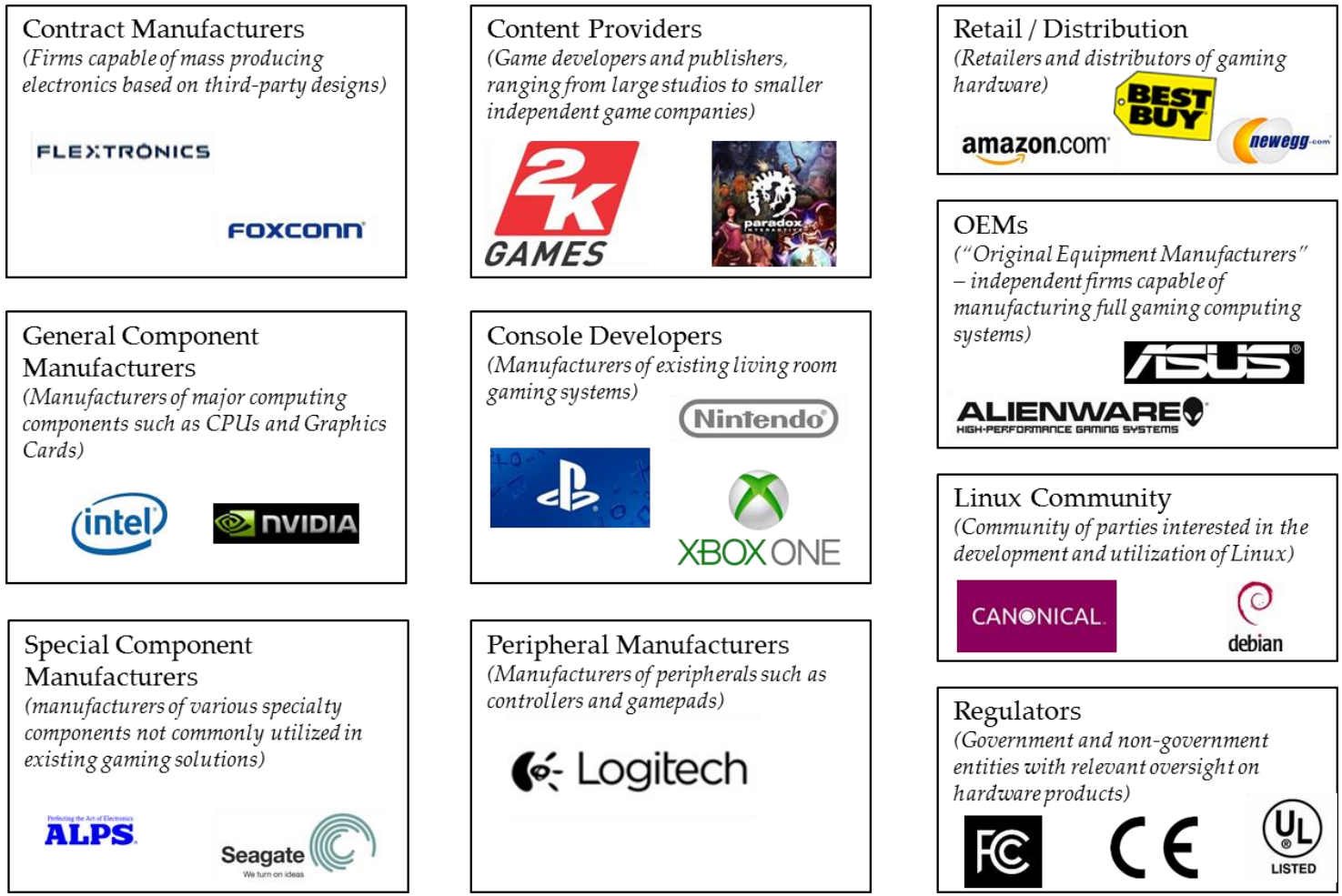
New Input Hardware: In 2012, Oculus VR announced the development of the Oculus Rift, a head-mounted display that promised to finally bring virtual reality immersion to video games.[52] A developers' version was released in 2013, and software support was steadily being added. In 2013, Oculus VR announced plans to release a retail version in the near future. Along with the shift to mobile computing, new input hardware technologies demonstrated how hardware could radically reshape the video game environment, just as the creation of first consoles had done forty years ago.

Source: Casewriter.

Exhibit 4 Gaming Trends

Source: Entertainment Software Association "Essential Facts About the Computer and Video Game Industry" Report (2013 Sales, Demographic and Usage Data).

Exhibit 5 Living Room Gaming Industry Ecosystem with Example Players



Source: Casewriter.

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