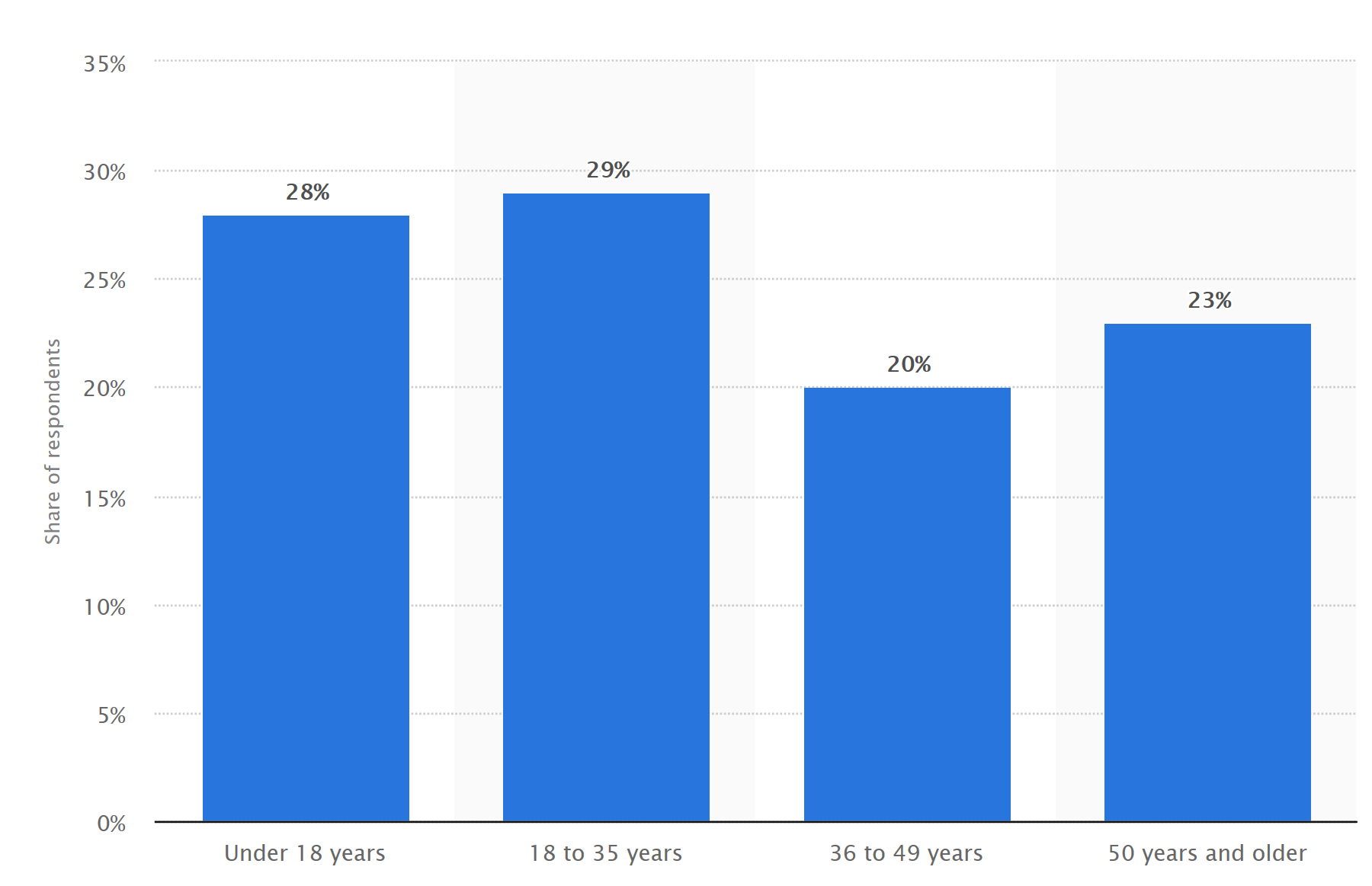
**Introduction**

I will be writing a report investigating the technologies used to create computer games as well as the social trends that are linked to computer gaming.

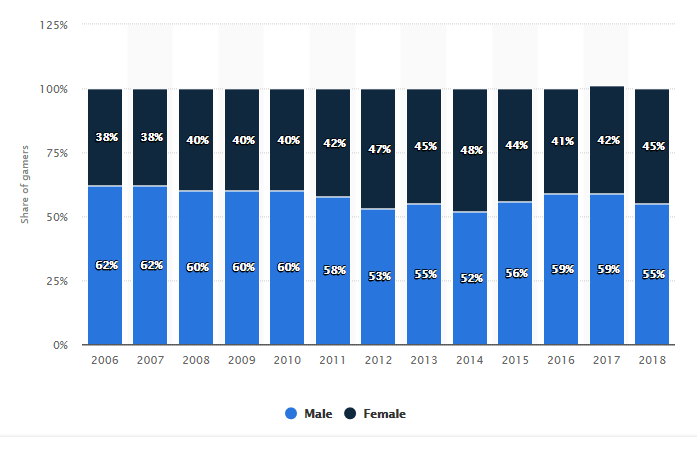
**A1 – Social trends in Computer gaming**

Video games have been around since the 1950s. Video games were created by MIT students as a past time or for their research during their Computer science degree. This brief history shows that the concept of gaming is something that is relatively new. However, it shows that gaming could only be done by those who had the knowledge to program the games themselves. Therefore, inferring the limited audience which video games had. It was only in the late 1970s that games become publicly available to people in the form of arcades and home consoles.

According to the graph below. In the USA 28% of gamers are under 18. 29% are between 18 and 35 years old. 20% are between 36 to 49 years old and 23% are 50 years old and above. However, the average age of a gamer is 35 years old. These statistics suggest that gaming takes place in a multitude of ways and not just the traditional sense of seating in front of a TV with a controller. This gives me reason to believe that the adults who are playing games are not only playing with a home console but also on portable devices such as smartphones. With gaming becoming more mobile, game developers now need to begin to find ways of making high quality games for smaller devices apart from consoles. The impact of this means the manufacturers of the components of these devices need to create equipment which is small enough to fit inside a handheld device but also is powerful enough to handle high quality games.



**Gender in gaming**

Statistics show that gaming is an activity which both men and women indulge in. According to the graph on the website Statista the “Distribution of computer and video gamers in the USA by gender” shows the percentage of gender split of gamers between 2006 and 2018. The trend shown in the graph below shows over the 12 years that there has been increase of 7% with the number of females playing games, with 2012 having the highest percentage of women playing over the 12-year period. With more female players, game developers are forced to produce content acceptable to both male and female players. The impact of more female players means more money will have be spent to collect data and to see what content they would like in games.

**Gaming Devices**

People play games on all different platforms such as PC, smartphones, handhelds and dedicated game consoles (Nintendo Switch, Xbox and PlayStation).

The best-selling home console of all time is currently the PlayStation 2 which was released in March 2000. As of January 4th, 2013, the PS2 had the largest number of units sold from launch being 158 million. With this number of units sold as of 2014 it became the best-selling console in the world. The PS2 brought to the gaming industry new ways to improve the gaming experience. The first thing that put it a step ahead from other consoles was the new function called backwards compatibility. This allowed players to play their original PlayStation games on their new PS2 but in higher quality due to the improvements in hardware and technology. Backwards compatibility became a major selling point of the PS2 which helped people overlook the expensive price of the console when it was released.

Another extremely successful console is the Nintendo DS which was the best-selling handheld of all time and the second best-selling console behind the PS2. The Nintendo DS was released in the USA on November 21st 2004. As of March 31st 2016, the DS has had 154.02 million units sold. Considering it was only a handheld console, it impacted the gaming community immensely. The Nintendo DS had a dual screen (which meant games would use both screens simultaneously), there was support for wireless connectivity which allowed multiple DS consoles to play together over a short distance. Similarly, to the PS2, the DS had backwards compatibility with Nintendo’s predecessor flagship handheld, the Gameboy Advance.

Gaming consoles can be split into generations. Currently there are 8 generations each with each mainstream company of the generation having their own each flagship console. The companies which have been the 3 major console makers of the past 3 generations are Microsoft, Sony, and Nintendo.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Microsoft | Sony | Nintendo |
| 6th Generation | Xbox | PlayStation 2 | GameCube |
| 7th Generation | Xbox 360 | PlayStation 3 | Nintendo Wii |
| 8th Generation | Xbox One | PlayStation 4 | Nintendo Wii U  (Was discontinued in January 2017 due to sales) Replaced by Nintendo Switch |

**PC vs Macs (As a gaming console)**

|  |  |  |
| --- | --- | --- |
|  | Benefits | Limitations |
| PC | Games are cheaper.  Larger variety of game types. According to PC Gamer reports in the first 7 months of 2015, 8 games were added every day to the online game streaming and hosting platform, Steam.  The DirectX API produced by Microsoft made it easier for game developers to leverage Sound and GPU capabilities on the PC. To produce more immersive games.  Original equipment manufacturers (OEMS) produced a wide variety of PC specifications and components. Making the PC a very customizable platform.  Large industry dedicated to the production of gaming accessories. E.g. Joy Sticks, Steering wheels, mice, keyboards, with easily available device drivers. | Quality of games depends on CPU and GPU quality. GPUs can’t be afforded by everyone.  When one component gets damaged depending on what it is, it could be costly to replace.  Unlike a console which can guarantee playability for an extremely long time. |
| Mac | OSX has the largest number of Virtual Machines which can run Windows. | OSX for a while was not based x86 architecture. Used Power PC architecture)    Game developers could not port games easily to the OSX platform.  OSX lacked a compelling gaming API like DirectX to make it for game developers to access hardware resources.  Mac hardware more expensive than PC it also cannot be easily upgraded for game performance. |
|  |  |  |

**Xbox One VS PS4 (Gaming Capabilities)**

|  |  |  |
| --- | --- | --- |
|  | **Xbox One** | **PlayStation 4** |
| **CPU Cores/Threads** | **8/8** | **8/8** |
| **CPU Frequency** | **1.6GHz** | **1.6GHz** |
| **CPU arch** | **AMD Jaguar** | **AMD Jaguar** |
| **GPU Cores** | **768** | **1152** |
| **Peak Shader Throughput** | **1.23 TeraFlops** | **1.84 TeraFlops** |

The specification of the Xbox One was comparable to the PS4. But with more GPU cores it could render and run games at a higher frame rate and graphical quality.

The PS4 has sold almost double the number of consoles compared to the Xbox One. (Sony have sold 83 million units while Microsoft have sold 39.1 million units) As a result the PS4 has become more popular than the Xbox One. Microsoft has been able to keep the Xbox One relevant with continued OS refreshes and updates.

**Types of gamers**

Gamers can be split up into 4 categories. Casual, Social, Immersive and Professional.

Casual gamers tend to be those who play games as relaxing down time. The games that Casual gamers play tend to have simple rules and don’t require much time and skill to master. Since casual gamers will not play games for a long period of time they are developed to have short completion time and major replay value. Therefore, they are generally played on devices which are mobile and can be started and exited a short notice. With people having

**Examples of casual games**

Windows OS games such as Minesweeper, Solitaire

Wii Sports

Farmville

Candy Crush

Tetris

Angry Birds

**Social games**

Social gamers are those who play games with the intention of making friends through gaming. The games that these people play can be determined by what their group of friends might be into. In this category this is where multiplayer games like Call of Duty tend to dominate. This is due to the large groups of people who can play online simultaneously with their friends or other fellow gamers. These groups of games are designed to be large-scale and also need to be able to manage large volumes of people

**Examples of Social games**

Call of Duty

Fortnite

Halo

Overwatch

FIFA

**Immersive Gamers**

Immersive gamers play games to try and eliminate real-world distractions by using new technology to immerse themselves in the virtual world of the game they are playing. These games tend to have large worlds for the player to explore which enhances their gaming experience.

**Examples of Immersive Games**

Skyrim – The Elder Scrolls

The Witcher 3

Bioshock – Rapture in Rupture

Stalker – Shadow in Chernobyl

**Genres of Videogames**

Computer Games have a vast number of genres. The most common are Action, Adventure, Role-playing, Simulation.

Action games generally focus on giving the player in-game physical challenges for them to progress through the levels. In this genre, there is a general framework which the player controls some sort of protagonist through levels collecting objects while using skills to battle against enemies.

Unlike action games which give the player physical challenges to complete, Adventure games use puzzle-solving and exploration along with an interactive story. When first introduced in the 1970s, they were not 3d games like we would imagine but in fact text-based. The first adventure game was called “Colossal Cave Adventure” which was created for the PDP Model 10. Initially, the game had 700 lines of code in FORTRAN which was then expanded to 3000 lines of code in turn leading to 1000 lines of data.

Role-playing games are games which players assume the roles of characters in a fictional setting. RPGs generally have a set of in-game guidelines which help determine actions within the game. The development of the narrative is normally done by the players acting. Originally, RPGs were called table-top role-playing games which were played through discussions. Another type of RPG are LARPs (Live action role playing) where players perform the characters actions themselves in a real-life setting. Both types of role-playing games have someone who organizes and manages the whole event, they are called GMs.

Simulation games try to emulate various situations in real life and change into a form of a game. These games are generally used for testing theories or analysis of data, or even predictions that people might come up with. Due to simulation games tending not to have any real objectives, the player has complete control of the characters actions. Popular types of simulation games include war, business and role play. The first simulation games were introduced in the 1980s by game company Code masters and Oliver Twins. They had released 3 sport games from 1986 to 1988 which were BMX Simulator, Grand Prix Simulator and Pro Boxing Simulator. The company was inspired by Concertmasters best-selling video games which were all based on real sports such as BMX racing and boxing.

**Game Production**

Game development companies can be split into 4 party categories. First-party developers are those who create games exclusively for their companies’ console. An example of this is when the Wii was released it came with Wii sports which was directly developed by Nintendo themselves.

Next are 2nd party developers, (this is not the official name for these companies, but it was conjured up game enthusiasts). Like FPDs, games are created exclusively for the company that they are contracted to. But, once the contract is terminated or completed they are no longer bound by the company that they were contracted by and they can continue to make games for any console that they please. A well-known example is Insomniac Games who have been contracted to make many games for the Sony consoles, but they still have a collection of games which have been made exclusively for other platforms. For example, Sunset Overdrive which was released in 2014 but exclusively for the Xbox One and Spider-Man (2018) which was made for only the PS4

Then there are 3rd party developers who create but also publish the games they create. 3rd party game developers are contracted by a publisher who will give them a contract (containing all details of what they want developed). The contract will contain milestones which have deadlines the publisher expects the developer to meet. When each milestone is completed to the proper standard and accepted by the publisher. The developers will accept a payment in royalties. Since this system allows the publisher to make sure the developers are meeting the milestones set. It has the negative effect of the developers being under constant pressure with the possibility of not getting paid. This is one of the reasons why many 3rd Party developers don’t last very long in the game development market. An example of a 3rd party developer is Activision (First 3rd party developer) who were founded in 1979.

Indie games are games which are developed without a publisher. This allows the developers to have total control of the game style, content and release date. Because of the vast freedom it leads to numerous numbers of innovative and original indies games. Developers only begin to make profit when the game has been published and often the revenue generated goes directly into the development of the next game. When released Indie games are generally only available for digital download since releasing the game on discs requires extra money since box and disc art will have to be designed as well as the boxes and discs needing to be shipped to game distributors.

Mainstream Publishers are multinational companies responsible for funding the production of games of varied genres over a release period aimed at certain seasons and holidays. An example of a company that follows this model is Electronic Arts also known as EA. The FIFA series (Sport), and the Battlefield series (Shooter) are just 2 examples of games which have been published by EA. These are ‘triple A’ games an informal terminology for games which have been developed and published by a single company. Triple A games rely on huge sales to be profitable as they are generally very expensive to produce. Sometimes with budgets in the tens of millions of dollars. The impact of these games is extreme if they are successful. They can remain on the market for extended periods of time well after of the release date and generate a considerable amount of revenue. For example, Microsoft have a collection of games (Platinum Hits) which if they have sold a considerable number of units within the first nine months of its release it can remain on the market.

**Components of PC and how they affect gaming**

**CPU – Central Processing Unit**

All instructions are carried out and calculated here using thousands of tiny microswitches which perform arithmetic, output and input logic. Modern CPUs generally come from the OEMs (Original Equipment Manufacturers) such as Intel and AMD.

**GPU – Graphical Processing Unit**

The GPU works along side the CPU and it has the sole purpose of producing images for the display. As games start to have better graphics more work must be done by the GPU for the image to be rendered on screen. GPUs and CPUs can be part of a single motherboard but most of the time GPUs are kept in a separate compartment which is connected to the motherboard. For a PC game to run at minimum and recommended requirements, the GPU must be of a certain standard.

**Memory and Storage**

There are 2 types of memory, ROM and RAM. ROM stands for Read only memory while RAM stands for Random Access Memory. ROM is used as storage for the game’s software. This is usually in the form of a DVD or Blu-ray disc. However, for handheld games ROM was used in cartridges. An example of cartridges being used for game storage is on the DS.

RAM is memory which is used as a store for data which allows data to be read or written in almost the same amount of time irrespective of the physical location of data inside the memory. More RAM generally improves the game’s performance.

For storage, consoles use a Hard disc drive (HDD) which is integrated into the console. Technological advancements have allowed storage within consoles to increase exponentially with each gaming generation. The original Xbox 360 had 20gb and the final model had 320gb. The vast increase in storage size has allowed consoles to become more of a general-purpose computer which can perform a multitude of functions. Whether it be listening to music, watching a film or browsing the internet. Game developers can now take advantage of more storage and improve the quality of their graphics and content.

Cloud storage usage allows files to be accessible from anywhere as long you have access to the account which it was saved to. This gives gamers the option to store game-related data.

**Output – Sound and Graphics**

Sound is an important component when playing video games. Sound effects also unconsciously influence the player. If they complete a level and a positive outro plays, they might have a sense of accomplishment. The opposite effect could occur if the player maybe dies and is unable to complete the level, and a game over effect plays. This could give the player a sense of defeat.

Another type of output which the player could experience is haptic feedback. This type of output is a physical sensation experienced by the player via a controller. An example of feedback is the rumble feature on a controller.

**Inputs - Controllers**

There are multiple ways in which players can interact in games. Whether it be by a controller, mouse and keyboard or touchscreen. The best controller comes down to personal preference and the type of game you are playing. As most modern games are now played on PC and console, the most used game controller is the joypad. Due to its easy usage, gamepads have been developed so it can be used as a replacement to keyboard and mouse.

Depending on the genre of the game there are other types of game controllers which are used. An example are motion sensor controllers. The first motion sensor controller was the Sega Activator which was released in 1993. It fired light beams from each of the 8 segments and for an input to be detected you had to ‘break’ the light beams by punching or kicking. However due to how easy it was for the light beam to break by other objects interfering, it was a commercial failure for Sega and was retired a couple of months after launch. Until Microsoft released Kinect in 2010 there have been no successful motion controllers compatible with consoles.

**Operating Systems**

Operating Systems are the system software which manages computer hardware and resources. It acts as the intermediary between the hardware and the programs which means actions can be controlled by an external source (That being the user).

There are 3 mainstream operating systems in the market. Windows, OSX and Linux. Microsoft holds 82.74% of the market share, Apple holds 13.27% and Linux has 1.57%. Since Windows is the most popular desktop OS, most games and software will be available on this platform.

**Programming Languages**

Most games released on consoles are developed using C++ which has been the dominant game-programming language for over 30 years.

Other languages like C#, Java, Python and JavaScript are also popular amongst independent developers and hobbyists. These languages generally don’t have the raw performance of C++, as the generally run within a sandbox virtual machine.

Scripting languages are often employed for the larger games where, post-development configurations are required. This is useful for developers as it allows them to make improvements without having to make alterations to core code.

They rely on available assets to create the game as a result it keeps the volume of code to a minimum. These types of languages are what people would use if they want to create game without learning how to code.

Most triple A games are created using a game engine which are normally written in C++ and C. C++ object oriented, compiles to a binary executable file, is incredibly “portable” and performant. C++ written games can be built to target multiple platforms with minimal change to the core code. Therefore triple-A games can be released on both Xbox one and PS4.

**Device Drivers**

Device drivers are software which controls and operates a device which is connected to the computer. Drivers work by communicating with the device through the computer bus or communications subsystem to which the hardware connects. When a calling program invokes a routine in the driver, the driver issues commands to the device. Drivers are often hardware dependent and operating-system-specific. Meaning that they only work on specific operating systems. Peripherals require up to date device drivers to perform at their utmost potential.

**Graphic Options**

Gaming systems use application programming interfaces which manage tasks which are completed by the GPU. APIs are a set of subroutines and communication protocols which help build software. In the case of gaming systems, Microsoft has DirectX as it’s graphics API and OpenGL being the open source alternative. Graphics APIs enables programmers to work closer to the hardware by exposing low-level OS API targeted.

DirectX is a collection of APIs used by Microsoft which they use to handle multimedia, especially with game programming. Direct3D is the closed source API which is used widely in the creation of video games on Windows and Xbox. It is also used for other software for other graphical related tasks such as CAD and CAM engineering.

**Game Engines**

Game engines are software development environments which are used to create video games. Typically, Game engines contain a list of sub-engines which all are used to make the development of games efficient. Here a list of examples of sub-engines used within a game engine. Using game engines, have allowed developers to speed up the process of creating games and meant inside of building an engine then developing a game which could take years, they can use existing software.

Rendering Engine – The rendering engine is used to generate animated 3D graphics by any method.

Physics Engines – The physics engine is responsible for emulating the laws of physics realistically within the game. It provides a set of functions which simulate physical systems.

Audio Engines - The audio engine is the component which consists of algorithms related to the loading, modifying and output of sound through the client's speaker system

Artificial Intelligence – AI in games are normally outsourced to a special section of the development team who are software engineers with specialist knowledge.

Here are some examples of well-known engines which are used to create games. Some of them are open-source (available to the public) and others maybe closed source (only available to the game developers and company who created the game).

CryEngine – Open Source

Unity – Open Source

Unreal Engine 4 – Open Source

Dark Engine – Closed Source

Force light Engine – Closed Source

Hero Engine – Closed Source

**Summary**

With all this information, I conclude that the game development industry is constantly evolving. Manufacturers must make sure that the equipment they produce is efficient and powerful enough to allow gamers to enjoy their games to the utmost settings. New technologies have allowed gamers to enhance their experience and with the extreme rate at which technology advancements are made. The gaming industry will continue to grow and have a lasting impact on our life’s.