The Effects of Future Computer Hardware on Business
Introduction:

The world has always been in a constant mode of change. When primitive man was cold, they made fire to keep warm. When they needed to move heavy objects a long distance, they made the wheel. The evolution of new ideas was slow and the time between the ideas was great, but the stages of evolution were in motion. In today’s world, the pace of evolution far surpasses the pace of early man. Technology is the driving factor for today’s evolution. As the knowledge of technology increases, the faster and easier life seems to become. About sixty years ago, the first computer was invented. The ENIAC, short for Electronic Numerical Integrator and Computer, weighed in at roughly 30 short tons (27 t) and was 8 feet (2.4 m) by 3 feet (0.9 m) by 100 feet (30 m), took up 1800 square feet (167 m²), and consumed 150 kW of power. Today’s handheld computers have move functionality than the ENIAC had in the 1940s. Vaughan Pratt, a professor of computer science at Stanford University, has created the world's smallest web server. The device is the same size as a match box and can fit into a shirt pocket. In comparison of time from the invention of fire and the first computer, it seems that almost overnight technology has changed. The world has been surrounded by a net of technology that connects everyone on the planet. It has changed from vast unknown lands and people, to an interconnected web of shared information. Time also has seemed to change with the advancement of technology. Information that used to takes days, weeks, or even months to receive, now only takes fractions of a second. This change has made the world a global economy. A “mom and pop” shop in a small town can now do business around the world with little effort. The effects of technology have changed the way we do business, now and in the future.
Objectives:

The first objective of this paper is to look at the future trends in computer hardware that are emerging in the world today. Computer hardware is getting smaller and faster which makes computers more portable. The reliability of computer systems is getting better which makes computers more efficient. The future of technology holds what seem to be endless possibilities for new computer hardware. This paper will discuss some of the future trends of the central processing units, the computer’s memory, the computer’s motherboards, and the computer’s graphics cards.

The second objective of this project is to recommend future trends in computer hardware that businesses need to be aware about. Businesses have flourished from new computer hardware because it has increased the capabilities for them to do an effective job. In the same aspect, businesses that have not adapted to the new wave of computer hardware have fallen to their competitors. Businesses today need to keep up with the new and ever-changing world.

Scope of Project:

The scope of the project will be limited because of the unlimited possibilities for future growth. Companies spend millions of dollars to come up with prototypes and concepts. Listing all or even most of them would be beyond the limits of the paper. The research section will only cover some of the future trends for computer hardware. The hardware that will be covered is the central processing unit, memory, motherboards, and the graphics card. The recommendations section will also be limited. This is because of the vast number of businesses in the world. Recommendations should be industry
specific. This paper will give general recommendations that businesses can use to help with the fast paced changes in the computer hardware world.

**Methodology**

There were several methods used for this paper to obtain knowledge. The first method to obtain knowledge was to use personal information. This information was gained through experience and learning. The second method to obtain knowledge was the use of library and books. The last method was the use of the Internet. This was the most used source of knowledge for this paper. The world is changing every second of the day and the Internet gave the most up-to-date information that was available. The knowledge that was collected was put together in the rough thesis style format. The topic of the paper was narrowed down because of myriad information on the subject. The scope was revised to follow the topic.

**Research:**

We begin our examination into the evolving world of computer hardware technology by looking at the very heart of the desktop computer – the central processing unit or CPU. One trend that has been prevalent for many years is that the computer’s temporary working storage, which we call dynamic random access memory (DRAM), runs at a much slower speed than the CPU. Every time that the CPU has to wait for this slower RAM to feed it data, precious processing time is wasted. You can imagine, then, the importance of having a high speed buffer or cache to keep the CPU from stalling. Today’s state-of-the-art CPU is the Intel Core2Duo. It integrates 32 kilobytes of level 1
cache onto the CPU itself, plus a level 2 cache of 2-4 megabytes of high-speed static RAM. As CPU speeds continue to climb in the future, there will be more need for larger and faster caches to keep up with them.

One solution is to simply add more cache. As the chips are fabricated with finer and finer integrated circuits, the CPU can be made smaller, leaving more room for either expanding the CPU or adding to the on-chip cache. Intel’s next desktop chip, currently known only by its codename Penryn, will have 12 megabytes of level 2 cache.ii

Today’s CPU cache is made of high-speed static RAM (SRAM) with an access time as fast as 10 nanoseconds. One limitation of SRAM is that it requires up to 6 transistors to store a single bit of information. In contrast, DRAM only requires 1 transistor plus 1 capacitor, so it takes up much less space. We could squeeze a lot more cache onto the CPU die if only we had DRAM fast enough to keep up with the CPU. Early this year, IBM announced that they had created a super fast DRAM with an access time of only 1.5 nanoseconds. This new memory takes up about one-third of the space that the SRAM requires, and consumes about one-fifth the amount of energy. IBM estimates we will be able to quadruple the amount of level 1 cache on CPUs. Because level 1 cache is onboard the CPU, it is much faster than level 2 (or level 3) cache. Level 2 caches may lose their importance. Large level 1 caches will become more important as we see more multi-threaded and multi-core (combining multiple independent processors in a single package) CPUs. They will have to keep track of many different threads (multiple pieces of the software program simultaneously). Larger caches also help with cache coherence.iii Cache coherence means that if a data value gets changed in one
cache, any other copies of that data that may be residing in other caches need to be updated to reflect the new value.

Another tactic that Intel is looking into is called die stacking. Currently, CPUs are designed on a flat, 2-dimensional surface. With die stacking, the CPU is composed of several 2d layers, stacked vertically above each other. Intel feels that 8 layers is a very real possibility, and that 256 megabytes of memory could be stacked on top of a CPU. Because the memory is on-chip, it can be accessed very quickly. Another bonus is the increased number of connections between the CPU and memory. Instead of the hundreds of pins we have today, with die stacking, there will be 1-10 million interconnections. This will greatly increase the available memory bandwidth. If future CPUs were to have many more processors, say dozens, or even hundreds, we would not have enough pins to provide a wide enough memory bus to feed all of those microprocessors. Die stacking may provide an answer to this limitation.

Speaking of many cores, this leads us to our next CPU technology trend. For years, it was enough to simply crank up the speeds at which CPU operated. This speed, called the clock speed, is measured in gigahertz, which is billions of cycles per second. Unfortunately, increasing constraints on heat and power make this future course impossible with today’s technology. Intel recently showed a prototype CPU that contained 80 floating-point cores. One problem with this kind of design is how to have very high speed connections between the many cores. Intel has been talking about using photonics to replace the wire interconnects that we have today. Its recent development of a silicon laser could help to make this a reality.
Another twist on multi-core technology is having different types of microprocessors combined in a single package. This increases efficiency and reduces power consumption. One of the big news stories of 2006 was when CPU-maker Advanced Micro Devices (AMD) purchased ATI Technologies, the world’s second largest graphics processor manufacturer. AMD forecasts that by 2010 the multi-core expansion will end, and they plan to focus on what they call their Fusion technology for creating Accelerated Processing Units (APUs). Fusion combines the CPU and the GRU (graphics processor unit) onto a single chip. AMD sees these APUs as modular building blocks for creating customized computing solutions that are tailored to match the specific computational needs of the user.\textsuperscript{viii}

Other exciting developments in CPU technology include processors with deeper power down modes. This will extend battery life for portable computers. We will also see cores that will be able to power down individually when they are not needed, which will allow other dynamically clocked cores that are being used to run more quickly. Additional instructions designed to accelerate high-resolution video decoding with turn our personal computer systems into high-definition television receivers.\textsuperscript{ix}

The CPU attaches to another piece of hardware which is important in our examination of computer technology trends. The motherboard, sometimes called the mainboard, is a large printed circuit board that also provides electrical connections for the memory chips, the chipset, the expansion slots, and the power supply.\textsuperscript{x} The trend has been for more and more peripherals to be integrated onto the motherboard. Many of these features were previously added via the expansion slots, but are now included in the
chipset, or on other integrated chips. Today’s modern motherboard may include features such as:

- a serial advanced technology attachment (SATA) controller capable of 3.0 Gbit/s transfers
- an integrated Gigabit Ethernet controller
- 5.1 (or more) channels of digital sound
- IEEE 1394a ports (FireWire) capable of 400 Mbit/s transfers
- USB 2.0 ports capable of 480 Mbit/s transfers
- PCI Express (PCIe) connectors with each lane (up to 16) capable of 2.5 Gbit/s in each direction

So what can we expect in the future? The PCIe 2.0 specification was completed in January of 2007, and it promises to double the transfer speed per lane to 5.0 Gbit/s in each direction, with up to 32 lanes. Future versions are also expected to up the amount of power provided to support high-end graphics cards which require 240-300 watts of power. Intel is also working on a project called Geneseo which will allow graphics card to be even more tightly connected to CPUs.

Other interfaces are expected to see a boost in the future as well. A SATA controller capable of 6.0 Gbit/s transfers is in the works from the Serial ATA International Organization. Although today’s hard drives cannot sustain data transfers exceeding the current controllers, future solid-state drives may. External SATA ports, known as eSATA are starting to appear on motherboards. Faster IEEE 1394b ports capable of 800 Mbit/s transfers are already in existence. Although they are currently
uncommon, they may be commonplace in the future. Older serial and parallel interfaces are disappearing quickly and perhaps PS/2 and AT keyboard ports will do the same.

One motherboard feature that has been around a long time is the Basic Input-Output System from the original IBM PC computer. Although the BIOS has been greatly expanded to handle today’s more complex PCs, in many ways it has not fundamentally changed. It still contains 16-bit code, and today’s chips must emulate the old Intel 8086/8088 processors while accessing it, which restricts memory access to 1 MB. The BIOS is also limited in its ability to handle a large number of hard drive partitions. The Unified Extensible Firmware Interface (UEFI) is expected to replace many of the BIOS functions, although the BIOS will still be responsible for the Power-On Self-Test (POST). The UEFI is more modular, allows for faster booting, and is no longer tied to the old Intel microprocessor architecture.

Future motherboards will also support faster front side buses. Intel may have a chipset supporting a 1333MHz processor system bus before the end of 2007. The new integrated graphics chip will fully support the latest Microsoft multimedia application programmer interface (API) known as DirectX 10, and it will accelerate the decoding of high-definition video. This chipset also supports new features like high-definition multimedia interface (HDMI) output, performance auto-tuning, flash memory cache (Robson), trusted execution technology (TXT), and DDR3 system memory.

DDR3 is the next evolution in memory technology that may replace the double data rate (DDR) synchronous DRAM in use now. DDR3 is in production today. A DDR3 module requires 30% less power than DDR2 but provides more bandwidth.
Thanks to improved signaling, pin outs, and packaging, DDR3 will operate stably at higher frequencies than are now possible.\textsuperscript{xvi}

Other, much more revolutionary technologies hold promise for future memory. Although flash memory is gaining some attention as a cache to reduce computer boot (startup) times, its slow write speeds and limited lifespan make it unsuitable for a computer’s main memory. A main benefit of flash memory is that it is non-volatile, meaning that it retains its contents without power. One interesting alternative to flash memory is called magnetoresistive random access memory (MRAM). MRAM is composed of transistors but uses magnetic charges, instead of electrical charges, to store information. It is non-volatile, but it has much faster write speeds compared with flash memory. It also does not suffer from flash’s degradation with use, so it does not share flash’s limited life.\textsuperscript{xvii} Currently, the fastest MRAM chip is a 16 Mbit chip developed by NEC and Toshiba that achieves a transfer rate of 200 Mbs with a 34 ns cycle time. MRAM densities are approaching those of DRAM, and the MRAM’s speed is superior, though it does not currently approach the speed of static RAM (SRAM). MRAM technology is currently very expensive.\textsuperscript{xviii}

Phase-change RAM (PRAM) is another technology that Intel is investigating with performance characteristics similar to that of MRAM. It is fast and non-volatile. It works using chalcogenide glass. The state of the glass can be altered by the heat from an electric current, changing it from crystalline to amorphous.\textsuperscript{xix}

Yet another non-volatile memory technology entering the fray is called nanotechnology RAM or NRAM. With the NRAM, tiny carbon nanotubes are used to
Although it seems there might be some blending of the lines in the future differentiating between technologies used for primary and secondary storage, let us shift our examination to the latter. Although the perpendicular recording technology used today is allowing hard drive manufacturers to increase drive density by about 50% annually, we will need new technologies in a few years to sustain such growth. This sustained increase in recording density will be necessary to stave off flash memory, which is already threatening to replace notebook hard drives. The largest hard drive maker, Seagate Technologies, is looking into heat-assisted magnetic recording. Microscopic cells on the platter are heated during the recording process. Number 2 hard drive maker, Hitachi, wants to go with a technology called patterned media. Instead of having the data cells next to each other in a continuous film, they would be isolated from each other like dots. A combination of these 2 technologies could yield drive densities 280-560 times what we have today.

Another hard drive trend is the increasing sales of external hard drives. With terabyte class hard drives on the market, many users are turning to external hard drives instead of tape drives to archive their data. With ever larger collections of photos, music, and videos, users are finding current FireWire and USB 2.0 external hard drives to be too slow. As more motherboards support the substantially faster eSATA interface, we should see an increasing number of external eSATA hard drives. Western Digital says they will probably have such a drive before the end of 2007.
Samsung is using flash memory for its 32 gigabyte solid state disc (SSD). It has read speeds of 57 MB/s and write speeds of 32 MB/s. Although this is not equal to today’s fastest hard drives, the real win is its latency of <1ms, which is 10-15 times faster than a hard disk drive. The SSD also requires 95% less power, is lighter, more impervious to shock, and is silent. Flash memory prices are declining at about 50% annually. According to Samsung’s Director of Flash Marketing, the drive’s lifetime exceeds 10 years.xxiv

Another popular type of storage is the optical drive. Digital video discs (DVDs) are replacing compact discs (CDs) as the medium for software distribution. We may see Blu-Ray or HD-DVD eventually replacing the DVD. These new drives offer a storage capacity of 25-50 GB and 15-30 GB respectively.xxx Maybe we will see drives that combine the 2 technologies become the next standard? There are other alternatives, however, which might not be as well-known. A company called InPhase Technologies has created an optical drive that used holographic technology to squeeze 300 GB of information onto an optical disc.xxvi

One radical idea I found proposed is that we do not need another optical disc format. Media will simply be distributed via the Internet and stored on a huge hard drive. Why search through a library of discs, when you can have all of the data stored in 1 central location?xxvii

Graphics cards are another technology area that is advancing at an astonishing rate. Most video cards today have a fixed number of pixel shaders and vertex shaders, but the newest trend is to have unified shaders which perform both functions, and the number just keeps going up. Having unified shaders is a requirement of Microsoft’s
DirectX 10. The upcoming R600 series of graphics chips from AMD/ATI is purported to have 320 unified shaders, which they call stream processors, and a huge 512-bit memory memory interface. It reportedly will contain about 700 million transistors. Graphics processing units (GPUs) have become so powerful, companies like AMD/ATI are looking to harness their power for other computational purposes. For more information, check out AMD’s stream computing page:

http://ati.amd.com/technology/streamcomputing/index.html. The R600 will also include hardware acceleration for H.264 and VC-1 decoding, which are video compression formats often used for high-definition video. The more work the GPU can do, the more the CPU is free to perform its tasks, so this would decrease the CPU utilization while watching a high-definition video. Speaking of video, High-Bandwidth Digital Content Protection (HDCP) is another feature that will be prevalent in future video cards. Without HDCP present, the playing of copy-protected material could result in the video outputting a blank screen.

Looking farther into the future, some see the huge single GPUs being replaced by multiple, smaller GPUs. This is similar to what is happening already in the CPU market. This could lead to more modular, scalable, and cheaper designs. High-end graphics cards would contain more of these modular GPUs, tightly connected, and cheaper solutions would contain fewer or only 1, of these GPUs.
Recommendations:

Most company today is running their business over the Web service technology and invests a lot in the new technology. Information system tend to change very often, therefore organizations should be inform to those changes. Not every change is good for the business, thus organizations need to:

- Plan the use of IT to accomplish organizational goals and strategy
- Managing the computing infrastructure
- Managing the enterprise application
- Protect information asset
- Manage outsourcing relationships

1. Plan the use of IT

Organization creates goals and strategies to maximize their profits; and, the information system should be in conformity with the company path to accomplish what they established. The align information system with the organizational strategy usually create problem between the IT department and the CIO because of the cost involved in those changes. They look at that as a drag on the company opportunity.

When an IT department considers a change in the organizational information system, they should have a good communication of the information system issues to the executive group. They should be able to determine the cost and time to the top manager in case of failure.

Prioritizing is the main key to implement new change in the company because no organization can afford changes without consideration of what comes first and last. Information System is very seductive among IT professionals. Before even take action on
the new technology, the CIO should meet with all top managers to examine the project
and decide whether or not to take action.

2. Managing the computing infrastructure

As soon the project of adapting new technology is accepted by the company, the
IT department should align the infrastructure design with the organizational structure.
Before decentralize the adopted project, the infrastructure should be centralized first until
the company develop a high controlled of the situation.

The use of the innovative technology will create new tasks within the company.
The IT department has to be able to maintain the infrastructure for end-user computing;
moreover, they should be able to create, operate, and maintain networks, data centers,
data warehouses, and data marts.

The IT department has to make sure that the product or technology which they are
going for to be standard on every level of the company. They will not only be able to
track problems, but also to monitor resolutions. In addition, it will be easy for them to
manage the computing infrastructure staff.

3. Managing the enterprise application

The development of new application by the IS department begins by the
alignment of priorities within the organization. However each organization has its own
strategy, priorities, and direction; thus, the IS department needs to document each steps of
the process that they are doing.

It is the responsibility of the IS department to maintain the new the new system
with consideration of the old system. Because the change will affect the entire enterprise,
the IS department must have the means to truck the end users issues and problems, prioritize them, and their resolutions.

Besides the integration of new application, the IS department needs to manage the development of staff. Check how comfortable the staff is on the use of new technology after the data had been administered to each department.

4. Outsourcing

Many companies hire other local or international organizations to perfume a service. Outsourcing information system has some advantages and disadvantages. Some of the advantages that the Using of MIS describes are:

- The management advantages (obtain expertise, avoid management problem, and free management time).
- The cost reduction (obtain part-time service and gain economies of scale)
- The risk of reduction (cap financial exposures, improves quality, and reduce implementation risk).

Some of the disadvantages also from the Using of MIS are:

- Loss of control (vendors in diver seat, vendor management, direction, or identity changes, CIO superfluous)
- Benefits of outweighed by long term costs (High unit cost, paying for someone else mismanagement, and may not get what you pay for but don’t know it)
- No easy exit (More knowledge in the vendor than the employee and expensive to change vendor).
There are many ways to incorporate new hardware in a business. It is up to the individual business to decide what actions to take when obtaining new hardware. The direction, size, and need of a business will directly impact the decision. Hardware technology is increasing on an increasing upward slope. A company needs to decide how to acquire new hardware. If a company buys all new hardware that becomes available, it will be very expensive. There will be an initial outlay of money and because it is new, there is a chance of paying more fees in upgrades that the hardware might need. There are also fees to obtain licenses for the hardware. Companies should consider buying hardware in a pattern as it comes out. A company could buy every other “new” hardware or every third. These types of patterns will be determined on the companies need for new hardware and financial ability to purchase it. These patterns should be written in the company’s prospective business plans for the future.

**Conclusion:**

In 1965 semiconductor pioneer Gordon Moore predicted that the number of transistors contained on a computer chip would double every year. This is now known as Moore’s Law, and it has proven to be somewhat accurate. The number of transistors and the computational speed of microprocessors currently double approximately every 18 months. Components continue to shrink in size and are becoming faster, cheaper, and more versatile.
With their increasing power and versatility, computers simplify day-to-day life.

Unfortunately, as computer use becomes more widespread, so do the opportunities for misuse.

Computers will become more advanced and they will also become easier to use. Improved speech recognition will make the operation of a computer easier. Virtual reality, the technology of interacting with a computer using all of the human senses, will also contribute to better human and computer interfaces.

Communications between computer users and networks will benefit from new technologies such as broadband communication systems that can carry significantly more data faster or more conveniently to and from the vast interconnected databases that continue to grow in number and type.

As the changes take place, the end users have the right to the computer equipment and computer environment in order to better accomplish their job; they also have the responsibility to protect the entire community of the information system users by making sure that they are acting professionally.
Bibliography:


