Technology and Society

Interaction of Technology and Humans

Society drives the improvement and creation of new technologies and these technologies serve society as well as change it. The needs and desires of people determine which technologies are going to be developed or evolve or morph into other technologies. The cellphone is an example of the metamorphosis that takes place without planning. What started out as literally a wireless telephone has evolved in a miniature computer with hundreds of applications. Initially a luxury, it has turned into a necessity that society cannot do without. This metamorphosis was not planned, but was driven by improvement in technology, specifically moving from analog to digital, and in return, this new technology changed the very society it was serving.

The term *Human-computer Interaction (HCI)* was made famous at Carnegie Mellon University by Stuart K. Card and Allan Newell. Traditionally researchers studied the principle of the 'five E's' of usability that a proper design consisted of; effective, efficient, engaging, error tolerant and easy to learn. This term was first used in 1975 and became much more popular after the book; *The Psychology of Human-computer Interaction* came out in 1983. But much about computing has changed since then. Unlike the simple tools of the past that only have one function, i.e. a hammer, nail or a saw, computers have many uses and is only limited by the imagination. A different paradigm was set in order to fully understand the evolving nature of computer-Human interaction.

Research is becoming more interested in in the user experience. Ideas such as understanding and designing relationships between users that would make their experience affective, fun, engaging sociable, playable creative innovative, meaningful exciting and ambitious have taken center stage for research. Other issues have arisen from this shift in perspective. Ethical, moral, social issues cultural and political issues were not important to researchers in the past. But with the new type of computing, which moved out of the hands of college professors in University labs, into the hands of most Americans while crossing social, age, and cultural gags, a new way to study HCI had to be developed.

From the beginning HCI studied ease of use as the main decisive factor for a user to accept a certain application. With the ever-growing ubiquity of computer applications, a broader scope was needed beyond what HCI initially conceived. All aspects such as social and cultural context had to be considered. Ease of use has and always will be a huge factor in Human-computer interaction. However, behavior, lifestyle compatibility, societal norms and overall usefulness are now investigated when evaluating new computer software and hardware.

Investigation of these issues is important when a digital product replaces an analog product, such as a newspaper of magazine. The newspaper was an integral and central part of American culture and a foundation for a large economic system. Digital technology replaced much of the major paper based newspapers across the country. The ease of use had to be greatly considered, not only for the computer literate, but for all of the people who were not computer literate and for whom reading the paper based newspapers. Even with ease of use, many found the

transition from analog to digital very difficult. So the evaluation process had to go beyond what was traditionally set.

Use is related to design. The only way to know if a design is successful is to observe it in use. This observation and evaluation extends well beyond social use and goes into the territory of social importance. Evaluation takes place at many levels, such as individuals, organizations and cultural. HCI is an interdisciplinary field. Design has involved not only the people who design software and hardware but also the social sciences such as anthropology and sociology. This in no way discounts computer science specialties, but in order for design of systems to be most effective, it requires literacy in several fields and multidisciplinary partnership.

What drives technology? Answer: The needs and desires of people is what have driven technology. This point is easy to see when you think about inventions such as:

1. The Printing Press
2. Electricity
3. Semiconductors
4. Optical Lenses
5. The Airplane

This list is just a small sample of innovation born from peoples needs and desires and a reference point to which we'll move away from and into the modern use and function of the design of these inventions.

The Printing Press – 1430s: We take printing for granted these days, whether it's in digital form or printed. You may not think much of it now but it's

invention changed the way humankind evolved. Before its invention, everything had to be written by hand. Scribes that worked in monasteries in a room called a scriptorium did this work. They worked silently while measuring and outlining layouts and copied one test from one book to another. With this painstaking labor it took to produce a book, very few people had access to them. It was mainly reserved for rich people or those who worked in educational institutions. Many of the early books were religious in nature. In the 1430s, Johann Gutenberg realized from working at a mint, that instead of using cutting blocks as they did in the mint, he could take that same idea and use it to produce text. Instead of wood he used metal. This was know a moveable type machine and the very first book he printed was the bible, now called the Gutenberg Bible and one of the most treasured items in the world.

The impact of the printing press was enormous. It helped spread information quickly and accurately. Initially in Europe it created a much larger and literate population. It spread information and opinions and as a result there were a couple of unintended consequences.

More and more secular books were printed. This had a huge effect on science. Scientist was now able to share information more rapidly and this greatly enhanced innovation and technology. In a few short years this would lead to the Scientific Revolution and the Enlightenment and alter how we saw our universe and world forever.

The other consequence was it took printing out of the hands of the church's control. The church was no longer able to control production or censor what was

written. Thousand of books were being produced at a fraction of the cost and in a small amount of time. This eventually led to the breakup of religious unity in Europe, which corresponded, directly with the spread of printing. The invention of the printing press is the most important invention between the time when man first wrote and the invention of the computer.

Electricity – late 19th Century: We have heard about Benjamin Franklyn and his experiment and he was the first to use the terms positive and negative charge. Most people credit Thomas Edison for inventing the light bulb. And if you read history books from my childhood in the 60s this would be the general impression you would come up with. He may not have invented the light bulb out of thin air, but he was instrumental in helping to user in the age of light. In 1879, he and his cadre of assistants produced a reliable, long lasting electric light bulb. Within ten years electrical stations based on Edison's designs were in many American cities. By 1939 most cities and 25% of rural homes had electricity. Today, nearly everyone has electricity. Just as many inventions, it is no longer a luxury and even people living on the lowest of social-economic conditions has electricity (and a cell phone). The standard of living of everyone has gone up because of this invention.

Semiconductors – mid-20th century: Is someone asked you what was the physical foundation of the digital universe, what would you say? If you shouted semiconductors you would have been correct. A semiconductor is a good medium for controlling electrical current due to its ability to conduct electrical currents under some conditions and not others. All computers require semiconductors. The

technology for modern laptops, cameras, and cell phones all benefitted greatly from the use of semiconductors. Silicon is the main ingredient of semiconductors. The silicon based semiconductors enabled manufactures to make devices much smaller and helped to ramp-up the digital revolution.

Optical Lenses – 13 Century: For some strange reason, it took a long time for society to figure out the benefits of refracting light through glass. Lucius Annaeus Seneca talked about the optical effects of a glass bowl of water and Roman culture had a thriving glass industry. But it took centuries before the invention of eyeglasses that led to other inventions such as the telescope and microscope. The use of eyeglasses spread throughout Italy in the late thirteenth century. Only a few decades before eyeglasses was a must have they didn't exist. Just as many other inventions, what started as a luxury, quickly became a necessity. As the demand for eyeglasses increased, the industry that manufactured the glasses began to grow and new ways to produce glasses more cheaply and efficiently developed. They found that extreme magnification was able to open the human eye to worlds that was only imagined before.

Microscopes revealed the existence of microbes and cells. With telescopes that magnified 30X, scientist such as Galileo mapped the night sky. Details of the moon and the stars replaced false assumptions and beliefs scientific fact began to take hold of the human conciseness. The Earth no longer stood still while everything in space whirled around it. The invention of the optic lens transformed everything we knew about the world of science and religion.

The Airplane – Early 20ᵗʰ Century: Being able to fly was always the desire of humankind from the time we first observed birds in the sky. And for just as long, we have been trying to figure out ways to defy gravity. The Wright Brothers had the first successful flight (four as a matter of fact) on December 7, 1903. On January 1, 1914, one commercial passenger flew on one commercial flight between St. Petersburg and Tampa. The plane was piloted by Tony Jannus and his one paying passenger. On that same day 100 years later, 8 million people flew on nearly 100,000 flights.

By increasing travel speed the world has become more global and connected. Before the airplane, even people with monetary means did not travel due to the mere time it took to go and return to far off places. Additionally, there was no infrastructure to support travel in some areas.

Now people live in a world where even the farthest regions are technically only a few hours away. Culture has spread due to this technology and international business and trade has benefited greatly. The airplane has made it possible for businesses to operate on an international basis at a level that was unthinkable before the airplane. This has allowed the growth of international politics as well, as given people the opportunity to learn about other lands and cultures that were previously only available in books.

However just as with all inventions, it comes with certain unplanned consequences. It helped to change the course of modern warfare. Just as it was easier to travel, it was also easier to attack other countries and culture. In just a few

short years after the plane was invented, World War I became a major stage to show the world the technological impact of the new invention.

Technology and Society – Coevolution

Kevin Kelly, a tech enthusiast, once gave a tech speech where he stated, "*Technologies don't die.*" I thought about this in two different ways. First I took it to be quite literal, because in my life, I have and still use technologies that have long been declared obsolete or old and sometimes when I take these items out to use or talk about them in the classroom, I always get smirks and grins from students and others who think that I'm painfully out-of-step with modern living.

I own a digital camera. As a matter of fact, I purchased one of the first digital cameras in the mid 90s and I'm very embarrassed to let you know how much it cost me. But I've been using digital cameras ever since. But I also own film cameras. As a mater of fact I've purchased six film cameras within the last two years and I still use them all the time. Why would I use a film camera and pay the cost of film, and developing not to mention the features I'm missing that are on a digital camera? I believe the answer to this is much more complex then I'm willing to divulge here but I'll tell you that there's something about the aesthetics of film that I really love. I love the older all-manual cameras because it makes me feel I really have a skill set instead of putting my digital camera on automatic and letting it go without making a single adjustment. Mentally there's something very soothing to me thinking about that.

A person can be easily dismiss this and put it in the same categories of those ex-hippies and audiophiles from the 70s who think that vinyl is better than MP3. In the classroom, I play vinyl records, use a reel-to-reel and VHS tapes to demonstrate to my high school students that even though the method of delivery of these ancient technologies may differ from those of the digital age, the end results have changed little. Close your eyes and listen; can you really tell the difference between good analog and digital sound? Look at a great photo from a top photographer, can you tell the difference or see a great quality improvement between the digital and film cameras?

The second thing I thought about Kevin Kelly's remark is that it hits upon a more abstract idea; just as in living organisms, technology doesn't die, it evolves. Maybe for the sake of argument, film cameras have died, but the camera is still alive and well and still thriving in a form very different than the one used to capture the *View form the Window at Le Gras.* When you look at the great inventions, it's obvious that none of those ideas came out of thin air, but were build upon the steps of innovation from what was before it. No one person invented the camera, television or computer, but the end result came from the work of others that preceded it. Some of the advancements were little steps and some were huge leaps.

Technology has been coevolving with society from the beginning. The driving force behind this has been humans solving problems to meet their own needs. The need to move people and goods across long distances has forced society to develop a succession of inventions by solving problems to meet their needs. Walking eventually led to chariots, horse drawn carriages, steam engines, combustible

engines, electric cars and so on; each step fulfilling a need and solving problems for that time of its innovation. Along the way these problems being solved sparked innovation to support these technologies. Roads had to be built, gasoline had to be refined, gas stations had to be built along the route, mechanics had to be trained to repair the new technology, factories had to be built to manufacture the products, people had to migrate from the farm to the cities in order to run the factories. If we factor in rail and air transportation, its easy to see how these innovations helped to shape our world. We grow side-by-side with our technology in what could easily be called a symbiotic relationship.

Another example of this can be made with the innovation of textile machinery in England in the 1860s. Before the innovation of textile machinery, wool and cotton were spun in homes. Machinery replaced the need for doing it in homes and helped to start the factory system. In this system the machinery was just a component. This system also ushered in a chain of needs, just as the transportation industry. Factories needed people; people needed housing and of course this created further needs (or problems to be solved). Solutions create further needs. This took close to 100 years before it came close to completing.

The interplay between culture and technology is dynamic. In speaking about the life cycle of technology, Ray Kurzweil, in his book, *The Singularity Is Near*, identified seven stages in the life cycle of technology:

1. Dreaming – when we first contemplate something new
2. Inventing – when we actually try to bring that dream into the analog world and try to bring it to life.

3. Development – Trying out the invention and making several modifications. This may take a long while such as the innovation of the light bulb and sound recording.

4. Maturity – The technology continues to evolve and takes a life of its own as it becomes part of the fabric of our society. It may seem to be immortal at this time and no one can even imagining going away.

5. The upstart – A new technology threatens to replace the old one. Sometimes the stage is a false alarm and the old technology prevails for a little while longer.

6. Declining – Even though the old technology was able to hang on for a little while, its gradual decline is imminent. There may even be a time when the two technologies co-exist for a time before the tipping point finally fall on the side of a new technology. Vinyl albums and CDs co-existed in record stores for a short amount of time but the demise of the vinyl record was immanent and everyone new it because each year, less and less space was devoted to vinyl albums until they all disappeared completely.

7. Gone (but not forgotten) – This stage puts vinyl albums in the antique store, alongside VCR tapes, cassette tapes, rotary telephones, typewriters, CRT televisions. Ironically with the advent of streaming music, CD players are also in the antique store. It's safe to say the CDs are in stage 6

Alternative solutions and tradeoffs as well as unintended consequences are part of the history of technology. Humans insatiable quest for light led to the almost extinction of one of the most majestic species of animals known to humankind. Humans would arduously make tallow candles, which were made from beef or mutton. The candles provided them with light during those very dark days before the electric light bulb was perfected. I say perfected because it took many years for the invention to become practical.

Legend has it that in 1712 a sperm whale washed ashore in Nantucket and when the locals dissected it, they found a white oily substance in its skull and named it spermaceti because of its resemblance to seminal fluid. They found that the substance burned brighter without the smoke and offensive smells that tallow candles provided. The candles made of spermaceti were highly sought after and when the while oil started to be used for lamps, providing bright light deep into the night, that fate of the whale was almost set. An explosion of demand was created for the artificial light the sperm whales provided. Approximately three hundred thousand sperm whales were killed during the first century of hunting. If innovation didn't intervene, it's safe to assume that sperm whales would have been something we only read about or saw in special effects laden movies.

The light that sperm whales provided gave growth to the whaling industry. Fleets of ships had to be built and manned. New Bedford was the central point for this industry and it became know as the "City that lit the world."