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What is the relationship between technology and social values?

During class discussions we covered a number of cross-cutting themes, but never directly addressed the relationship between technology and social values. However, after working on case studies and seeing the presentations of other students it became clear to me that values held by the society can have a large influence on the development and adoption of technologies. Every technology has to pass the test of societal standards and ideals. We judge them based on some internal and societal metrics to determine whether or not they are acceptable.

In the most simple form a technology will only be adopted by the public if it fits with the value structure of that public and will fail otherwise. However, this is made more complex by the fact that social values and metrics used for judging whether a technology is acceptable and desirable are not steady but rather change over time. A change in values can be external to the development and adoption of a technology or it can be caused by it. For example, uses of technology sometimes emerge only after it has been adopted by the public. As new uses emerge and are incorporated into the societal structure, the original values that the technology supported can also change. This poses uncertainties for developers of technology because if the standards change a technology that was previously desirable may no longer be so.

This paper will explore the different relationships between technology and societal values using three cases from class: the mini computer, the Supersonic Transport, and

Unmanned Aerial Vehicles. In the case of the Supersonic Transport, an external change in values occurred during the development phase of the aircraft making the technology less desirable and eventually leading to its demise. In contrast, the successful adoption of the mini computer created a computing culture that eventually evolved to value properties that were better offered by the personal computer. In the first case the technology was significantly affected by societal values, and in the second the technology first had an effect on societal values and then was affected by them. The Unmanned Aerial Vehicle case is one where the technology is emerging and how the relationship between values and the technology will play out is still unknown. However, it is possible to examine the current values of the system and how these new vehicles fit or do not fit within that existing structure.

While societal values can have a large effect on the development of a technology and a technology can also greatly shape our value structure this relationship is not often examined when new technologies are being designed or adopted. Understanding this relationship better may provide more understanding of what societal consequences can be expected as a result of emerging technologies.

Mini Computer

"Mini computer" is a term used for computers that were used during the middle ages of computing, between large mainframe computers and more modern personal computers. These computers were "mini" because they only occupied a few cubic feet as opposed to the room or more taken up by the mainframe computer. Mini computers had a central memory with terminals for individual users. The need for the mini computer arose as government projects continued to increase in capacity requiring more computation power, and as the booming economy led to new business needs.

The first commercial mini computer was the PDP-1, introduced in 1959, and was followed in rapid succession by a number of smaller and cheaper models. The decreasing prices of the mini computer led to more adoption by companies. As mini computers become more pervasive, the need for fast efficient computing became part of our societal structure. The types of problems that could be tackled changed as did the means of addressing them.

However, the companies designing mini computers strived to design machines that would foster a sense of ownership and responsibility among users. They were successful at creating a culture of innovation and participation among users. Thus, over time users wanted control and freedom over their machines. As a result, commercial pressures and technological advancements led to the development of the personal computer which replaced the centralized data storage and processing of the mini computer with distributed computing power and storage.

Many companies making mini computer did not foresee the boom of personal computers because the original setting in which they developed their technology was one with different values. As the technology grew and showed its potential the values of customers changed making a less centralized computing paradigm more desirable.

Currently we are dealing with the consequences of the personal computer and networking. Where early advances in computing were motivated by the need to have more powerful computers available to more people, most people now have access to entirely adequate computational resources: for example, in 2000, there was concern that

Iraq was purchasing video game console systems to use their computing power for military applications and in 2003, researchers at UIUC built a supercomputer out of Sony PlayStations. The scarcer resource today is the ability to access data remotely.

The increased value of networking has led to the development of more centralized solutions which can more effectively handle problems of security, controllability, and reliable data storage. Many large companies have centralized data storage and software applications, operating in a manner conceptually like the old mini-computer environment. Web applications such as email, blogs, and picture storage are also providing a central space for storage and replacing information stored on the personal computer. This represents a new shift in values where a computing paradigm, resembling the one of the mini computer, is once again becoming more desirable.

SST

Supersonic Transport or SST is a commercial aircraft capable of flying over the speed of sound. The most known SST is the Concorde, which was flown until 2003 by Air France and British Airways. The Concorde flew at mach 2.04 (or 2.04 times the speed of sounds) and was capable of crossing the Atlantic ocean in about 3 hours. While the Concorde is the most famous SST because it was in regular operations, the US also had a program to develop such aircraft.

The road to the US SST program started in the 1940s with NASA's research into flight during the transonic regime. The transonic regime occurs around mach 1 right as the sound barrier is reached. During this time the aircraft experiences greatly increased drag and reduced lift making flight difficult. Though out the 1940s and 50s many of the technical challenges surrounding supersonic flight where addressed and experimental and military aircraft were built. These aircraft demonstrated the possibility of supersonic flight and created enthusiasm and a desire for supersonic commercial aircraft.

The push for the development of commercial supersonic aircraft occurred during a time of technological optimism. In this setting, speed was considered a virtue and tied to a stronger economy. In aviation progress was defined in terms of speed and altitude where faster and higher were better. Jet aircraft were just being introduced into regular service and opening air travel to more and more people. The belief was that Supersonic aircraft would replace all other aircraft. This meant that developing such planes would place the US in a strong global position, whereas not developing them would essentially mean that the country would be shut out from the global economy. In addition, this development occurred during the cold war where maintaining technological superiority was considered of paramount importance. All these beliefs created a strong support to develop an SST even though the project would require government funding (the government does not usually fund commercial enterprises).

As a result of these pressures in 1961 a government program to fund an SST was established and $11 million was appropriated for the task. The program lasted for 10 years and cancelled in 1971. In the mean time societal values shifted dramatically. During this time the environmental movement came into existence. In the late 1960s legislation was passed curbing automobile emissions, water pollution, and air pollution in general. These initial regulations were followed by The National Environmental Policy Act in 1969, The Clean Air Act in 1970, and The Clean Water Act in 1973. In addition, the Environmental Protection Agency (EPA) was formed in 1970. During the time progress stopped being defined by the metrics of faster. Instead society began to value technology that was cleaner, more efficient, quieter, and in general more "responsible".

In this new setting the SST no longer fit. The values that it was designed to support were no longer held by the majority of the population and as a result the development program was vulnerable to attack. From the beginning of the program there were those who opposed the development of the technology mostly because they did not see it as economically viable or because they opposed to the government funding a commercial project. As the program became more mature and studies of the noise generated by sonic booms took place a coalition against the SST arose because of the noise pollution that the aircraft would generate. However, it wasn't until the Citizen's League Against the Sonic Boom joined with the environmental movement that the fight against the SST gained real strength.

A number of environmental groups joined together and in 1969 formed a new organization called Friends of the Earth. The organization dedicated itself "to a morally based environmentalism and a fight against "undisciplined technology."" The group picked the SST as its first symbolic target of environmentally irresponsible technology. The choice made sense because the technology was a large symbol of previously held societal values that the organization was trying to change, it was still in development and costing large sums of money, there was still a significant number of technical challenges surrounding development, and it was not clear that such an aircraft would be economically viable. The campaign waged by the organization was highly successful and in 1971 the House voted to cancel all funding.

Although the SST still had its supporters (Nixon, for example, called the cancellation of the program "the number one technological tragedy of our time"[6]), the values of the US society had changed enough that an SST no longer seemed desirable.

UAVs

Unmanned Aerial Vehicles or UAVs are a technology that is currently still emerging. These aircraft do not carry any humans on board and are operated either through remote control or autonomously. UAVs range in size and capability; they can be as small as 2 lbs and as large as commercial aircraft, fly at altitudes from a few feet to 60,000 feet above the surface, and stay aloft for minutes, hours, days, or even weeks. UAVs were developed for and first used by the military for high risk and surveillance missions. However, non-military and potential commercial applications are emerging. Non military government applications include border patrol, law enforcement, maritime surveillance, and scientific uses such as data collection in dangerous or hard to reach areas. Commercial uses include stratospheric telecommunications where UAVs would be used instead of cell towers or satellites, environmental or agricultural sensing where UAVs can be used to determine when grapes or coffee beans are ready to be harvested, and film capturing in difficult situations (such a technique was used in the movie *Winged Migration*).

While non military uses for UAVs are emerging, currently such operations do not fit into the structure of the US National Airspace System (NAS). To fly within the system aircraft and operators must meet a number of regulations to guarantee safety. At the moment all of these regulations are written for manned aircraft. As a result, to fly a UAV special Federal Aviation Administration (FAA) permission has to be obtained for each individual flight. This makes commercial or regular scheduled flight impossible.

In order to accommodate regular UAV flights a regulatory framework for incorporating them into the NAS has to be developed. While the FAA is working on such frameworks they are having a difficult time. This is in large extent due to the fact that in order to accommodate UAV operations a number of fundamental values about how the system works and should work need to be changed.

The current system evolved, starting in the early 1930s, to accommodate increasing volumes of manned flight operations. The structure that has developed is one where control is located on the ground and all communications are conducted person to person though radio. The reason for this evolution is that aircraft were first controlled only at airports, where ground based control made sense. In addition, the evolution is connected to the development of communication, navigation, and surveillance (CNS) technologies which all support ground control and ground to air communication.

Given that a UAV is unmanned, person to person and ground to air communication is not possible. This means that either UAVs have to have a separate infrastructure of CNS technologies or that how the current system works must change to incorporate them. Both of these strategies pose questions about safety. The current system is very safe and there are those who fear that major changes would disrupt that level of safety.

The culture of safety in the aviation community is very strong. Most of the regulations for flight and equipment deal with ensuring safety, and the number one criteria that new technologies or procedures incorporated into the NAS must meet is that of safety.

Given the current make up of the NAS and the strong value that is placed on safety within the aviation community it would seem that UAVs would never be allowed to emerge as a significant part of NAS operations. However, a number of other factors are forcing the system to change. The number one factor currently driving change in the NAS is the need to increase the capacity of the system. Many of the current plans for increasing capacity include changing CNS to satellite based technology. These plans also include moving responsibility for separating aircraft from controllers to the pilots. As a result, CNS would no longer need to be conducted ground to air. The amount of change necessary to bring such a future about is large and creates room for incorporating procedures and regulations specific to the operation of UAVs. However, while the room for change and the inclusion of UAVs exists, current values and perceptions of what the system is and should be are still strong and will have a large influence in shaping what the future NAS system will look like and as a result whether or not it will include regular and numerous UAV operations.

Conclusions

Much of technology development today happens without addressing the question of how it will affect our value structure or how it fits within it. This paper has argued that the interaction between technology and societal values can play an important role in the success or failure of a technology. Examining this interaction would force technology developers, policy makers and the public to explicitly consider whether a technology is desirable. While the interaction of a technology with the values structure cannot always be predicted, even considering and tracking this interaction could help direct policy or development and adoption of the technology.

In the case of the mini computer and also the personal computer, no public discussion ever took place to determine or analyze whether the technology was desirable. The market decided that this was something wanted and needed; however with the benefits of the technology also came a number of significant consequences. Smaller and faster became also hotter and more numerous making power consumption and waste heat important problems. As a result, we now want computers with lower power consumption, both for the environment and for mobility. Computers also have a fairly short time of use, after which they are thrown out creating a significant landfill impact, which most people are not aware about and not discussing.

In contrast, the SST had a very visible technology development program which helped to generate a discussion abut whether or not this was a publicly desirable technology. Early on, development of the SST was seen as an extension of technology that already existed. Developers viewed the SST as a way not only to fly, but do it faster and therefore better. This mind-set made sense when the technology was being developed. It resonated with and was motivated by the general culture of technological optimism. The century had shown tremendous growth and progress of technology. Much of this development allowed for an expansion of the economy and a dramatic increase in the speed at which we could do things.

The mindset of same but better allowed many of the individuals pushing for development to be blind sided by unanticipated consequence of the technology. When viewed as a better way to do the same thing, the new technology was not framed in a way that called for an analysis of what was actually different. The fact that the SST was also dirtier, noisier, more expensive, with development unsustainable by private industry was not considered. When environmental responsibility started to become important, public outcry eventually killed the entire SST project.

How a technology may change our values cannot always be predicted; however, it is important that a discussion about the topic. The termination of the SST development was a result of such a discussion. A group against the SST was formed and conducted significant public education campaigns as well as lobbying campaigns eventually convincing the public that the technology no longer fit with their new environmental values.

In the case of UAVs, the fact that regulations and infrastructure must exist before they can be integrated into the NAS ensures that some discussion about UAVs and how they fit into the existing system will take place. However, while that sounds optimistic, the discussion that is currently taking place deals with how to make UAVs a reality and not with whether or not we want or need these vehicles in the system. The NAS is already capacity constrained and adding a significant number of small UAV flights can greatly increase congestion. Is the added congestion worth it, especially if we are not sure that there are many economically viable uses for the UAV? Such a discussion should be taking place, but currently is not.

Considering the impact of new technology on society and its values is important but also difficult. Currently no process exists for the public to discuss the impacts of new technologies and to be involved in deciding how these technologies should be handled. This is in contrast to public projects like housing and education where significant discussion often occurs before and during the project. Generating a discussion is easier for large and specific programs like the SST but can be harder for more decentralized and general technologies like computing, biotechnology and nanotechnology. In these cases, policy makers should encourage broad debates much like the debate around stem cell research. These debates would help analyze whether a technology fits into our value structure and help it evolve in ways that are more in line with our societal goals.

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