

Moreover, just as social context—including, among other things, a society's preexisting technological order—regulates each technology's material functions and effects, it also regulates a technology's communicative functions and cultural meanings. A few decades ago a belching smokestack symbolized progress. Today—in a different historical context—the same smokestack is more likely to evoke distress or even outrage.

Finally, one important influence on a technology's functions and effects is the minds and culture of people. Nineteenth-century high-wheeler bicycles were perceived by athletic young men as virile, high-speed devices. But to some women and elderly men the same devices signified personal danger. Indeed, conflicting perceptions of the high-wheeler proved consequential to its subsequent technological development. Its perception as a “macho machine” prompted new bicycle designs with ever higher front wheels. The competing perception of the high-wheeler as an “unsafe machine” prompted designs with smaller front wheels, different seat placement, or higher rear wheels. Thus to understand the social function, meaning, and evolution of the high-wheeler, it is essential to explore its psychological and cultural context.

Public controversies concerning technology offer another occasion for observing the role of culture and cognition in establishing a technology's context, and hence its social role. For example, during the 1970s nuclear engineers and electric utility executives generally viewed centralized production of electricity as a critical social need and essential to the concept of commercial nuclear power. To them an alternative to nuclear power needed to be another means of performing this critical function. But other energy policy analysts saw the expanded production of electricity as so inessential that a perfectly viable alternative could be a panel of foam wall insulation that did not generate any electricity.

In evidence here are fragments of a social process of contesting or negotiating what is or is not to count as an essential function of a technology and hence as an alternative. Thus, when technological consequences or meanings become

controversial, processes through which technologies are culturally constituted may emerge openly.

Contingent Social Products

There is residual variability in the structural effects associated with any deployed technology—*within a particular social context and even more so among different contexts*. However, a technology's greatest flexibility exists before its final deployment, when artifacts and their accompanying social organization are being conceived and designed.

Technologies do not just appear or happen; they are contingent social products. Thus it is possible, both before and after the fact, to imagine alternative designs. The process by which one set of designs rather than another comes to fruition is influenced by prevailing social structures and forces, including the preexisting technological order. However, this process also reflects explicit or tacit social choices, including political negotiations or struggles.

For example, it is hard to imagine a modern home without an electric refrigerator, but had the accidents of competing corporate resources played out slightly differently, gas-powered refrigerators that would have run more reliably and quietly could have been the norm. Other feasible alternatives in household technology harbored the potential for even more dramatic social effects. Moreover, although today people think of the guiding impulses behind technological development as necessarily being profit, convenience, or military advantage, throughout history religious or aesthetic motivations have often been just as significant.

Thus there are many potential, competing technological pathways, and each is socially developed. But the flexibility associated with a given technology, or with other social structures, tends to diminish with time. After a society has habituated itself to one technology, alternatives tend to become less accessible. Once designed and deployed, a technology, like a law or a political institution, tends—if it is going to endure—gradually to become integrated into larger systems of functionally interdependent artifacts and organizations and then to influence the design of