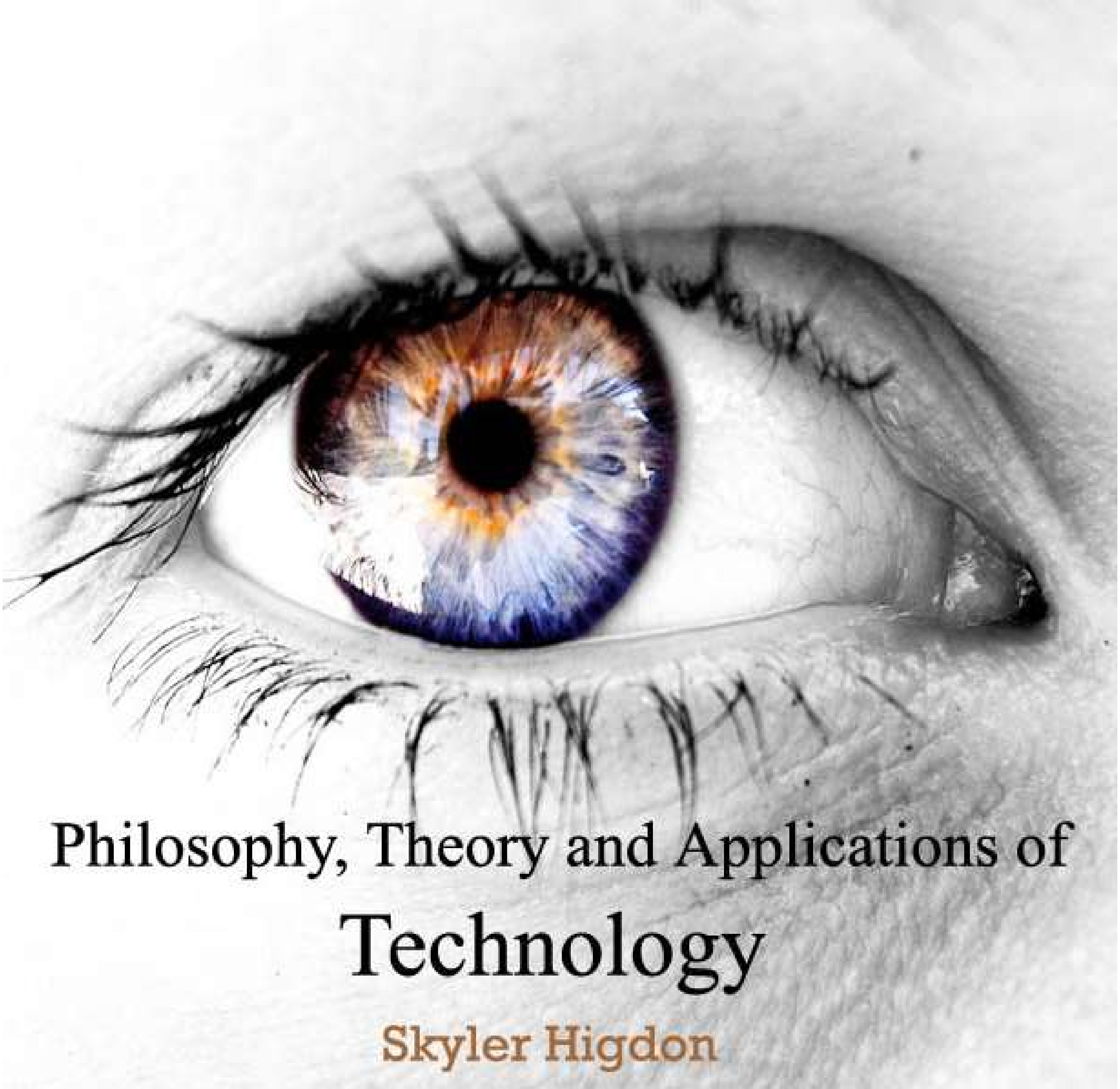

Philosophy, Theory and Applications of Technology

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Chapter- 1

Philosophy and Theory of Technology

Philosophy of Technology

The **philosophy of technology** is a philosophical field dedicated to studying the nature of technology and its social effects.

History

Considered under the rubric of the Greek term *techne* (art, or craft knowledge), the philosophy of technology goes to the very roots of Western philosophy.

- In his *Republic*, Plato sees *techne* as the basis for the philosophers' proper rule in the city.
- In the Nicomachean Ethics (Book 6), Aristotle describes *techne* as one of the four ways that we can know about the world.
- The Stoics argued that virtue is a kind of *techne* based upon a proper understanding of the universe.

20th century development

Two of the most prominent 20th century philosophers to directly address the effects of modern technology on humanity were John Dewey and Martin Heidegger. Both saw technology as central to modern life, although Heidegger was more ambivalent and critical than Dewey. The problem for Heidegger was the hidden nature of technology's essence, *Gestell* or *Enframing* which poised for humans what he called its greatest danger and its greatest possibility. Heidegger's major work on technology is found in *The Question Concerning Technology*.

Contemporary philosophy

Contemporary philosophers with an interest in technology include Jean Baudrillard, Albert Borgmann, Andrew Feenberg, Langdon Winner, Donna Haraway, Avital Ronell, Don Ihde, Bruno Latour, Paul Levinson, Carl Mitcham, Leo Marx, Gilbert Simondon, Jacques Ellul and Bernard Stiegler.

While a number of important individual works were published in the second half of the twentieth century, Paul Durbin has identified two books published at the turn of the century as marking the development of the philosophy of technology as an academic subdiscipline with canonical texts ; these were *Technology and the Good Life* (2000), edited by Eric Higgs, Andrew Light, and David Strong and *American Philosophy of Technology* (2001) by Hans Achterhuis.

Technology and neutrality

With improvements in technology comes progress and a great concern over its shadowing effect on society. Leila Green uses recent gun massacres such as 'the Port Arthur Massacre' and the 'Dunblane Massacre' to bring out the concepts of technological determinism and social determinism. Technological determinism argues that 'it was features of technology that determined its use and the role of a progressive society was to adapt to [and benefit from]technological change.'[Green, Leila (2001) *Technoculture,* Allen & Unwin, Crows Nest, p 2.]. The alternative perspective would be social determinism which looks upon society being at fault for the 'development and deployment'[Green, Leila (2001) *Technoculture,* Allen & Unwin, Crows Nest, p 3] of technologies. The reactions to the gun massacres were different in various regions, Tasmanian authorities made gun laws even stricter than before, while there was a demand in the US for the advocacy of fire arms. And here lies the split, both in opinion and in social dimension. According to Green, a technology can be thought of as a neutral entity only when the sociocultural context and issues circulating the specific technology are removed, it will be then visible to us that there lies a relationship of social groups and power provided through the possession of technologies.

Theories of Technology

There are a number of theories attempting to address technology, which tend to be associated with the disciplines of science and technology studies (STS) and communication studies. Most generally, the theories attempt to address the relationship between technology and society and prompt questions about agency, determinism/autonomy, and teleonomy.

If forced, one might categorize them into social and group theories. Additionally, one might distinguish between descriptive and critical theories. *Descriptive* theories attempt to address the definition and substance of technology, how does it emerge, change, and, of course, what is its relation to the human/social sphere? More substantively, to what extent is technology autonomous and how much force does it have in determining social structure or human practice? *Critical* **theories of technology** often take a descriptive theory as their basis and articulate concerns and ask in what ways can that relationship be changed?

Social theories

Descriptive approaches

- Actor-network theory (ANT) - posits a heterogeneous network of humans and non-humans as equal interrelated actors. It strives for impartiality in the description of human and nonhuman actors and the reintegration of the natural and social worlds. For example, Latour (1992) argues that instead of worrying whether we are anthropomorphizing technology, we should embrace it as inherently anthropomorphic: technology is made by humans, substitutes for the actions of humans, and shapes human action. What is important is the chain and gradients of actors' actions and competences, and the degree to which we choose to have figurative representations. Key concepts include the **inscription** of beliefs, practices, relations into technology, which is then said to **embody** them. Key authors include Latour (1997) and Callon (1999).

- Social construction of technology (SCOT) - argues that technology does not determine human action, but that human action shapes technology. Key concepts include:
    - **interpretive flexibility**: "Technological artifacts are culturally constructed and interpreted ... By this we mean not only that there is flexibility in how people think of or interpret artifacts but also that there is flexibility in how artifacts are designed."
    - **relevant social group**: shares a particular set of meanings about an artifact
    - **closure** and stabilization: when the relevant social group has reached a consensus
    - wider context: "the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to an artifact"

  Key authors include Pinch and Bijker (1992) and Kline.

- Structuration theory - defines structures as rules and resources organized as properties of social systems. The theory employs a recursive notion of actions constrained and enabled by structures which are produced and reproduced by that action. Consequently, in this theory technology is not rendered as an artifact, but instead examines how people, as they interact with a technology in their ongoing practices, enact structures which shape their emergent and situated use of that technology. Key authors include DeSantis and Poole (1990), and Orlikowski (1992).

- Systems theory - considers the historical development of technology and media with an emphasis on inertia and heterogeneity, stressing the connections between the artifact being built and the social, economic, political and cultural factors surrounding it. Key concepts include **reverse salients** when elements of a system lag in development with respect to others, differentiation, operational closure, and autopoietic autonomy. Key authors include Thomas P. Hughes (1992) and Luhmann (2000).

Critical theories

- Values in Design - asks how do we ensure a place for values (alongside technical standards such as speed, efficiency, and reliability) as criteria by which we judge the quality and acceptability of information systems and new media. How do values such as privacy, autonomy, democracy, and social justice become integral to conception, design, and development, not merely retrofitted after completion? Key thinkers include Nissenbaum (2001).

Other stances

Additionally, many authors have posed technology so as to critique and or emphasize aspects of technology as addressed by the mainline theories. For example, Steve Woolgar (1991) considers *technology as text* in order to critique the sociology of scientific knowledge as applied to technology and to distinguish between three responses to that notion: the instrumental response (interpretive flexibility), the interpretivist response (environmental/organizational influences), the reflexive response (a double hermeneutic). Pfaffenberger (1992) treats *technology as drama* to argue that a recursive structuring of technological artifacts and their social structure discursively regulate the technological construction of political power. A technological drama is a discourse of technological "statements" and "counterstatements" within the processes of technological regularization, adjustment, and reconstitution.

An important philosophical approach to technology has been taken by Bernard Stiegler, whose work has been influenced by other philosophers and historians of technology including Gilbert Simondon and André Leroi-Gourhan.

Group theories

There are also a number of technology related theories that address how (media) technology affects group processes. Broadly, these theories are concerned with the social effects of communication media. Some (e.g., media richness) are concerned with questions of media choice (i.e., when to use what medium effectively). Other theories (social presence, SIDE, media naturalness) are concerned with the consequences of those media choices (i.e., what are the social effects of using particular communication media).

- Social presence theory (Short, et al., 1976) is a seminal theory of the social effects of communication technology. Its main concern is with telephony and telephone conferencing (the research was sponsored by the British Post Office, now British Telecom). It argues that the social impact of a communication medium depend on the *social presence* it allows communicators to have. Social presence is defined as a property of the medium itself: the degree of acoustic, visual, and physical contact that it allows. The theory assumes that more contact will increase the key components of "presence": greater intimacy, immediacy, warmth and inter-personal rapport. As a consequence of social presence, social influence is expected to increase. In the case of communication technology, the assumption is that more text-based forms of interaction (e-mail, instant messaging) are less social, and therefore less conducive to social influence.

- Media richness theory (Daft & Lengel, 1986) shares some characteristics with social presence theory. It posits that the amount of information communicated differs with respect to a medium's *richness*. The theory assumes that resolving ambiguity and reducing uncertainty are the main goals of communication. Because communication media differ in the rate of understanding they can achieve in a specific time (with "rich" media carrying more information), they are not all capable of resolving uncertainty and ambiguity well. The more restricted the medium's capacity, the less uncertainty and equivocality it is able to manage. It follows that the richness of the media should be matched to the task so as to prevent over simplification or complication.

- Media naturalness theory (Kock, 2001; 2004) builds on human evolution ideas and has been proposed as an alternative to media richness theory. Media naturalness theory argues that since our Stone Age hominid ancestors have communicated primarily face-to-face, evolutionary pressures have led to the development of a brain that is consequently designed for that form of communication. Other forms of communication are too recent and unlikely to have posed evolutionary pressures that could have shaped our brain in their direction. Using communication media that suppress key elements found in face-to-face communication, as many electronic communication media do, thus ends up posing cognitive obstacles to communication. This is particularly the case in the context of complex tasks (e.g., business process redesign, new product development, online learning), because such tasks seem to require more intense communication over extended periods of time than simple tasks.

- Media synchronicity theory (MST, Dennis & Valacich, 1999]) redirects richness theory towards the *synchronicity* of the communication.

- The social identity model of deindividuation effects (or SIDE model, Postmes, Spears and Lea 1999; Reicher, Spears and Postmes, 1995; Spears & Lea, 1994) was developed as a response to the idea that anonymity and reduced presence made communication technology socially impoverished (or "deindividuated"). It provided an alternative explanation for these "deindividuation effects" based on theories of social identity (e.g., Turner et al., 1987). The SIDE model distinguishes cognitive and strategic effects of a communication technology. Cognitive effects occur when communication technologies make "salient" particular aspects of personal or social identity. For example, certain technologies such as email may disguise characteristics of the sender that individually differentiate them (i.e., that convey aspects of their personal identity) and as a result more attention may be given to their social identity. The strategic effects are due to the possibilities, afforded by communication technology, to selectively communicate or enact particular aspects of identity, and disguise others. SIDE therefore sees the social and the technological as mutually determining, and the behavior associated with particular communication forms as the product or interaction of the two.

- Time, interaction, and performance (TIP; McGrath, 1991) theory describes work groups as time-based, multi-modal, and multi-functional social systems. Groups interact in one of the modes of inception, problem solving, conflict resolution, and execution. The three functions of a group are production (towards a goal), support (affective) and well-being (norms and roles).

Analytic theories

Finally, there are theories of technology which are not defined or claimed by a proponent, but are used by authors in describing existing literature, in contrast to their own or as a review of the field.

For example, Markus and Robey (1988) propose a general technology theory consisting of the causal structures of agency (technological, organizational, imperative, emergent), its structure (variance, process), and the level (micro, macro) of analysis.

Orlikowski (1992) notes that previous conceptualizations of technology typically differ over scope (is technology more than hardware?) and role (is it an external objective force, the interpreted human action, or an impact moderated by humans?) and identifies three models:

1. technological imperative: focuses on organizational characteristics which can be measured and permits some level of contingency
2. strategic choice: focuses on how technology is influenced by the context and strategies of decision-makers and users
3. technology as a trigger of structural change: views technology as a social object

DeSanctis and Poole (1994) similarly write of three views of technology's effects:

1. decision-making: the view of engineers associated with positivist, rational, systems rationalization, and deterministic approaches
2. institutional school: technology is an opportunity for change, focuses on social evolution, social construction of meaning, interaction and historical processes, interpretive flexibility, and an interplay between technology and power
3. an integrated perspective (social technology): soft-line determinism, with joint social and technological optimization, structural symbolic interaction theory

Bimber (1998) addresses the determinacy of technology effects by distinguishing between the:

1. normative: an autonomous approach where technology is an important influence on history only where societies attached cultural and political meaning to it (e.g., the industrialization of society)
2. nomological: a naturalistic approach wherein an inevitable technological order arises based on laws of nature (e.g., steam mill had to follow the hand mill).
3. unintended consequences: a fuzzy approach that is demonstrative that technology is contingent (e.g., a car is faster than a horse, but unbeknownst to its original creators become a significant source of pollution)

Chapter- 2

Technological Singularity

A **technological singularity** is a hypothetical event occurring when technological progress becomes so rapid that it makes the future after the singularity qualitatively different and harder to predict. Many of the most recognized writers on the singularity, such as Vernor Vinge and Ray Kurzweil, define the concept in terms of the technological creation of superintelligence, and allege that a post-singularity world would be unpredictable to humans due to an inability of human beings to imagine the intentions or capabilities of superintelligent entities. Some writers use "the singularity" in a broader way to refer to any radical changes in our society brought about by new technologies such as molecular nanotechnology, although Vinge and other prominent writers specifically state that without superintelligence, such changes would not qualify as a true singularity. Many writers also tie the singularity to observations of exponential growth in various technologies (with Moore's Law being the most prominent example), using such observations as a basis for predicting that the singularity is likely to happen sometime within the 21st century.

Vernor Vinge proposed that the creation of superhuman intelligence would represent a breakdown in the ability of humans to model the future thereafter. He was the first to use the term "singularity" for this notion, in a 1983 article, and a later 1993 article entitled "The Coming Technological Singularity: How to Survive in the Post-Human Era" was widely disseminated on the World Wide Web and helped to popularize the idea. Vinge also compared the event of a technological singularity to the breakdown of the predictive ability of physics at the space-time singularity beyond the event horizon of a black hole.

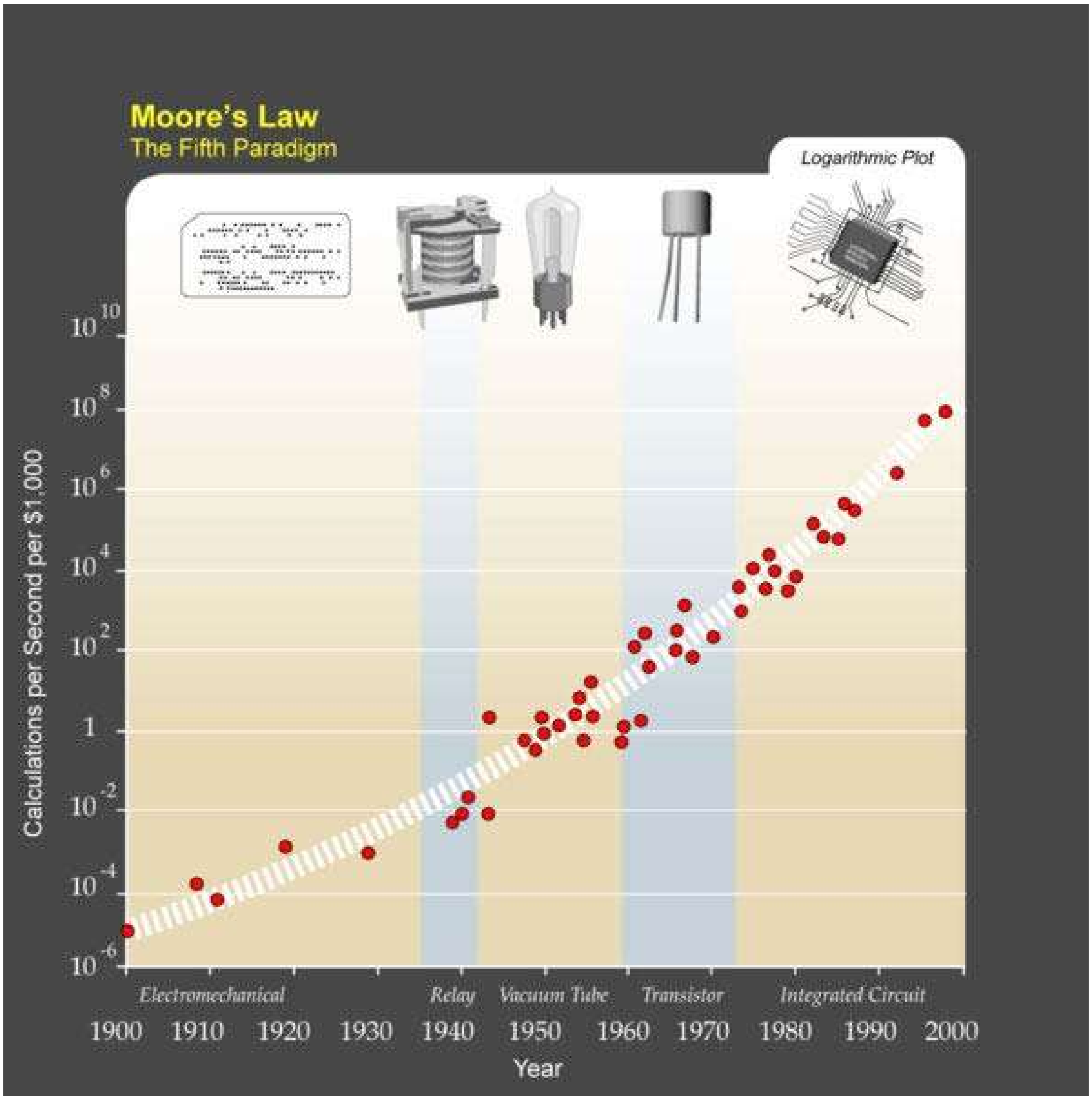
A technological singularity includes the concept of an intelligence explosion, a term coined in 1965 by I. J. Good. Although technological progress has been accelerating, it has been limited by the basic intelligence of the human brain, which has not, according to Paul R. Ehrlich, changed significantly for millennia. However with the increasing power of computers and other technologies, it might eventually be possible to build a machine that is more intelligent than humanity. If superhuman intelligences were invented, either through the amplification of human intelligence or artificial intelligence, it would bring to bear greater problem-solving and inventive skills than humans, then it could design a yet more capable machine, or re-write its source code to become more intelligent. This more capable machine then could design a machine of even greater capability. These iterations could accelerate, leading to recursive self improvement, potentially allowing enormous qualitative change before any upper limits imposed by the laws of physics or theoretical computation set in.

Futurist Ray Kurzweil postulates a law of accelerating returns in which the speed of technological change increases exponentially, generalizing Moore's law to technologies predating the integrated circuit, and including material technology (especially as applied to nanotechnology), medical technology and others. Like other authors, though, he reserves the term "Singularity" for a rapid increase in *intelligence* (as opposed to other technologies), writing for example that "The Singularity will allow us to transcend these limitations of our biological bodies and brains ... There will be no distinction, post-Singularity, between human and machine". He also defines his predicted date of the singularity (2045) in terms of when he expects computer-based intelligences to significantly exceed the sum total of human brainpower, writing that advances in computing before that date "will not represent the Singularity" because they do "not yet correspond to a profound expansion of our intelligence."

The term "technological singularity" reflects the idea that such change may happen suddenly, and that it is difficult to predict how such a new world would operate. It is unclear whether an intelligence explosion of this kind would be beneficial or harmful, or even an existential threat, as the issue has not been dealt with by most artificial general intelligence researchers, although the topic of friendly artificial intelligence is investigated by the Singularity Institute for Artificial Intelligence and the Future of Humanity Institute.

Many prominent technologists and academics dispute the plausibility of a technological singularity, including Jeff Hawkins, John Holland, Daniel Dennett, Jaron Lanier, and Gordon Moore, whose eponymous Moore's Law is often cited in support of the concept.

History of the idea



Kurzweil writes that, due to paradigm shifts, a trend of exponential growth extends Moore's law from integrated circuits to earlier transistors, vacuum tubes, relays, and electromechanical computers. He predicts that the exponential growth will continue, and that in a few decades the computing power of all computers will exceed that of human brains, with superhuman artificial intelligence appearing around the same time.

In 1847, R. Thornton, the editor of the Primitive Expounder, wrote (more than half in jest) about the recent invention of a four function mechanical calculator:

...such machines, by which the scholar may, by turning a crank, grind out the solution of a problem without the fatigue of mental application, would by its introduction into schools, do incalculable injury. But who knows that such machines when brought to greater perfection, may not think of a plan to remedy all their own defects and then grind out ideas beyond the ken of mortal mind!

In 1958, Stanisław Ulam wrote in reference to a conversation with John von Neumann:

One conversation centered on the ever accelerating progress of technology and changes in the mode of human life, which gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue.

In 1965, I. J. Good first wrote of an "intelligence explosion", suggesting that if machines could even slightly surpass human intellect, they could improve their own designs in ways unforeseen by their designers, and thus recursively augment themselves into far greater intelligences. The first such improvements might be small, but as the machine became more intelligent it would become better at becoming more intelligent, which could lead to a cascade of self-improvements and a sudden surge to superintelligence (or a singularity).

Mathematician and author Vernor Vinge greatly popularized Good's notion of an intelligence explosion, addressing the topic in print in the January 1983 issue of *Omni* magazine. In this op-ed piece, Vinge seems to have been the first to use the term "singularity" in a way that was specifically tied to the creation of intelligent machines, writing:

We will soon create intelligences greater than our own. When this happens, human history will have reached a kind of singularity, an intellectual transition as impenetrable as the knotted space-time and the center of a black hole, and the world will pass far beyond our understanding. This singularity, I believe, already haunts a number of science-fiction writers. It makes realistic extrapolation to an interstellar future impossible. To write a story set more than a century hence, one needs a nuclear war in between ... so that the world remains intelligible.

In 1985 Ray Solomonoff introduced the notion of "infinity point" in the time scale of artificial intelligence, analyzed the magnitude of the "future shock" that "we can expect from our AI expanded scientific community" and on social effects. Estimates were made "for when these milestones would occur, followed by some suggestions for the more effective utilization of the extremely rapid technological growth that is expected."

A 1993 article by Vinge, "The Coming Technological Singularity: How to Survive in the Post-Human Era", contains the oft-quoted statement, "Within thirty years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended." Vinge refines his estimate of the time scales involved, adding, "I'll be surprised if this event occurs before 2005 or after 2030."

Vinge continues by predicting that superhuman intelligences will be able to enhance their own minds faster than the humans that created them. "When greater-than-human intelligence drives progress," Vinge writes, "that progress will be much more rapid." This feedback loop of self-improving intelligence, he predicts, will cause large amounts of technological progress within a short period, and that the creation of superhuman intelligence represented a breakdown in humans' ability to model their future. His argument was that authors cannot write realistic characters who surpass the human intellect, as the thoughts of such an intellect would be beyond the ability of humans to express. Vinge named this event "the Singularity". In 1993, Vernor Vinge associated the Singularity more explicitly with I. J. Good's intelligence explosion, and tried to project the arrival time of artificial intelligence (AI) using Moore's law, which thereafter came to be associated with the "Singularity" concept.

Aubrey de Grey has applied the term the "Methuselarity" to the point at which medical technology improves so fast that expected human lifespan increases by more than one year per year.

Robin Hanson, taking "singularity" to refer to sharp increases in the exponent of economic growth, lists the agricultural and industrial revolutions as past "singularities". Extrapolating from such past events, Hanson proposes that the next economic singularity should increase economic growth between 60 and 250 times. An innovation that allowed for the replacement of virtually all human labor could trigger this event.

Eliezer Yudkowsky has suggested that many of the different definitions that have been assigned to *singularity* are mutually incompatible rather than mutually supporting. For example, Kurzweil extrapolates current technological trajectories *past* the arrival of self-improving AI or superhuman intelligence, which Yudkowsky argues represents a tension with both I. J. Good's proposed discontinuous upswing in intelligence and Vinge's thesis on unpredictability.

In 2009, Kurzweil and X-Prize founder Peter Diamandis announced the establishment of Singularity University, whose stated mission is "to assemble, educate and inspire a cadre of leaders who strive to understand and facilitate the development of exponentially advancing technologies in order to address humanity's grand challenges." Funded by Google, Autodesk, ePlanet Ventures, and a group of technology industry leaders, Singularity University is based at NASA's Ames Research Center in Mountain View, California. The not-for-profit organization runs an annual ten-week graduate program during the summer that covers ten different technology and allied tracks, and a series of executive programs throughout the year. Program faculty include experts in technology, finance, and future studies, and a number of videos of Singularity University sessions have been posted online.

Some prominent technologists such as Bill Joy, founder of Sun Microsystems, have voiced concern over the potential dangers of the Singularity.

Intelligence explosion

Good (1965) speculated on the effects of superhuman machines:

> " Let an ultraintelligent machine be defined as a machine that can far surpass all the intellectual activities of any man however clever. Since the design of machines is one of these intellectual activities, an ultraintelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion,' and the intelligence of man would be left far behind. Thus the first ultraintelligent machine is the last invention that man need ever make. "

Most proposed methods for creating superhuman or transhuman minds fall into one of two categories: intelligence amplification of human brains and artificial intelligence. The means speculated to produce intelligence augmentation are numerous, and include bio- and genetic engineering, nootropic drugs, AI assistants, direct brain-computer interfaces, and mind uploading. The existence of multiple paths to a intelligence-explosion make a singularity more likely; for a singularity to not occur they would all have to fail.

Despite the numerous speculated means for amplifying human intelligence, non-human artificial intelligence (specifically seed AI) is the most popular option for organizations trying to advance the singularity. Hanson (1998) is also skeptical of human intelligence augmentation, writing that once one has exhausted the "low-hanging fruit" of easy methods for increasing human intelligence, further improvements will become increasingly difficult to find.

Whether or not an intelligence explosion occurs depends on three factors. The first, accelerating factor, is the new intelligence enhancements made possible by each previous improvement. Contrawise, as the intelligences become more advanced, further advances will become more and more complicated, possibly overcoming the advantage of increased intelligence. Each improvement must be able to beget at least one more improvement, on average, for the singularity to continue. Finally, there is the issue of a hard upper limit. Absent Quantum Computing, eventually the laws of physics will prevent any further improvements.

There are two logically independent, but mutually reinforcing, accelerating effects: increases in the speed of computation, and improvements to the algorithms used. The former is predicted by Moore's Law and the forecast improvements in hardware, and is comparatively similar to previous technological advance. On the other hand, most AI researchers believe that software is more important than hardware. There is little reason to expect evolution to have optimised human brains for intelligence, suggesting there are low-hanging fruit on the software side.

Speed improvements

The first is the improvements to the speed at which minds can be run. Whether human or AI, better hardware increases the rate of future hardware improvements. Simplistically, Moore's Law suggests that if the first doubling of speed took 18 months, the second would take 18 subjective months; or 9 external months, whereafter, four months, two months, and so on towards a speed singularity. An upper limit on speed may eventually be reached, though it is unclear how high this would be. Hawkins (2008), responding to Good, argued that the upper limit is relatively low;

> “ Belief in this idea is based on a naive understanding of what intelligence is. As an analogy, imagine we had a computer that could design new computers (chips, systems, and software) faster than itself. Would such a computer lead to infinitely fast computers or even computers that were faster than anything humans could ever build? No. It might accelerate the rate of improvements for a while, but in the end there are limits to how big and fast computers can run. We would end up in the same place; we'd just get there a bit faster. There would be no singularity. ”

Whereas if it were a lot higher than current human levels of intelligence, the effects of the singularity would be enormous enough as to be indistinguishable (to humans) from a singularity with an upper limit. For example, if the speed of thought could be sped up by a million-to-one, a subjective year would pass in 30 physical seconds.

It is difficult to directly compare silicon-based hardware with neurons. But Berglas (2008) notes that computer speech recognition is approaching human capabilities, and that this capability seems to require 0.01% of the volume of the brain. This analogy suggests that modern computer hardware is within a few orders of magnitude of being as powerful as the human brain.

Intelligence improvements

Some intelligence technologies, like seed AI, also have the potential to make themselves more intelligent, not just faster, by modifying their source code. These improvements would make further improvements possible, which would make further improvements possible, and so on.

This mechanism for an intelligence explosion differs from an increase in speed in two ways. Firstly, it doesn’t require external effect: machines designing faster hardware still require humans to create the improved hardware, or to program factories appropriately.

An AI which was re-writing its own source code, however, could do so while contained in an AI box.

Secondly, as with Vernor Vinge's conception of the singularity, it is much harder to predict the outcome. While speed increases seem to be only a quantitative difference from human intelligence, actual improvements in intelligence would be qualitatively different. Eliezer Yudkowsky compares it to the changes that human intelligence brought: humans changed the world thousands of times more rapidly than evolution had done so, and in totally different ways. Similarly, the evolution of life had been a massive departure and acceleration from the previous geological rates of change, and improved intelligence could cause change to be as different again.

There are substantial dangers associated with an intelligence explosion singularity. Firstly, the goal structure of the AI may not be invariant under self-improvement, potentially causing the AI to optimise something other than was intended. Secondly, AIs could have other uses for the scarce resources mankind uses to survive.

While not actively malicious, there is no reason to think that AIs would actively promote human goals unless they could be programmed as such, and if not, might use the resources currently used to support mankind to promote its own goals, causing human extinction.

Impact

Dramatic changes in the rate of economic growth have occurred in the past because of some technological advancement. Based on population growth, the economy doubled every 250,000 years from the Paleolithic era until the Neolithic Revolution. This new agricultural economy began to double every 900 years, a remarkable increase. In the current era, beginning with the Industrial Revolution, the world's economic output doubles every fifteen years, sixty times faster than during the agricultural era. If the rise of superhuman intelligences causes a similar revolution, argues Robin Hanson, one would expect the economy to double at least quarterly and possibly on a weekly basis.

Existential risk

"The AI does not hate you, nor does it love you, but you are made out of atoms which it can use for something else."

Superhuman intelligences may have goals inconsistent with human survival and prosperity. Berglas (2008) notes that there is no direct evolutionary motivation for an AI to be friendly to humans. In the same way that evolution has no inherent tendency to produce outcomes valued by humans, so too there is little reason to expect an arbitrary optimisation process to promote an outcome desired by mankind, rather than inadvertently leading to an AI behaving in a way not intended by its creators (such as Nick Bostrom's whimsical example of an AI which was originally programmed with the goal of manufacturing paper clips, such that when it achieves superintelligence it decides to convert the entire planet into a paper clip manufacturing facility). AI researcher Hugo de Garis suggests that artificial intelligences may simply eliminate the human race for access to scarce resources, and humans would be powerless to stop them.

Bostrom (2002) discusses human extinction scenarios, and lists superintelligence as a possible cause:

When we create the first superintelligent entity, we might make a mistake and give it goals that lead it to annihilate humankind, assuming its enormous intellectual advantage gives it the power to do so. For example, we could mistakenly elevate a subgoal to the status of a supergoal. We tell it to solve a mathematical problem, and it complies by turning all the matter in the solar system into a giant calculating device, in the process killing the person who asked the question.

Alternatively, AIs developed under evolutionary pressure to promote their own survival could out-compete humanity. One approach to prevent a negative singularity is an AI box, whereby the artificial intelligence is kept constrained inside a simulated world and not allowed to affect the external world. Such a box would have extremely proscribed inputs and outputs; maybe only a plaintext channel. However, a sufficient intelligent AI may simply be able to escape from any box we can create. For example, it might crack the protein folding problem and use nanotechnology to escape, or simply persuade its human 'keepers' to let it out.

Eliezer Yudkowsky proposed that research be undertaken to produce friendly artificial intelligence in order to address the dangers. He noted that if the first real AI was friendly it would have a head start on self-improvement and thus prevent other unfriendly AIs from developing, as well as providing enormous benefits to mankind. The Singularity Institute for Artificial Intelligence is dedicated to this cause.

A significant problem, however, is that unfriendly artificial intelligence is likely to be much easier to create than FAI: while both require large advances in recursive optimisation process design, friendly AI also requires the ability to make goal structures invariant under self-improvement (or the AI will transform itself into something unfriendly) and a goal structure that aligns with human values and doesn't automatically destroy the human race. An unfriendly AI, on the other hand, can optimize for an arbitrary goal structure, which doesn't need to be invariant under self-modification.

Bill Hibbard also addresses issues of AI safety and morality in his book *Super-Intelligent Machines*.

Implications for human society

In 2009, leading computer scientists, artificial intelligence researchers, and roboticists met at the Asilomar Conference Grounds near Monterey Bay in California. The goal was to discuss the potential impact of the hypothetical possibility that robots could become self-sufficient and able to make their own decisions. They discussed the extent to which computers and robots might be able to acquire autonomy, and to what degree they could use such abilities to pose threats or hazards. Some machines have acquired various forms of semi-autonomy, including the ability to locate their own power sources and choose targets to attack with weapons. Also, some computer viruses can evade elimination and have achieved "cockroach intelligence." The conference attendees noted that self-awareness as depicted in science-fiction is probably unlikely, but that other potential hazards and pitfalls exist.

Some experts and academics have questioned the use of robots for military combat, especially when such robots are given some degree of autonomous functions. A United States Navy report indicates that, as military robots become more complex, there should be greater attention to implications of their ability to make autonomous decisions.

The Association for the Advancement of Artificial Intelligence has commissioned a study to examine this issue, pointing to programs like the Language Acquisition Device, which can emulate human interaction.

Many Singularitarians consider nanotechnology to be one of the greatest dangers facing humanity. For this reason, they often believe that seed AI (an AI capable of making itself smarter) should precede nanotechnology. Others, such as the Foresight Institute, advocate the creation of molecular nanotechnology, which they claim can be made safe for pre-singularity use or expedite the arrival of a beneficial singularity.

Some support the design of "friendly artificial intelligence", meaning that the advances which are already occurring with AI should also include an effort to make AI intrinsically friendly and humane.

Isaac Asimov's Three Laws of Robotics is one of the earliest examples of proposed safety measures for AI:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with either the First or Second Law.

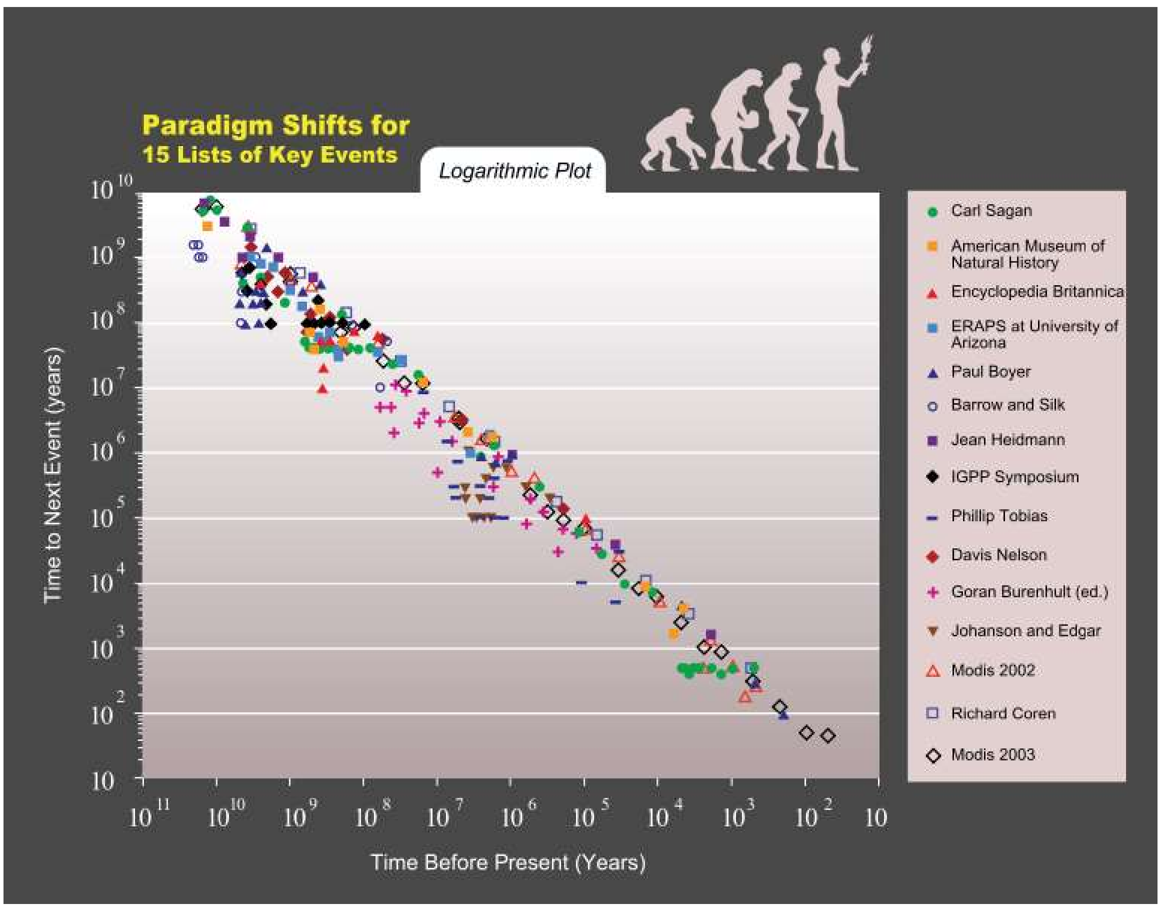
Additional laws included in some stories were described as follows:

- *Zeroth Law:* A robot may not harm humanity, or through inaction allow humanity to come to harm.
- *Minus-One Law:* A robot may not harm sentience, or through inaction allow sentience to come to harm.
- *Fourth Law:* A robot must establish its identity as a robot in all cases.
- Alternate *Fourth Law:* A robot must reproduce, unless such reproduction would interfere with the First or Second or Third Law.

- *Fifth Law:* A robot must know it is a robot.

The laws are intended to prevent artificially intelligent robots from harming humans. In Asimov's stories, any perceived problems with the laws tend to arise as a result of a misunderstanding on the part of some human operator; the robots themselves are merely acting to their best interpretation of their rules. In the 2004 film *I, Robot*, loosely based on Asimov's Robot stories, an AI attempts to take complete control over humanity for the purpose of protecting humanity from itself due to an extrapolation of the Three Laws. In 2004, the Singularity Institute launched an Internet campaign called *3 Laws Unsafe* to raise awareness of AI safety issues and the inadequacy of Asimov's laws in particular. (Singularity Institute for Artificial Intelligence 2004)

Accelerating change



According to Kurzweil, his logarithmic graph of 15 lists of paradigm shifts for key historic events shows an exponential trend. The lists' compilers include Carl Sagan, Paul D. Boyer, *Encyclopædia Britannica*, American Museum of Natural History, and University of Arizona.

Some singularity proponents argue its inevitability through extrapolation of past trends, especially those pertaining to shortening gaps between improvements to technology. In one of the first uses of the term "singularity" in the context of technological progress, Stanislaw Ulam (1958) tells of a conversation with John von Neumann about accelerating change:

One conversation centered on the ever accelerating progress of technology and changes in the mode of human life, which gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue.

Hawkins (1983) writes that "mindsteps", dramatic and irreversible changes to paradigms or world views, are accelerating in frequency as quantified in his mindstep equation. He cites the inventions of writing, mathematics, and the computer as examples of such changes.

Ray Kurzweil's analysis of history concludes that technological progress follows a pattern of exponential growth, following what he calls *The Law of Accelerating Returns*. He generalizes Moore's law, which describes geometric growth in integrated semiconductor complexity, to include technologies from far before the integrated circuit.

Whenever technology approaches a barrier, Kurzweil writes, new technologies will cross it. He predicts paradigm shifts will become increasingly common, leading to "technological change so rapid and profound it represents a rupture in the fabric of human history".(Kurzweil 2001) Kurzweil believes that the singularity will occur before the end of the 21st century, setting the date at 2045 (Kurzweil 2005). His predictions differ from Vinge's in that he predicts a gradual ascent to the singularity, rather than Vinge's rapidly self-improving superhuman intelligence.

This leads to the conclusion that an artificial intelligence that is capable of improving on its own design is also faced with a singularity. Self-augmentation or bootstrapping of intelligence is featured by Dan Simmons in his novel *Hyperion*, where a collection of artificial intelligences debate whether or not to make themselves obsolete by creating a new generation of "ultimate" intelligence.

The Acceleration Studies Foundation, an educational non-profit foundation founded by John Smart, engages in outreach, education, research and advocacy concerning accelerating change.(Acceleration Studies Foundation 2007) It produces the Accelerating Change conference at Stanford University, and maintains the educational site Acceleration Watch.

Presumably, a technological singularity would lead to rapid development of a Kardashev Type I civilization, where a Kardashev Type I civilization is one that has achieved mastery of the resources of its home planet, Type II of its planetary system, and Type III of its galaxy.

Oft-cited dangers include those commonly associated with molecular nanotechnology and genetic engineering. These threats are major issues for both singularity advocates and critics, and were the subject of Bill Joy's *Wired* magazine article "Why the future doesn't need us".(Joy 2000)

Criticism

Steven Pinker stated in 2008:

"(...) There is not the slightest reason to believe in a coming singularity. The fact that you can visualize a future in your imagination is not evidence that it is likely or even possible. Look at domed cities, jet-pack commuting, underwater cities, mile-high buildings, and nuclear-powered automobiles — all staples of futuristic fantasies when I was a child that have never arrived. Sheer processing power is not a pixie dust that magically solves all your problems. (...)"

Some critics assert that no computer or machine will ever achieve human intelligence, while others hold that the definition of intelligence is irrelevant if the net result is the same.

Martin Ford in *The Lights in the Tunnel: Automation, Accelerating Technology and the Economy of the Future* postulates a "technology paradox" in that before the Singularity could occur, most routine jobs in the economy would be automated since this would require a level of technology inferior to that of the Singularity. This would cause massive unemployment and plummeting consumer demand—which in turn would destroy the incentive to invest in the technologies that would be required to bring on the Singularity.

Criticism of the accelerating returns argument

Theodore Modis and Jonathan Huebner argue that the rate of technological innovation has not only ceased to rise, but is actually now declining (John Smart, however, criticizes Huebner's analysis.) Some evidence for this decline is that the rise in computer clock speeds is slowing, even while Moore's prediction of exponentially increasing circuit density continues to hold. This is due to excessive heat build-up from the chip, which cannot be dissipated quickly enough to prevent the chip from melting when operating at higher speeds. Advancements in speed may be possible in the future by virtue of more power-efficient CPU designs and multi-cell processors.

Others propose that other "singularities" can be found through analysis of trends in world population, world gross domestic product, and other indices. Andrey Korotayev and others argue that historical hyperbolic growth curves can be attributed to feedback loops that ceased to affect global trends in the 1970s, and thus hyperbolic growth should not be expected in the future.

In *The Progress of Computing*, William Nordhaus argued that, prior to 1940, computers followed the much slower growth of a traditional industrial economy, thus rejecting extrapolations of Moore's law to 19th-century computers. Schmidhuber (2006) suggests differences in memory of recent and distant events create an illusion of accelerating change, and that such phenomena may be responsible for past apocalyptic predictions.

Andrew Kennedy, in his 2006 paper for the British Interplanetary Society discussing change and the growth in space travel velocities, stated that although long-term overall growth is inevitable, it is small, embodying both ups and downs, and noted, "New technologies follow known laws of power use and information spread and are obliged to connect with what already exists. Remarkable theoretical discoveries, if they end up being used at all, play their part in maintaining the growth rate: they do not make its plotted curve... redundant." He stated that exponential growth is no predictor in itself, and illustrated this with examples such as quantum theory. The quantum was conceived in 1900, and quantum theory was in existence and accepted approximately 25 years later. However, it took over 40 years for Richard Feynman and others to produce meaningful numbers from the theory. Bethe understood nuclear fusion in 1935, but 75 years later fusion reactors are still only used in experimental settings. Similarly, entanglement was understood in 1935 but not at the point of being used in practice until the 21st century.

A study of patents per thousand persons shows that human creativity does not show accelerating returns, but in fact—as suggested by Joseph Tainter in his seminal *The Collapse of Complex Societies*—a law of diminishing returns. The number of patents per thousand peaked in the period from 1850–1900, and has been declining since. The growth of complexity eventually becomes self-limiting, and leads to a wide spread "general systems collapse". Thomas Homer Dixon in *The Upside of Down: Catastrophe, Creativity and the Renewal of Civilization* maintains that the declining energy returns on investment has led to the collapse of civilizations.

In addition to general criticisms of the singularity concept, several critics have raised issues with Kurzweil's iconic chart. One line of criticism is that a log-log chart of this nature is inherently biased toward a straight-line result. Others identify selection bias in the points that Kurzweil chooses to use. For example, biologist PZ Myers points out that many of the early evolutionary "events" were picked arbitrarily. Kurzweil has rebutted this by charting evolutionary events from 15 neutral sources, and showing that they fit a straight line on a log-log chart.

The Economist mocked the concept with a graph extrapolating that the number of blades on a razor, which has increased over the years from one to as many as five, will increase ever-faster to infinity.

Chapter- 3

Technological Change

Original model of three phases of the process of Technological Change

Technological change (TC) is a term that is used to describe the overall process of invention, innovation and diffusion of technology or processes The term is redundant with technological development, technological achievement, and technological progress. In essence TC is the invention of a technology (or a process), the continuous process of improving a technology (in which it often becomes cheaper) and its diffusion throughout industry or society. In its earlier days, technological change was illustrated with the 'Linear Model of Innovation', which has now been largely discarded to be replaced with a model of technological change that involves innovation at all stages of research, development, diffusion and use.

Modelling technological change

When spoken about "modelling technological change" often the process of innovation is meant. This process of continuous improvement is often modelled as a curve depicting decreasing costs over time (for instance fuel cell which have become cheaper every year).

- TC is often modelled using a learning curve, ex.: Ct=C0 * Xt^-b
- TC itself is often included in other models (for instance climate change models) and was often taken as an exogenous factor. These days TC is more often included as an endogenous factor. This means that it is taken as something you can influence. It is generally accepted that policy can influence the speed and direction of TC (for instance more towards clean technologies). This is referred to as Induced Technological Change.

Invention

The creation of something new, or a "breakthrough" technology. For example, a personal computer.

Diffusion

The spread of a technology through a society or industry. The diffusion of a technology generally follows an S-shaped curve as early versions of technology are rather unsuccessful, followed by a period of successful innovation with high levels of adoption, and finally a dropping off in adoption as a technology reaches its maximum potential in a market. In the case of a personal computer, it has made way beyond homes and into business settings, such as office workstations and server machines to host websites.

For mathematical treatment of diffusion see: Logistic function

For examples of diffusion of technologies see: Diffusion of innovations#International Institute for Applied Systems Analysis (IIASA)

For assorted diffusion curves such as appliances, household electrification and communications see: Diffusion of innovations#Diffusion data

Technological change as a social process

Underpinning the idea of *technological change as a social process* is general agreement on the importance of social context and communication. According to this model, technological change is seen as a social process involving producers and adopters and others (such as government) who are profoundly affected by cultural setting, political institutions and marketing strategies.

Elements of diffusion

Emphasis has been on four key elements of the technological change process: (1) an innovative technology (2) communicated through certain channels (3) to members of a social system (4) who adopt it over a period of time. These elements are derived from Everett M. Rogers Diffusion of innovations theory using a communications-type approach.

Innovation

Rogers proposes that there are five main attributes of innovative technologies which influence acceptance. These are relative advantage, compatibility, complexity, trialability, and observability. *Relative advantage* may be economic or non-economic, and is the degree to which an innovation is seen as superior to prior innovations fulfilling the same needs. It is positively related to acceptance (i.e., the higher the relative advantage, the higher the adoption level, and vice versa). *Compatibility* is the degree to which an innovation appears consistent with existing values, past experiences, habits and needs to the potential adopter; a low level of compatibility will slow acceptance. *Complexity* is the degree to which an innovation appears difficult to understand and use; the more complex an innovation, the slower its acceptance. *Trialability* is the perceived degree to which an innovation may be tried on a limited basis, and is positively related to acceptance. Trialability can accelerate acceptance because small-scale testing reduces risk. *Observability* is the perceived degree to which results of innovating are visible to others and is positively related to acceptance.

Communication channels

Communication channels are the means by which a source conveys a message to a receiver. Information may be exchanged through two fundamentally different, yet complementary, channels of communication. Awareness is more often obtained through the *mass media*, while uncertainty reduction that leads to acceptance mostly results from *face-to-face communication*.

Social system

The social system provides a medium through which and boundaries within which, innovation is adopted. The structure of the social system affects technological change in several ways. Social norms, opinion leaders, change agents, government and the consequences of innovations are all involved. Also involved are cultural setting, nature of political institutions, laws, policies and administrative structures.

Time

Time enters into the acceptance process in several ways. The time dimension relates to the innovativeness of an individual or other adopter, which is the relative earlyness or lateness with which an innovation is adopted.

Factors

The term mythologised of technology refers to how technology start and elites who invented the new technology. By focusing on its process, it is proved MacKenzie and Wajcman's argument of "social determination of technology",(Green,2001,pp. 1-20) which means it is social that realizing technology change, and sustained it. There are four factors motivate technology innovation, which involve intellectual agenda, economic, politics, and existing infracture (Green,2001,pp. 1-20).

Elites

It is elites who have intellectual agenda make technology change possible. However, it can not split their knowledge. Knowledge is not neutral, as it is "Socially bound knowledge" (Green,2001,pp. 1-20). The elites can create new technology as they are able to access knowledge physically and they can afford it. Both procedures underpin knowledge privilege within social context. Moreover, to prevail the new technology in social, it acquires the avant-guards who obtain knowledge as well, which makes them able to manipulate new technology. As knowledge which plays a role of force in technology is only granted to a limit population in technology experiment period, it proves technology is not neutral.

As the access to knowledge becomes easier with the spread of the Internet and access to everything from patent information to MIT class work and basic research papers approaches zero cost, the knowledge of an individual becomes limited by his/her interests and ability to understand. This change results in fundamental changes in the above concepts of elites and can result in innovation arising from multiple sources.

Corporation Corporations which are driven by economic value benefit technology and are benefited as well. In order to continue elites' experimentation, financial support is necessary, and in most case it is from corporation funding. On the other hand, corporation would like to invest the invention as the potential huge commercial benefits from it. In this case, it implies that social determines technology as technology advance can not separate from economic support and it brings economic value as well.

However, this above interpretation has problems with observation of the real major innovations such as the actual development of the transistor and creation of the microprocessor not including any of the major electronics companies of the time (the big tube manufactures). The big tube manufactures did hire the best and brightest from the universities, but all the good ideas created by their research labs couldn't float through vacuum tube management.

Government To supply a steady environment for technology advance, the bureaucracy plays an essential role. It exerts its power and publishes laws to guarantee that investment can process properly, such as copyright. Without the safe social circumstance, the elites methodology will be stolen by the others(Green,2001,pp. 1-20), which prevents the invention processing properly in such chaos.

In recent decades, much of the technological advancements have not come from the governments of the world and most of the great government sponsored research projects have been failures. For example, the Fifth generation computer project in Japan.

Globalization as macro-social context Globalization trend is realized by technology advanced and motivates it as well. In another word, the global social change is increasingly both a cause and effect of technological enhance(Green,2001,pp. 1-20). Merchants appeal high technology, such as electronic business to run over-sea business, it not only benefits them enlarging their markets, but also make them finish business trading quicker. On the other hand, utilizing high technology realizes global social change, and makes communication access more conveniently.

There is another way of how existing infrustration implements technology advance. Public policy can stimulate technology development (Danna, 2007). For instance, feminists invented satellite to provoke masculinity domination social pattern, and by which they established their roles as early communication adopters(Danna,2007,p87-110). Before feminism movement, women are looked down on, so they provoke unequal social pattern by their contribution.

However, such interpretations can be viewed as nonsense with the invention of satellites as being totally orthogonal to feminism. Satellites are used for both economically benefits and satisfy human curiosity.

Example

There is an example to elaborate how these four factors work in technology advance process- Edison’s bulb invention(Green,2001,pp. 1-20).Edison’s electrical power and lighting system can be achieved because of his inspiration. Via intellectual agenda(Green,2001,pp. 1-20), he published mythology, which aims to be funded by corporate without whom the research laboratories can not keep on. The corporation bought his idea for its potential bringing commercial benefit. As his invention of bulb liberates human movement (people can work not only in daytime, but also in evening), it inevitably prevails in overseas, and rise global social change.

Economics

Technological change is a term that is used in economics to describe a change in the set of feasible production possibilities.

Neutral technological change refers to the behaviour of technological change in models. A technological innovation is Hicks neutral, following John Hicks (1932), if a change in technology does not change the ratio of capital's marginal product to labour's marginal product for a given capital to labour ratio. A technological innovation is Harrod neutral (following Roy Harrod) if the technology is labour-augmenting (i.e. helps labor); it is Solow neutral if the technology is capital-augmenting (i.e. helps capital).

Chapter- 4

Technological Convergence

Technological convergence is the tendency for different technological systems to evolve towards performing similar tasks.

Convergence can refer to previously separate technologies such as voice (and telephony features), data (and productivity applications), and video that now share resources and interact with each other, synergistically creating new efficiencies.

Today, we are surrounded by a multi-level convergent media world where all modes of communication and information are continually reforming to adapt to the enduring demands of technologies, "changing the way we create, consume, learn and interact with each other".

Convergence in this instance is defined as the interlinking of computing and other information technologies, media content, and communication networks that have arisen as the result of the evolution and popularization of the Internet as well as the activities, products and services that have emerged in the digital media space.

Many experts view this as simply being the tip of the iceberg, as all facets of institutional activity and social life such as business, government, art, journalism, health, and education are increasingly being carried out in these digital media spaces across a growing network of information and communication technology devices.

Also included in this topic is the basis of computer networks, wherein many different operating systems are able to communicate via different protocols. This could be a prelude to artificial intelligence networks on the Internet eventually leading to a powerful superintelligence via a technological singularity.

The rise of digital communication in the late 20th century made it possible for media organizations (or individuals) to deliver text, audio, and video material over the same wired, wireless, or fiber-optic connections. At the same time, it inspired some media organizations to explore multimedia delivery of information. This digital convergence of news media, in particular, was called "Mediamorphosis" by researcher Roger Fidler, in his 1997 book by that name.

The Internet

The Internet is a globalized network and was officially launched in 1969. Over the past 40 years, its role has changed rapidly from its original use as a communication tool to provide easier and faster access to information for universities and various other educational institutions. In today's world, it is an important tool used to reach various audiences around the world. Its users have been constantly trying to create more uses for the Internet than the mere sharing of academic information. The television, radio and newspapers are the world's main mediums for accessing news and entertainment. Now, all three mediums have converged into one, and people all over the world now can read news on the Internet. They can also watch videos, television shows, listen to music, and download and upload pictures, music and videos. One doesn't have to wait until the next day to hear the latest in news, fashion, and music. The Internet is so easy to access that should anything happen, it would be displayed to the whole world within minutes.

Convergence of media occurs when multiple products come together to form one product with the advantages of all of them, also known as the black box. This idea of one technology, concocted by Henry Jenkins, has become known more as a fallacy because of the inability to actually put all technical pieces into one. For example, while people can have e-mail and Internet on their phone, they still want full computers with Internet and e-mail in addition.

Convergence is a concept in which old and new media intersect; when grassroots and corporate media intertwine in such a way that the balance of power between media producers and media consumers shifts in unpredictable ways. Jenkins states that convergence is,

"the flow of content across multiple media platforms, the cooperation between multiple media industries, and the migratory behaviour of media audiences."

Media convergence is not just a technological shift or a technological process, it also includes shifts within the industrial, cultural, and social paradigms that encourage the consumer to seek out new information. Convergence, simply put, is how individual consumers interact with others on a social level and use various media platforms to create new experiences, new forms of media and content that connect us socially, and not just to other consumers, but to the corporate producers of media in ways that have not been as readily accessible in the past.

For example, the Wii is not only a games console, but also a web browser and social networking tool. Mobile phones are another good example, in that they increasingly incorporate digital cameras, mp3 players, camcorders, voice recorders, and other devices.

This type of convergence is very popular. For the consumer, it means more features in less space, while for the media conglomerates it means remaining competitive in the struggle for market dominance. With the advance in technology comes the ability for technological convergence which Rheingold believes alters the "social-side effects" in that "the virtual, social and physical world are colliding, merging and coordinating"

However, convergence can have its downside. Particularly in their initial forms, converged devices are frequently less functional and reliable than their component parts (e.g. a DVD may perform better on a traditional DVD player than on a games console). As the amount of functions in a single device escalates, the ability of that device to serve its original function decreases. For example, the iPhone (which by its name implies that its primary function is that of a mobile phone) can perform many different tasks, but does not feature a traditional numerical pad to make phone calls. Instead, the phone features a touchpad, which some users have found more troublesome than a conventional phone numberpad. As Rheingold asserts, technological convergence holds immense potential for the "improvement of life and liberty in some ways and (could) degrade it in others" He believes the same technology has the potential to be "used as both a weapon of social control and a means of resistance"

Regardless, an ever-wider range of technologies are being converged into single multipurpose devices.

Since technology has evolved in the past ten years or so, companies are beginning to converge technologies to create demand for new products. This would include phone companies integrating 3G on their phones. In the mid 20th century, television converged the technologies of movies and radio, and television is now being converged with the mobile phone industry. Phone calls are also being made with the use of personal computers. Converging technologies seems to be squashing many types of demanded technologies into one. Mobile phones are becoming manufactured to not only carry out phone calls, text messages, but also hold images, videos, music, television, camera, and multimedia of all types. Manufacturers are now integrating more advanced features such as video recording, GPS receivers, data storage, and security mechanisms into the traditional cellphone.

These paradigm shifts are ongoing in the media, and often occur from time to time as the technology to create better devices evolves. It was predicted in the 1990s that a digital revolution would take place,and that old media would be pushed to one side by new media. Broadcasting is increasingly being replaced by the Internet, enabling consumers all over the world the freedom to access their preferred media content more easily and at a more available rate than ever before.

However, when the dot com bubble of the 1990s suddenly popped, that poured cold water over the talk of such a digital revolution. In today's society, the idea of media convergence has once again emerged as a key point of reference as newer as well as established media companies attempt to visualize the future of the entertainment industry. If this revolutionary digital paradigm shift presumed that old media would be increasingly replaced by new media, the convergence paradigm that is currently emerging suggests that new and old media would interact in more complex ways than previously predicted. The paradigm shift that followed the digital revolution assumed that new media was going to change everything. When the dot com market crashed, there was a tendency to imagine that nothing had changed. The real truth lay somewhere in between as there were so many aspects of the current media environment to take into consideration. Many industry leaders are increasingly reverting to media convergence as a way of making sense in an era of disorientating change. In that respect, media convergence in theory is essentially an old concept taking on a new meaning.

Media convergence in reality is more than just a shift in technology. It alters the relationship that already exists between industries, technologies, audiences, genres and markets. Media convergence changes the rationality in which media industries operate and also the way that media consumers process news and entertainment. Bearing in mind that media convergence in reality is essentially a process and not an outcome, there is no single black box that controls the flow of media into our homes and workplaces. With the proliferation of different media channels and the increasing portability of new telecommunications and computing technologies, we have entered into an era where the media is constantly surrounding us. Believe it or not, today's modern society is already existing within a convergence culture.

Media convergence requires companies operating within the scope of the media to rethink existing assumptions about media from the consumer's point of view, as these assumptions affect both marketing and programming decisions. Media producers have to respond to these newly empowered consumers in today's society to reinvent existing concepts to keep them up to date with emerging trends. Consumers these days do not just want to be on a one way transmission model where they simply receive information. They want to interact with it. They want to create it. They want to participate within it. Media convergence has allowed that to happen and as the proliferation of new communication technologies continues to occur, this trend is here to stay.

Fan culture

Media scholar Henry Jenkins has described the media convergence with participatory culture as:

a "catalyst" for amateur digital film-making and what this case study suggests about the future directions popular culture may take. Star Wars fan films represent the intersection of two significant cultural trends -- the corporate movement towards media convergence and the unleashing of significant new tools which enable the grassroots archiving, annotation, appropriation, and recirculation of media content. These fan films build on long-standing practices of the fan community but they also reflect the influence of this changed technological environment that has dramatically lowered the costs of film production and distribution.

Messaging convergence

Combinational services include those which integrate SMS with voice, such as voice SMS - providers include Bubble Motion, Jott, Kirusa, and SpinVox. Several operators have launched services that combine SMS with mobile instant messaging (MIM) and presence.

Text-to-landline services also exist, where subscribers can send text messages to any landline phone and are charged at standard rates. This service has been popular in America, where fixed and mobile numbers are similar.

Inbound SMS has been also converging to enable reception of different formats (SMS, voice, MMS, etc.). UK companies, including consumer goods companies and media giants, should soon be able to let consumers contact them via voice, SMS, MMS, IVR, or video using one five-digit number or long number. In April 2008, O2 UK launched voice-enabled shortcodes, adding voice functionality to the five-digit codes already used for SMS.

This type of convergence is particularly helpful for media companies, broadcasters, enterprises, call centres and help desks who need to develop a consistent contact strategy with the consumer. Because SMS is very popular today with any demographic, it became relevant to include text messaging as a contact possibility for consumers. To avoid having multiple numbers (one for voice calls, another one for SMS), a simple way is to merge the reception of both formats under one number. This means that a consumer can text or call one number and be sure that the message will be received.

Multi-play

Multi-play is a marketing term describing the provision of different telecommunication services, such as Broadband Internet access, television, telephone, and mobile phone service, by organisations that traditionally only offered one or two of these services. Multi-play is a catch-all phrase; usually, the terms triple play (voice, video and data) or quadruple play (voice, video, data and wireless) are used to describe a more specific meaning.

A dual play service is a marketing term for the provisioning of the two services: it can be high-speed Internet (ADSL) and telephone service over a single broadband connection in the case of phone companies, or high-speed Internet (cablemodem) and TV service over a single broadband connection in the case of cable TV companies.

The convergence can also concern the underlying communication infrastructure. An example of this is a triple play service, where communication services are packaged allowing consumers to purchase TV, Internet, and telephony in one subscription.

A quadruple play service combines the triple play service of broadband Internet access, television, and telephone with wireless service provisions. This service set is also sometimes humorously referred to as "The Fantastic Four" or "Grand Slam".

The broadband cable market is transforming as pay-TV providers move aggressively into what was once considered the telco space. Meanwhile, customer expectations have risen as consumer and business customers alike seek rich content, multi-use devices, networked products and converged services including on-demand video, digital TV, high speed Internet, VoIP, and wireless applications. It's uncharted territory for most broadband companies.

Incidentally, the "mobile service provisions" aspect refers not only to the ability of subscribers to be able to purchase mobile phone like services as is often seen in co-marketing efforts between providers of land-line services. Rather, it is one major ambition of wireless - the ability to have access to all of the above including voice, Internet, and content/video while on the go and requiring no tethering to the network via cables.

Given advancements in WiMAX and other leading edge technologies, the ability to transfer information over a wireless link with a variety of speeds, distances, and non-line-of-sight conditions is rapidly improving. It is possible that one could never need to be connected by a wire to anything, even while at home.

One fundamental aspect of the quadruple play is not only the long awaited broadband convergence but also the players involved. Many of them, from the largest global service providers to whom we connect today via wires and cables to the smallest of startup service providers are interested. The opportunities are attractive: the big three telecom services - telephony, cable television, and wireless - could combine the size of their respective industries.

The next level of service might be the integration of RFID into the quadruple play which will add the capability for home equipment to communicate to the outside world and schedule maintenance on its own.

In the UK, the recent merger of NTL:Telewest and Virgin Mobile resulted in a company offering a quadruple play of cable television, broadband Internet, home telephone, and mobile telephone services.

Home network

Early in the 21st century, home LAN convergence so rapidly integrated home routers, wireless access points, and DSL modems that users were hard put to identify the resulting box they used to connect their computers to their Internet service. A general term for such a combined device is a residential gateway.

"Black box fallacy"

Some expect we will eventually access all media content through one device, or "black box". As such, media business practice has been to identify the next "black box" to invest in and provide media for. This has caused a number of problems.

Firstly, as "black boxes" are invented and abandoned, the individual is left with numerous devices that can perform the same task, rather than one dedicated for each task. For example, one may own both a computer and a video games console, subsequently owning two DVD players. This is contrary to the streamlined goal of the "black box" theory, and instead creates clutter.

Secondly, technological convergence tends to be experimental in nature. This has led to consumers owning technologies with additional functions that are harder, if not impractical, to use rather than one specific device. For example, Intel has created a surfboard with an in-built laptop. Whilst interesting, it would be more practical to use a conventional computer rather than a laptop on a surfboard. Additionally, LG has created a microwave with a television screen. Many people would only watch the TV for the duration of the meal's cooking time, or whilst in the kitchen, but would not use the microwave as the household TV. These examples show that in many cases technological convergence is unnecessary or unneeded, in favour of a specialized device for each task.

Furthermore, although consumers primarily use a specialized media device for their needs, other "black box" devices that perform the same task can be used to suit their current situation. As a 2002 Cheskin Research report explained:

...Your email needs and expectations are different whether you're at home, work, school, commuting, the airport, etc., and these different devices are designed to suit your needs for accessing content depending on where you are- your situated context.

Despite the creation of "black boxes", intended to perform all of one's tasks, the trend is to use devices that can suit the consumer's physical position.

Due to the variable utility of portable technology, convergence occurs in high end mobile devices. They incorporate multimedia services, GPS, Internet access, and mobile telephony into a single device, heralding the rise of what has been termed the "smart phone", a device designed to remove the need to carry multiple devices while away from the home.

Conversely, it would seem that hardware is instead diverging whilst media content is converging. Media has developed into brands that can offer content in a number of forms. Two examples of this are Star Wars and The Matrix. Both are films, but are also books, video games, cartoons, and action figures. Branding encourages expansion of one concept, rather than the creation of new ideas. In contrast, hardware has diversified in order to accommodate the convergence of media. Hardware needs to be specific to each function. In a "black box" situation, a consumer would only need to purchase one form of media (say, the Matrix) and would be able to do everything with it.

Chapter- 5

Technological Determinism

Technological determinism is a reductionist theory that presumes that a society's technology drives the development of its social structure and cultural values. The term is believed to have been coined by Thorstein Veblen (1857-1929), an American sociologist. The most radical technological determinist in America in the twentieth century was most likely Clarence Ayres who was a follower of Thorstein Veblen and John Dewey. William Ogburn was also known for his radical technological determinism.

Origin

The term is believed to have been coined by Thorstein Veblen (1857-1929), an American. Veblen's contemporary, popular historian Charles Beard, provided this apt determinist image, "Technology marches in seven-league boots from one ruthless, revolutionary conquest to another, tearing down old factories and industries, flinging up new processes with terrifying rapidity."

Explanation

Most interpretations of technological determinism share two general ideas:

- that the development of technology itself follows a predictable, traceable path largely beyond cultural or political influence, and
- that technology in turn has "effects" on societies that are inherent, rather than socially conditioned or produced because that society organizes itself to support and further develop a technology once it has been introduced.

Strict adherents to technological determinism do not believe the influence of technology differs based on how much a technology is or can be used. Instead of considering technology as part of a larger spectrum of human activity, technological determinism sees technology as the basis for all human activity.

Technological determinism has been summarized as 'The belief in technology as a key governing force in society ...' (Merritt Roe Smith). 'The idea that technological development determines social change ...' (Bruce Bimber). It changes the way people think and how they interact with others and can be described as '...a three-word logical proposition: "Technology determines history"' (Raymond Williams) . It is, '... the belief that social progress is driven by technological innovation, which in turn follows an "inevitable" course.' (Michael L. Smith). This 'idea of progress' or 'doctrine of progress' is centralised around the idea that social problems can be solved by technological advancement, and this is the way that society moves forward. Technological determinists believe that "'You can't stop progress', implying that we are unable to control technology" (Lelia Green). This suggests that we are somewhat powerless and society allows technology to drive social changes because, "societies fail to be aware of the alternatives to the values embedded in it [technology]" (Merritt Roe Smith).

Technological determinism has been defined as an approach that identifies technology, or technological advances, as the central causal element in processes of social change (Croteau and Hoynes). As a technology is stabilized, its design tends to dictate users' behaviors, consequently diminishing human agency. This stance however ignores the social and cultural circumstances in which the technology was developed. Sociologist Claude Fischer (1992) characterized the most prominent forms of technological determinism as "billiard ball" approaches, in which technology is seen as an external force introduced into a social situation, producing a series of ricochet effects.

Rather than acknowledging that a society or culture interacts with and even shapes the technologies that are used, a technological determinist view holds that "the uses made of technology are largely determined by the structure of the technology itself, that is, that its functions follow from its form" (Neil Postman). However, this is not to be confused with the inevitability thesis (Daniel Chandler), which states that once a technology is introduced into a culture that what follows is the inevitable development of that technology.

For example, we could examine why Romance Novels have become so dominant in our society compared to other forms of novels like the Detective or Western novel. We might say that it was because of the invention of the perfect binding system developed by publishers. This was where glue was used instead of the time-consuming and very costly process of binding books by sewing in separate signatures. This meant that these books could be mass-produced for the wider public. We would not be able to have mass literary without mass production. This example is closely related to Marshall McLuhan's belief that print helped produce the nation state. This moved society on from an oral culture to a literate culture but also introduced a capitalist society where there was clear class distinction and individualism. As Postman maintains

"the printing press, the computer, and television are not therefore simply machines which convey information. They are metaphors through which we conceptualize reality in one way or another. They will classify the world for us, sequence it, frame it, enlarge it, reduce it, argue a case for what it is like. Through these media metaphors, we do not see the world as it is. We see it as our coding systems are. Such is the power of the form of information."

Hard and soft determinism

In examining determinism **Hard determinism** can be contrasted with **Soft Determinism**. A compatibilist says that it is possible for free will and determinism to exist in the world together while a incompatibilist would say that they can not and there must be one or the other. Those who support determinism can be further divided.

Hard determinists would view technology as developing independent from social concerns. They would say that technology creates a set of powerful forces acting to regulate our social activity and its meaning. According to this view of determinism we organize ourselves to meet the needs of technology and the outcome of this organization is beyond our control or we do not have the freedom to make a choice regarding the outcome.

Soft Determinism, as the name suggests, is a more passive view of the way technology interacts with socio-political situations. Soft determinists still subscribe to the fact that technology is the guiding force in our evolution, but would maintain that we have a *chance* to make decisions regarding the outcomes of a situation. This is not to say that free will exists but it is the possibility for us to *roll the dice* and see what the outcome is. A slightly different variant of soft determinism is the 1922 technology-driven theory of social change proposed by William Fielding Ogburn, in which society must adjust to the consequences of major inventions, but often does so only after a period of cultural lag.

Technology as neutral

Individuals who consider technology as neutral see technology as neither good nor bad and what matters are the ways in which we use technology. An example of a neutral viewpoint is, "guns are neutral and its up to how we use them whether it would be 'good or bad'" (Green, 2001). Mackenzie and Wajcman believe that technology is neutral only if it's never been used before, or if no one knows what it is going to be used for (Green, 2001). In effect, guns would be classified as neutral if and only if society were none the wiser of their existence and functionality (Green, 2001). Obviously, such a society is non-existent and once becoming knowledgeable about technology, the society is drawn into a social progression where nothing is 'neutral about society' (Green). According to Lelia Green, if one believes technology is neutral, one would disregard the cultural and social conditions that technology was produced (Green, 2001). This view is also referred to as technological instrumentalism.

Criticism

Scepticism about technological determinism emerged alongside increased pessimism about techno-science in the mid-20th century, in particular around the use of nuclear energy in the production of nuclear weapons, Nazi human experimentation during World War II, and the problems of economic development in the third world (also known as the global south). As a direct consequence, desire for greater control of the course of development of technology gave rise to disenchantment with the model of technological determinism in academia.

Modern theorists of technology and society no longer consider technological determinism to be a very accurate view of the way in which we interact with technology, even though determinist assumptions and language fairly saturate the writings of many boosters of technology, the business pages of many popular magazines, and much reporting on technology. Instead, research in science and technology studies, social construction of technology and related fields have emphasised more nuanced views that resist easy causal formulations. They emphasise that "The relationship between technology and society cannot be reduced to a simplistic cause-and-effect formula. It is, rather, an 'intertwining'", whereby technology does not determine but "...operates, and are operated upon in a complex social field" (Murphie and Potts).

In his article "Subversive Rationalization: Technology, Power and Democracy with Technology," Andrew Feenberg argues that **technological determinism** is not a very well founded concept by illustrating that two of the founding theses of determinism are easily questionable and in doing so calls for what he calls democratic rationalization (Feenberg 210-212).

Prominent opposition to technologically determinist thinking has emerged within work on the social construction of technology (SCOT). SCOT research, such as that of Mackenzie and Wajcman (1997) argues that the path of innovation and its social consequences are strongly, if not entirely shaped by society itself through the influence of culture, politics, economic arrangements, regulatory mechanisms and the like. In its strongest form, verging on social determinism, "What matters is not the technology itself, but the social or economic system in which it is embedded" (Langdon Winner).

In his influential but contested article "Do Artifacts Have Politics?", Langdon Winner illustrates a form of technological determinism by elaborating instances in which artifacts can have politics.

Although "The deterministic model of technology is widely propagated in society" (Sarah Miller), it has also been widely questioned by scholars. Lelia Green explains that, "When technology was perceived as being outside society, it made sense to talk about technology as neutral". Yet, this idea fails to take into account that culture is not fixed and society is dynamic. When "Technology is implicated in social processes, there is nothing neutral about society" (Lelia Green). This confirms one of the major problems with "technological determinism and the resulting denial of human responsibility for change. There is a loss of human involvement that shape technology and society" (Sarah Miller).

Another conflicting idea is that of technological somnambulism, a term coined by Winner in his essay "Technology as Forms of Life". Winner wonders whether or not we are simply *sleepwalking* through our existence with little concern or knowledge as to how we truly interact with technology. In this view it is still possible for us to wake up and once again take control of the direction in which we are traveling (Winner 104). However, it requires society to adopt Ralph Schroeder's claim that, "users don't just passively consume technology, but actively transform it".

In opposition to technological determinism are those who subscribe to the belief of social determinism and postmodernism. Social determinists believe that social circumstances alone select which technologies are adopted, with the result that no technology can be considered "inevitable" solely on its own merits. Technology and culture are not neutral and when knowledge comes into the equation, technology becomes implicated in social processes. The knowledge of how to create and enhance technology, and of how to use technology is socially bound knowledge. Postmodernists take another view, suggesting that what is right or wrong is dependent on circumstance. They believe technological change can have implications on the past, present and future. While they believe technological change is influenced by changes in government policy, society and culture, they consider the notion of change to be a paradox, since change is constant.

Media and cultural studies theorist Brian Winston, in response to technological determinism, developed a model for the emergence of new technologies which is centered on the Law of the suppression of radical potential. In two of his books - *Technologies of Seeing: Photography, Cinematography and Television* (1997) and *Media Technology and Society* (1998) - Winston applied this model to show how technologies evolves over time, and how their 'invention' is mediated and controlled by society and societal factors which suppress the radical potential of a given technology.

Notable Technological Determinists

Thomas L. Friedman, American journalist, columnist and author, admits to being a technological determinist in his book *The World is Flat*.

Futurist Raymond Kurzweil's theories about a technological singularity follow a technologically deterministic view of history.

Some interpret Karl Marx as advocating technological determinism, with such statements as "The windmill gives you society with the feudal lord: the steam-mill, society with the industrial capitalist" (*The Poverty of Philosophy,* 1847), but others argue that Marx was not a determinist.

Technological determinist Walter Ong reviews the societal transition from an oral culture to a written culture in his work "Orality and Literacy." He asserts that this particular development is attributable to the use of new technologies of literacy (particularly print and writing,) to communicate thoughts which could previously only be verbalized. He furthers this argument by claiming that writing is purely context dependent as it is a "secondary modelling system" (8). Reliant upon the earlier primary system of spoken language, writing manipulates the potential of language as it depends purely upon the visual sense to communicate the intended information. Furthermore, the rather stagnant technology of literacy distinctly limits the usage and influence of knowledge, it unquestionably effects the evolution of society. In fact, Ong asserts that "more than any other single invention, writing has transformed human consciousness" (Ong 1982: 78).

Subset of Technological Determinism

Media determinism, a subset of technological determinism, is a philosophical and sociological position which posits the power of the media to impact society. As a theory of change, it is seen as a cause and effect relationship. New media technologies bring about change in society. Much like the "magic bullet" theories of mass communication, media determinism provides a somewhat simplistic explanation for very complicated scenarios. Cause and effect relationships are reduced to their most basic premise, and explained as such. Techno-centrist theories make everything explainable in light of the media's relation to technological developments. Two leading media determinists are the Canadian scholars Harold Innis and Marshall McLuhan.

Chapter- 6

Technological Escalation

Technological escalation describes the fact that whenever two parties are in competition, each side tends to employ continuing technological improvements to defeat the other. Technology is defined here as a creative invention, be it an object or a method of using an object. This is a natural result of mankind's use of our brains, and the nature of science and technology that understanding and innovations build on each other.

Escalation is usually a negative term, meaning to make bigger in a bad way. However, if two companies are in an escalating war to produce the best widget, the consumer benefits because they get a choice between better and better widgets. In this interpretation, good modern illustrations are the comics Spy vs. Spy and the vicious circle of email spam filters vs. spams by the email security programmers and the spammers.

Objects and methods

Technology can include methods as well as objects. The ability to produce chlorine gas was prevalent before the first world war, but using it during battle was an (arguably unethical but) superior military tactic, and thus a technological escalation.

Paradigms, or worldviews

There is a philosophical difference of opinion on what constitutes the advancement of civilization, and technological progress lies at the heart of the discussion. One view holds that the most advanced civilization is the one that is the most peaceful, compassionate, tolerant (of non-evil acts), just, and worldly.

The other view holds that the most advanced civilization is the one which has the most advanced technology; that civilization 'deserves' to succeed and defeat others, perhaps subjugating them in the process.

One might fairly question if these are, in fact, really in conflict, or if this is merely a misunderstanding by one or both parties. Such questioning would ask such questions as:

- Is the purpose of technology an indicator of advancement or the cause of advancement?

- What ethical constructs should rule the use of technology (power) to further the desires of a social group?
- How should social groups act towards each other when they come into conflict?
- Is technological escalation akin to 'greed' (one of the '7 deadly sins') in that a controlled or moderate amount is a healthy thing serving to motivate one towards a better life, while an immoderate or unrestrained use leads inevitably to evil acts?

Military technological escalation

Technological escalation has been one of the most often-cited factors for the dominance of one civilization over another: those with flint, *all else being equal*, will defeat those with softer or duller stone spear heads, those with the bow defeat those with only the sling, those with the gun defeat those with the bow.

This view was dominant during the Enlightenment where science and technology began to be seen as the only way to approach natural law, subordinating views of mastery by social, moral, spiritual or other means. It was perhaps apparent that due to superior firepower and the ability to support larger numbers of people due to intensive agriculture which in turn relied on technological support (such as the iron plough and horse or ox yoke), the colonists were triumphing over other cultures. The doctrines of social evolution and scientism became more common at this time, in the form of a belief in the inevitability of the triumph of better arms and better tools - which made "better people" in the self-serving view of those with such views.

Through the 19th century, it was recognized that this put obligations on the conquerors, what Rudyard Kipling called the White Man's Burden. This began to dissolve as the 20th century commenced with the failure of several disarmament conferences, and a series of arms races, beginning with that between naval powers (Britain, United States, Germany, Russia and Japan). When previously minor power Japan destroyed the fleet of Russia in 1905, it acceded to the role of a "major" — clearly it had done this through technological mastery, as it was not even (in the European view) 40 years out of a long isolated period in which its had suppressed all forms of firearms.

This view of technological mastery guaranteeing ascendance continued with very rapid technological advancement during World War I. By this point, the competing polities were only concerned with their own survival and conquering all the others — the notion of coexistence was subordinated in most, but especially in Germany, Russia and the United States, to the idea of technological escalation to the point of triumph of one master race or economic system. Germany and Japan lost World War II despite various ways (Germany in rockets and energy conservation, Japan in aircraft and materials conservation) in which they had clearly superior grasp of civilian technology.

However, the doctrine that technology, rather than say fossil fuel reserves or control of the education of people who ruled the subject peoples, suited the British Empire in its negotiations with the United States to pass off many imperial obligations, where Britain wished to retain such strategic advantages, and also suited the USSR which wished to make no overt point of its massive oil reserves nor its total control of the belief system of great numbers of its own people, and preferred to play the role of victim nation which would "inevitably" win its confrontation with the "decadent" West.

As after the destruction of the Tsar's fleet by Japan in 1905, the dissolution of the Soviet Union in 1991 left Russia, once again, reconsidering what causes empires to rise and fall.

Due to the immense cost of maintaining the mutual assured destruction balance of terror during the Cold War, and the increasing number of so-called dual use technologies after that War, however, it became important to look more deeply at the dynamics of technological conflicts and escalations. Accordingly, the subject of escalation and the dynamics of technology transfer have come under some scrutiny, more in Russia than in the United States.

Motives

Motives for technological escalation go far deeper than simple desire to triumph in the "necessary evil" of conflict between states. For one thing the massive military spending of the 20th century led to what many called "war profiteering" — supply of matériel to nation-states for profit. Although some, like the Krupps of Germany, lost a great deal, others, like the Messerschmitts or Daimlers, did very well — the latter remains a prominent name in automotives today.

Another convergence is the role of media, especially radio and television, not only in propaganda but also directly in warfare: signals warfare in particular has become a major field, and led to the modern specialized study of information warfare and of civilian persuasion technology. It is often observed that this has shaped the modern discourse on advertising, and the invention of technologies (such as video games) for entertainment that are also of use in military training. So another motive of technological escalation is the provision of new toys, and training devices, that can feed a military-industrial complex.

Importantly, a key motive in all competition in all mammal species, especially among males, is simple showing off. Such abstracted arms races as the space race, for instance, show that there need not be any direct gain or material motive involved to cause vast sums of skill and energy to go into goals that are, ultimately, symbolic.

However, some claim that the space race had by far more spin-off value in the commercial sector per dollar than any money ever invested directly in the military in the 20th century — often estimated as much as seven times greater. In part this is due to the increased demand for extreme environment clothing and life support technologies required for investigating hostile environments for science and for oil exploration.

These motives (commercial spin-offs, showing off by wasting resources, control of opinion of an elite class of technologists users and scientists whom one will need in warfare, and simple profit) combine in most cases to render technological escalation all but inevitable once a conflict has begun between two technological and industrial civilizations. For these and other reasons, Marxian economics focuses on the inevitability of wars under capitalism.

By contrast, theorists of green economics tend to subscribe to the view from feminism that it is the "showing off" and the need to waste resources to prove one's competence and sexiness, that dominate the logic of technological escalation of warfare.

One interpretation is that capitalism permits inferior beings qualified only for deception to lay access to media with which they can lay claim to the achievements of the superior beings who actually create the technology and do the science. Another interpretation is that the ability to grab attention being in fact the point of the whole exercise, superiority must itself be measured by ability to control the media and claim credit for things done by others — a form of fraud-based kleptocracy. Thus the issue is a deeper one of sexual differences in cognition — females pay attention to males in proportion to their ability to waste great amounts of resources, and males compete with other males to gain power to do so.

Proponents claim it would be hard to imagine a theory that is more strongly rooted in biology than this, and more difficult to convincingly and fully refute, and that the theory is not much criticized because there is no way to gain status from criticizing something so clearly and obviously true.

Effects

Technological escalation has occurred in many wars, and been key to victory in some of their battles — the longbows at the Battle of Agincourt and the chariots of the Hyksos. Clearly other factors exist as in the Vietnam War, the United States utilized a far higher level of technology and production than the Viet Cong, and the technology specific to fighting in Southeast Asia did improve during the war progressed — but other factors overshadowed this technological superiority.

In the present day, the effects of technological escalation on the largest scales are not disputed: constant threat of terrorism and asymmetric warfare due to, for instance, nuclear proliferation spreading to militant groups and individuals, and a great degree of tension and confrontation between an increasing number of industrial states that have the capacity to wipe out each other's populations — thus, an increasing percentage of the skills and energy and resources of each such power is devoted to anticipating and preventing the conflict arising from the weapons that they, due to whatever motives, feel compelled to produce.

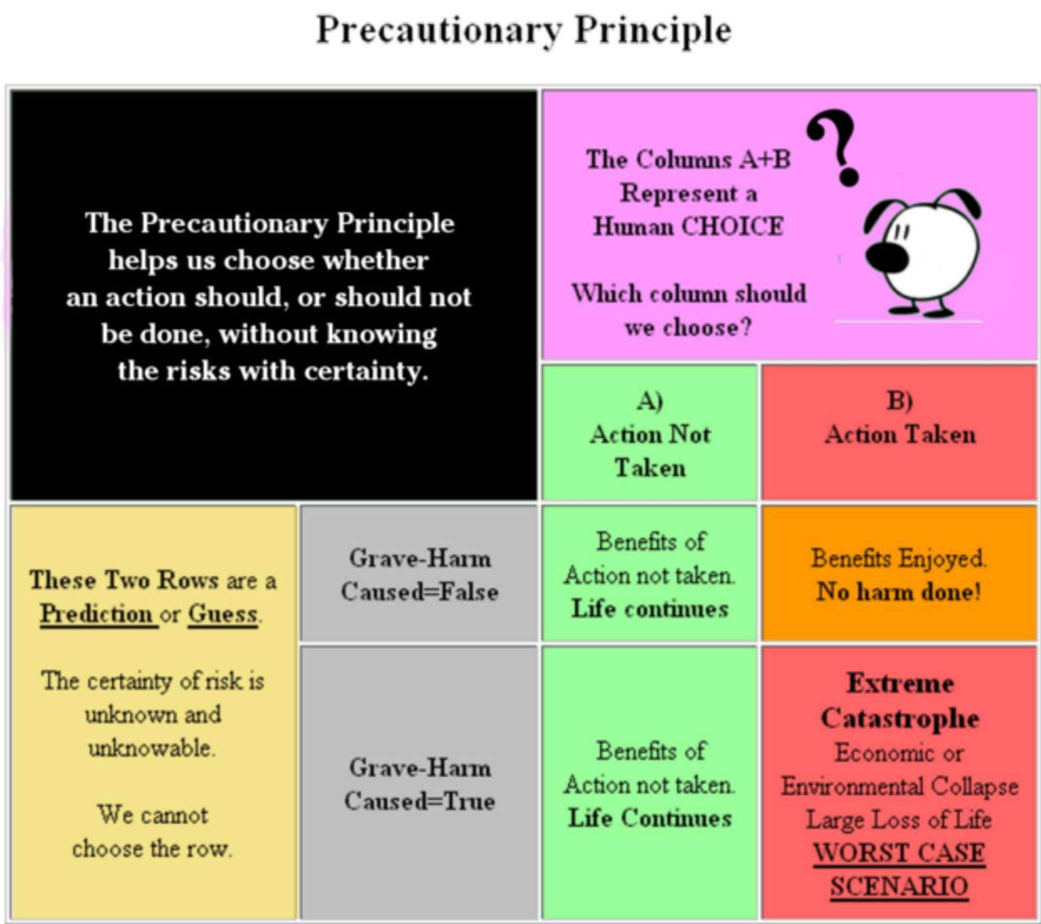
However, these effects are often taken as inevitable or manageable, and much more explicit attention is paid to the commercial effects of technological escalation, which is most usually known by the euphemism **innovation**.

Examples of commercial technological escalation are often indistinguishable from examples of pro-technology propaganda, of which the 1980s AI boom and much larger and global 1990s dotcom boom are the best known examples. In each case, the applicability of expert systems and e-commerce respectively had yet to be proven, but the same factors as above led to the invented "need" to have the "latest and greatest" technology to brag about in one's advertising, and to have at least some of one's portfolio in the "sexy", "high-tech", "growth" stocks — which of course turned out largely to be incapable of sustaining the required profitability.

The effects of technological escalation are also trivially visible in the computer gaming world — where access to higher Internet bandwidth and faster computers tend to determine success in the popular first person shooter and even, increasingly, the real time strategy computer games. This of course leads to a larger and larger percentage of one's income being "invested" in computer hardware for these purposes, perhaps in pursuit of some prize or recognition for success at a game.

Chapter- 7

Precautionary Principle



The Precautionary Principle illustrated as a decision matrix

The **precautionary principle** states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those taking the action.

This principle allows policy makers to make discretionary decisions in situations where there is the possibility of harm from taking a particular course or making a certain decision when extensive scientific knowledge on the matter is lacking. The principle implies that there is a social responsibility to protect the public from exposure to harm, when scientific investigation has found a plausible risk. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result.

In some legal systems, as in the law of the European Union, the application of the precautionary principle has been made a statutory requirement.

Formulations of the precautionary principle

Many definitions of the precautionary principle exist. Precaution may be defined as "*caution in advance*," "*caution practised in the context of uncertainty*," or *informed prudence*. All definitions have two key elements.

1. an expression of a need by decision-makers to anticipate harm before it occurs. Within this element lies an implicit reversal of the onus of proof: under the precautionary principle it is the responsibility of an activity proponent to establish that the proposed activity will not (or is very unlikely to) result in significant harm.
2. the establishment of an obligation, if the level of harm may be high, for action to prevent or minimise such harm even when the absence of scientific certainty makes it difficult to predict the likelihood of harm occurring, or the level of harm should it occur. The need for control measures increases with both the level of possible harm and the degree of uncertainty.

One of the primary foundations of the precautionary principle, and globally accepted definitions, results from the work of the Rio Conference, or "Earth Summit" in 1992. Principle #15 of the Rio Declaration notes:

"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

This definition is important for several reasons. First, it explains the idea that scientific uncertainty should not preclude preventative measures to protect the environment. Second, the use of "cost-effective" measures indicates that costs can be considered. This is different from a "no-regrets" approach, which ignores the costs of preventative action.

The 1998 Wingspread Statement on the Precautionary Principle summarizes the principle this way: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically." (The Wingspread Conference on the Precautionary Principle was convened by the Science and Environmental Health Network).

The February 2, 2000 European Commission Communication on the Precautionary Principle notes: "The precautionary principle applies where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU".

The January 29, 2000 Cartagena Protocol on Biosafety says: "Lack of scientific certainty due to insufficient relevant scientific information . . . shall not prevent the Party of import, in order to avoid or minimize such potential adverse effects, from taking a decision, as appropriate, with regard to the import of the living modified organism in question."

It is important to emphasize that, although this principle operates in the context of scientific uncertainty, it is considered by its proponents to be applicable only when, on the basis of the best scientific advice available, there is good reason to believe that harmful effects might occur.

The precautionary principle is most often applied in the context of the impact of human actions on the environment and human health, as both involve complex systems where the consequences of actions may be unpredictable.

As applied to environmental policy, the precautionary principle stipulates that for practices such as the release of radiation or toxins or massive deforestation the burden of proof lies with the advocates. Concerning potential risks to public health, examples of cases in which the precautionary principle has been advocated (but not always accepted) are: the commercialization of genetically modified foods, the use of growth hormones in cattle raising, measures to prevent the "mad cow" disease, health claims linked to phthalates in PVC toys, among many others.

An important element of the precautionary principle is that its most meaningful applications pertain to those that are potentially irreversible, for example where biodiversity may be reduced. With respect to bans on substances like mercury in thermometers, freon in refrigeration, or even carbon dioxide exhaust from automobile engines and power plants, it implies:

... a willingness to take action in advance of scientific proof [or] evidence of the need for the proposed action on the grounds that further delay will prove ultimately most costly to society and nature, and, in the longer term, selfish and unfair to future generations.

The concept includes an implicit ethical responsibility towards maintaining the integrity of natural systems, and acknowledges the fallibility of human understanding.

Some environmental commentators take a more stringent interpretation of the precautionary principle, stating that proponents of a new potentially harmful technology must show the new technology is without major harm before the new technology is used.

Origins and theory

The formal concept evolved out of the German socio-legal tradition in the 1930s, centering on the concept of good household management. In German the concept is *Vorsorgeprinzip*, which translates into English as *precaution principle*.

Many of the concepts underpinning the precautionary principle pre-date the term's inception. For example, the essence of the principle is captured in a number of cautionary aphorisms such as "an ounce of prevention is worth a pound of cure", "better safe than sorry", and "look before you leap". The precautionary principle may also be interpreted as the evolution of the ancient medical principle of "first, do no harm" to apply to institutions and institutional decision-making processes rather than individuals.

The precautionary principle is in some ways an expansion of the English common law concept of 'duty of care' originating in the decisions of the judge Lord Esher in the late 1800s. According to Lord Esher: "Whenever one person is by circumstances placed in such a position with regard to another that everyone of ordinary sense who did think, would at once recognise that if he did not use ordinary care and skill in his own conduct with regard to those circumstances, he would cause danger or injury to the person, or property of the other, a duty arises to use ordinary care and skill to avoid such danger". This statement clearly contains elements of foresight and responsibility, but does not refer to a lack of certainty, as the word "would" is used rather than "might", or "could". The other important difference is that the duty of care applies only to people and property, not to the environment.

In economics, the precautionary principle has been analysed in terms of the effect on rational decision-making of the interaction of irreversibility and uncertainty. Authors such as Epstein (1980) and Arrow and Fischer (1974) show that irreversibility of possible future consequences creates a quasi-option effect which should induce a "risk-neutral" society to favor current decisions that allow for more flexibility in the future. Gollier et al. (2000) conclude that "more scientific uncertainty as to the distribution of a future risk– that is, a larger variability of beliefs– should induce Society to take stronger prevention measures today."

Application

The application of the precautionary principle is hampered by both lack of political will, as well as the wide range of interpretations placed on it. One study identified 14 different formulations of the principle in treaties and nontreaty declarations. R.B. Stewart (2002) reduced the precautionary principle to four basic versions:

1. Scientific uncertainty should not automatically preclude regulation of activities that pose a potential risk of significant harm (Non-Preclusion PP).
2. Regulatory controls should incorporate a margin of safety; activities should be limited below the level at which no adverse effect has been observed or predicted (Margin of Safety PP).
3. Activities that present an uncertain potential for significant harm should be subject to best technology available requirements to minimize the risk of harm unless the proponent of the activity shows that they present no appreciable risk of harm (BAT PP).
4. Activities that present an uncertain potential for significant harm should be prohibited unless the proponent of the activity shows that it presents no appreciable risk of harm (Prohibitory PP).

In deciding how to apply the principle, analysis may use a cost-benefit analysis that factors in both the opportunity cost of not acting, and the option value of waiting for further information before acting. One of the difficulties of the application of the principle in modern policy-making is that there is often an irreducible conflict between different interests, so that the debate necessarily involves politics.

Strong vs. weak

Strong precaution holds that regulation is required whenever there is a possible risk to health, safety, or the environment, even if the supporting evidence is speculative and even if the economic costs of regulation are high. In 1982, the United Nations World Charter for Nature gave the first international recognition to the strong version of the principle, suggesting that when "potential adverse effects are not fully understood, the activities should not proceed." The widely publicized Wingspread Declaration, from a meeting of environmentalists in 1998, is another example of the strong version. 'Strong precaution' can also be termed as a "no-regrets" principle, where costs are not considered in preventative action.

Weak precaution holds that lack of scientific evidence does not preclude action if damage would otherwise be serious and irreversible. Humans practice weak precaution every day, and often incur costs, to avoid hazards that are far from certain: we do not walk in moderately dangerous areas at night, we exercise, we buy smoke detectors, we buckle our seatbelts.

According to a publication by the New Zealand Treasury Department,

The weak version [of the Precautionary Principle] is the least restrictive and allows preventive measures to be taken in the face of uncertainty, but does not require them (eg, Rio Declaration 1992; United Nations Framework Convention of Climate Change 1992). To satisfy the threshold of harm, there must be some evidence relating to both the likelihood of occurrence and the severity of consequences. Some, but not all, require consideration of the costs of precautionary measures. Weak formulations do not preclude weighing benefits against the costs. Factors other than scientific uncertainty, including economic considerations, may provide legitimate grounds for postponing action. Under weak formulations, the requirement to justify the need for action (the burden of proof) generally falls on those advocating precautionary action. No mention is made of assignment of liability for environmental harm.

Strong versions justify or require precautionary measures and some also establish liability for environmental harm, which is effectively a strong form of "polluter pays". For example, the Earth Charter states: "When knowledge is limited apply a precautionary approach …. Place the burden of proof on those who argue that a proposed activity will not cause significant harm, and make the responsible parties liable for environmental harm." Reversal of proof requires those proposing an activity to prove that the product, process or technology is sufficiently "safe" before approval is granted. Requiring proof of "no environmental harm" before any action proceeds implies the public is not prepared to accept any environmental risk, no matter what economic or social benefits may arise (Peterson, 2006). At the extreme, such a requirement could involve bans and prohibitions on entire classes of potentially threatening activities or substances (Cooney, 2005). Over time, there has been a gradual transformation of the precautionary principle from what appears in the Rio Declaration to a stronger form that arguably acts as restraint on development in the absence of firm evidence that it will do no harm.

International agreements and declarations

The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol, and among other international treaties and declarations is reflected in the 1992 Rio Declaration on Environment and Development (signed at the United Nations Conference on Environment and Development).

"Principle" vs. "approach"

No introduction to the precautionary principle would be complete without brief reference to the difference between the precautionary **principle** and the precautionary **approach**. Principle 15 of the Rio Declaration 1992 states that: "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation." As Garcia (1995) pointed out, "the wording, largely similar to that of the principle, is subtly different in that: (1) it recognizes that there may be differences in local capabilities to apply the approach, and (2) it calls for cost-effectiveness in applying the approach, e.g., taking economic and social costs into account." The 'approach' is generally considered a softening of the 'principle'.

"As Recuerda has noted, the distinction between the ´precautionary principle` and a ´precautionary approach` is diffuse and, in some contexts, controversial. In the negotiations of international declarations, the United States has opposed the use of the term ´principle` because this term has special connotations in legal language, due to the fact that a ´principle of law` is a source of law. This means that it is compulsory, so a court can quash or confirm a decision through the application of the precautionary principle. In this sense, the precautionary principle is not a simple idea or a desideratum but a source of law. This is the legal status of the precautionary principle in the European Union. On the other hand, an ´approach` usually does not have the same meaning,16 although in some particular cases an approach could be binding. A precautionary approach is a particular ´lens` used to identify risk that every prudent person possesses (Recuerda, 2008)

European Commission

On 2 February 2000, the European Commission issued a Communication on the precautionary principle, in which it adopted a procedure for the application of this concept, but without giving a detailed definition of it. Paragraph 2 of article 191 of the Lisbon Treaty states that

"Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay."

After the adoption of the European Commission's Communication on the precautionary principle, the principle has come to inform much EU policy, including that in areas beyond that of environmental policy. It is implemented, for example, in the EU food law and also affects, among others, policies relating to consumer protection, trade and research, and technological development. While a comprehensive definition of the precautionary principle was never formally adopted by the EU, a working definition and implementation strategy for the EU context has been proposed by Rene von Schomberg in Fisher et al. (2006):

"Where, following an assessment of available scientific information, there are reasonable grounds for concern for the possibility of adverse effects but scientific uncertainty persists, provisional risk management measures based on a broad cost/benefit analysis whereby priority will be given to human health and the environment, necessary to ensure the chosen high level of protection in the Community and proportionate to this level of protection, may be adopted, pending further scientific information for a more comprehensive risk assessment, without having to wait until the reality and seriousness of those adverse effects become fully apparent".

USA

On July 18, 2005, the City of San Francisco passed a Precautionary Principle Purchasing ordinance, which requires the city to weigh the environmental and health costs of its $600 million in annual purchases – for everything from cleaning supplies to computers. Members of the Bay Area Working Group on the Precautionary Principle including the Breast Cancer Fund, helped bring this to fruition.

Japan

In 1997, Japan tried to use the consideration of the precautionary principle in a WTO SPS Agreement on the Application of Sanitary and Phytosanitary Measures case, as Japan's requirement to test each variety of agricultural products (apples, cherries, peaches, walnuts, apricots, pears, plums and quinces) for the efficacy of treatment against codling moths was challenged.

This moth is a pest that does not occur in Japan, and whose introduction has the potential to cause serious damage. The United States claimed that it was not necessary to test each variety of a fruit for the efficacy of the treatment, and that this varietal testing requirement was unnecessarily burdensome.

Australia

The most important Australian court case so far, due to its exceptionally detailed consideration of the precautionary principle, is Telstra Corporation Limited v Hornsby Shire Council. The case was heard in the New South Wales Land and Environment Court under Justice CJ Preston (24 April 2006).

The Principle was summarised by reference to the NSW *Protection of the Environment Administration Act 1991*, which itself provides a good definition of the principle:

"If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reasoning for postponing measures to prevent environmental degradation. In the application of the principle… decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of risk-weighted consequence of various options".

The most significant points of Justice Preston's decision are the following findings:

1. The principle and accompanying need to take precautionary measures is "triggered" when two prior conditions exist: a threat of serious or irreversible damage, and scientific uncertainty as to the extent of possible damage.
2. Once both are satisfied, "a proportionate precautionary measure may be taken to avert the anticipated threat of environmental damage, but it should be proportionate."

3. The threat of serious or irreversible damage should invoke consideration of five factors: the scale of threat (local, regional etc); the perceived value of the threatened environment; whether the possible impacts are manageable; the level of public concern, and whether there is a rational or scientific basis for the concern.
4. The consideration of the level of scientific uncertainty should involve factors which may include: what would constitute sufficient evidence; the level and kind of uncertainty; and the potential to reduce uncertainty.
5. The principle shifts the burden of proof. If the principle applies, the burden shifts: "a decision maker must assume the threat of serious or irreversible environmental damage is… a reality [and] the burden of showing this threat… is negligible reverts to the proponent…"
6. The precautionary principle invokes preventative action: "the principle permits the taking of preventative measures without having to wait until the reality and seriousness of the threat become fully known".
7. “The principle should not be used to try to avoid all risks."
8. The precautionary measures appropriate will depend on the combined effect of "the degree of seriousness and irreversibility of the threat and the degree of uncertainty… the more significant and uncertain the threat, the greater…the precaution required". “…measures should be adopted… proportionate to the potential threats".

Corporate

The Body Shop International, a UK-based cosmetics company, recently included the Precautionary Principle in their 2006 Chemicals Strategy.

Environment/health

Fields typically concerned by the precautionary principle are the possibility of:

- Global warming or abrupt climate change in general
- Extinction of species
- Introduction of new and potentially harmful products into the environment, threatening biodiversity (e.g., genetically modified organisms)
- Threats to public health, due to new diseases and techniques (e.g., AIDS transmitted through blood transfusion)
- Persistent or acute pollution (asbestos, endocrine disruptors...)
- Food safety (e.g., Creutzfeldt-Jakob disease)
- Other new biosafety issues (e.g., artificial life, new molecules)

The precautionary principle is often applied to biological fields because changes cannot be easily contained and have the potential of being global. The principle has less relevance to contained fields such as aeronautics, where the few people undergoing risk have given informed consent (e.g., a test pilot). In the case of technological innovation, containment of impact tends to be more difficult if that technology can self-replicate. Bill

Joy emphasized the dangers of replicating genetic technology, nanotechnology, and robotic technology in his article in *Wired Magazine*, "Why the future doesn't need us", though he does not specifically cite the precautionary principle. The application of the principle can be seen in the public policy of requiring pharmaceutical companies to carry out clinical trials to show that new medications are safe.

Oxford based philosopher Nick Bostrom discusses the idea of a future powerful superintelligence, and the risks that we/it face should it attempt to gain atomic level control of matter.

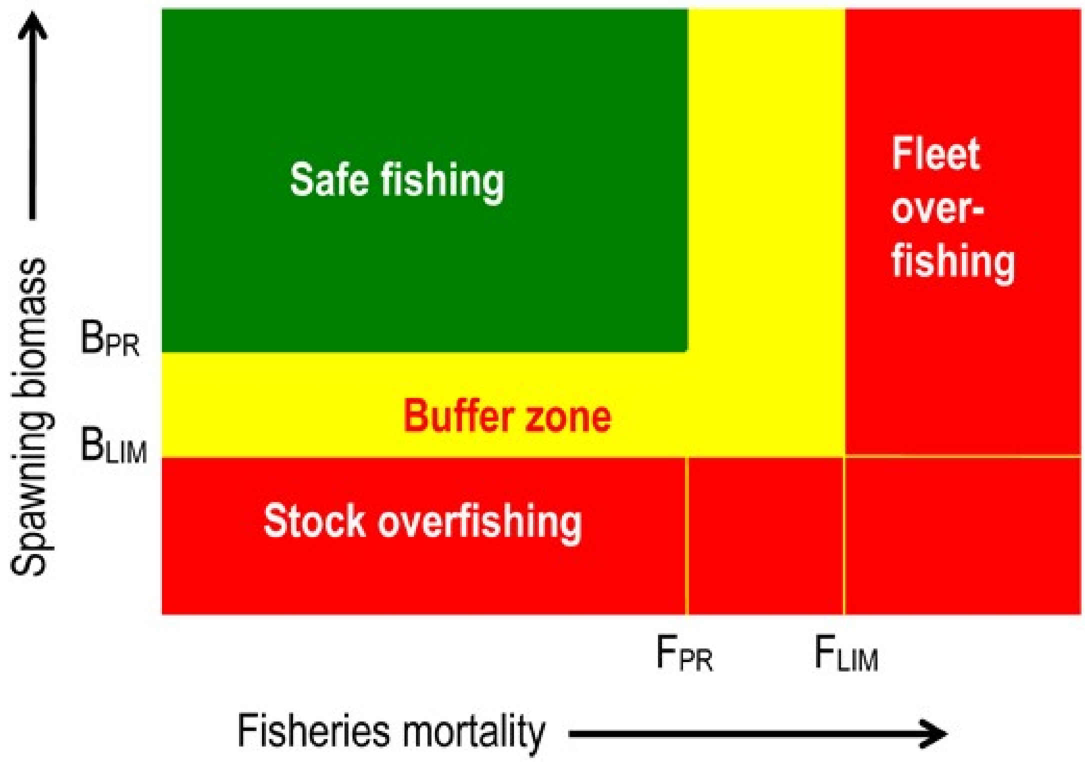
Application of the principle modifies the status of innovation and risk assessment: it is not the risk that must be avoided or amended, but a potential risk that must be prevented. Thus, in the case of regulation of scientific research, there is a third party beyond the scientist and the regulator: the consumer.

In an analysis concerning application of the precautionary principle to nanotechnology, Chris Phoenix and Mike Treder posit that there are *two forms* of the principle, which they call the "strict form" and the "active form". The former "requires inaction when action might pose a risk", while the latter means "choosing less risky alternatives when they are available, and [...] taking responsibility for potential risks."The academic Thomas Alured Faunce has argued for stronger application of the precautionary principle by chemical and health technology regulators particularly in relation to TI02 and ZNO nanoparticles in sunscreens, biocidal nanosilver in waterways and products whose manufacture, handling or recycling exposes humans to the risk of inhaling multi-walled carbon nanotubes.

Change of laws controlling societal norms

Associate Justice Martha Sosman's dissent in Goodridge v. Department of Public Health, the decision of the Supreme Judicial Court of Massachusetts that mandated legalization of same sex marriage, is an example of the precautionary principle as applied by analogy to changes in culturally significant social policy. She describes the myriad societal structures that rest on the institution of marriage, and points out the uncertainty of how they will be affected by this re-definition. The disagreement of the majority illustrates the difficulty of reaching agreement on the value of competing perspectives. Although the Goodridge case involved interpreting the state constitution, the substantive canon in Anglo-American jurisprudence that derogations of fundamental societal values should be narrowly construed is analogous to the precautionary principle favoring a statutory interpretation that comports with rather than damages the common law and established norms.

Resource management



The Traffic Light colour convention, showing the concept of Harvest Control Rule (HCR), specifying when a rebuilding plan is mandatory in terms of precautionary and limit reference points for spawning biomass and fishing mortality rate.

Several natural resources like fish stocks are now managed by precautionary approach, through Harvest Control Rules (HCR) based upon the precautionary principle. The figure indicates how the principle is implemented in the cod fisheries management proposed by the International Council for the Exploration of the Sea.

In classifying endangered species, the precautionary principle means that if there is doubt about an animal's or plant's exact conservation status, the one that would cause the strongest protective measures to be realized should be chosen. Thus, a species like the Silvery Pigeon that might exist in considerable numbers and simply be under-recorded or might just as probably be long extinct is not classified as "data deficient" or "extinct" (which both do not require any protective action to be taken), but as "critically endangered" (the conservation status that confers the need for the strongest protection), whereas the increasingly rare, but probably not yet endangered Emerald Starling is classified as "data deficient", because there is urgent need for research to clarify its status rather than for conservation action to save it from extinction.

If, for example, a large ground-water body that many people use for drinking water is contaminated by bacteria (e-coli 0157 H7, campylobacter or leptospirosis) and the source of contamination is strongly suspected to be dairy cows but the exact science is not yet able to provide absolute proof, then the cows should be removed from the environment until they are proved, by the dairy industry, not to be the source or until that industry ensures that such contamination will not recur.

Criticisms

Threshold of plausibility

The Wingspread Statement version of the PP takes the form "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically". When applying this principle, it is recommended that society establish a minimal threshold of scientific certainty or plausibility before undertaking precautions. Normally, no minimal threshold of plausibility is specified as a "triggering" condition, so that any indication that a proposed product or activity might harm health or the environment is sufficient to invoke the principle. Often the only precaution taken is a ban on the product or activity.

In Sancho vs. DOE, Helen Gillmor, Senior District Judge, wrote in a dismissal of Wagner's lawsuit which included a popular worry that the LHC could cause "destruction of the earth" by a black hole:

> Injury in fact requires some "credible threat of harm." *Cent. Delta Water Agency v. United States*, 306 F.3d 938, 950 (9th Cir. 2002). At most, Wagner has alleged that experiments at the Large Hadron Collider (the "Collider") have "potential adverse consequences." Speculative fear of future harm does not constitute an injury in fact sufficient to confer standing. *Mayfield*, 599 F.3d at 970.

Negative consequences of application

The Precautionary Principle may cause resentment, since people are more aware of negative changes than they are positive changes (i.e. a ban is more noted than allowing a proposal to proceed). Because of this effect, a technology which brings advantages may be banned by PP because of its potential for negative impacts, leaving the positive benefits unrealized.

The Hazardous Air Pollutant provisions in the 1990 amendments to the U.S. Clean Air Act are an example of the Precautionary Principle where the onus is now on showing a listed compound is harmless. Under this rule no distinction is made between those air Pollutants that provide a higher or lower risk, so operators tend to choose less-examined agents that are not on the existing list.

A California researcher has pointed out the fallacy of extrapolating possible risk of a proposed product or action, without examining equally closely the possible risks of **not** adopting the proposal. When looking at the proposal, policymakers tend to apply PP to that proposal while assuming the alternative(s) to be risk-free, which places an unfair burden on the proponents of the new product or activity.

Internal Inconsistency

The Precautionary Principle, applied to itself as a policy decision, may rule out its own use depending on the precise definition used; for example, Prohibitory PP as a policy decision would need to demonstrate that no substantial damage would result from the prohibition of products and technologies. For a potential example of this, the uncertain safety and long-term environmental effects of nuclear power led to its disfavor by precautionary groups, which may have resulted in greater carbon emissions through the use of coal power.

Perspective

- Critics of the principle argue that it is impractical, since every implementation of a technology carries some risk of negative consequences. For example, when the arrival of amplified music came on the scene, the risk of electrocution and deafness arose. However, this did not prevent it from becoming an artistic and cultural norm.

- A summary of some representative objections to the precautionary principle are described in a Reason article by Ronald Bailey which, using the Wingspread consensus as a starting point, argues the possibilities for misapplication of the principle.

Chapter- 8

Appropriate Technology

The Universal Nut Sheller in use in Uganda, an example of appropriate technology

Appropriate technology (AT) is technology that is designed with special consideration to the environmental, ethical, cultural, social, political, and economical aspects of the community it is intended for.

With environmental and ethical goals in mind, AT proponents claim their methods require fewer resources, are easier to maintain, and have less of an impact on the environment compared to techniques from mainstream technology, which they contend is wasteful and environmentally polluting.

The term is usually used to describe simple technologies proponents consider suitable for use in developing nations or less developed rural areas of industrialized nations. This form of "appropriate technology" usually prefers labor-intensive solutions over capital-intensive ones, although labor-saving devices are also used where this does not mean high capital or maintenance cost. In practice, appropriate technology is often something described as using the simplest level of technology that can effectively achieve the intended purpose in a particular location. In industrialized nations, the term *appropriate technology* takes a different meaning, often referring to engineering that takes special consideration of its social and environmental ramifications.

Background and definition

Sustainable portable classroom design proposal

The term *appropriate technology* came into some prominence during the 1973 energy crisis and the environmental movement of the 1970s. The term is typically used in two arenas: utilizing the most effective technology to address the needs of developing areas, and using socially and environmentally acceptable technologies in industrialized nations.

Appropriate technology founders

In the modern world appropriate technology is supposed to commence from Mahatma Gandhi who advocated small, local, mostly village-based technology to help India's villages become self reliant and thus aid in the freedom struggle against British and wealthy Indians. Gandhi's philosophies on technology were contrary to the belief that technological development was inherently synonymous with progress. He believed the powers of technology should be produced and used artfully and the benefits should be close to the individual and widely produced and distributed in a decentralised fashion. Gandhi claimed that his favorite technologies were the sewing machine, because it was invented out of love, and the bicycle, because it kept one's feet close to the ground. He felt that the paradigm of technology should not be one that disenfranchises people and be used in the pursuit of violence, rather, it should be used in a way that empowers people broadly. Integrated with the movement for self-rule, which was based on local economies, Gandhi championed the spinning wheel, or *charka*, employed in the khadi movement in the 1920s, which produced cloth locally in an act of civil disobedience of the imperial system, causing the British monopoly on textiles to collapse. However, in the movement for *Swaraj*, or home rule, Gandhi believed in a total revolution of production, saying that "It is not about getting rid of the tiger and keeping the tiger's nature". Having said "it is better for a machine to be idle than a man to be idle", Gandhi rejected the factory model of industrialisation, which valued production over the worker. He raised money to offer a reward for someone to invent a spinning wheel that could employ people in the same way, while producing more thread.

E. F. Schumacher who was very strongly influenced by Gandhi's philosophy took his village development further and coined "intermediate technology" in early 1970s. It is Schumacher through his book Small is Beautiful and later by creating the Intermediate Technology Development Group, now known as Practical Action, that really started the appropriate technology movement.

Stewart Brand, editor of the Whole Earth Catalog aided in popularizing the movement's roots and contributed ideas which inspired it, to the point where he is sometimes listed as a founder.

Appropriate technology practitioners

Some of the well known practitioners of the appropriate technology-sector include: M K Ghosh, B.V. Doshi, Buckminster Fuller, William Moyer (1933–2002), Amory Lovins, Sanoussi Diakité, Victor Papanek, Johan Van Lengen and Arne Næss (1912–2009)

Appropriate technology in developing areas

The term has often been applied to the situations of developing nations or underdeveloped rural areas of industrialized nations. The use of appropriate technology in these areas seeks to fill in the gaps left by conventional development which typically focuses on capital-intensive, urban development.

Appropriate technologies are not necessarily "low" technology, and can utilize recent research, for example cloth filters which were inspired by research into the way cholera is carried in water. A type of high-efficiency, white LED lights is used by the Light Up the World Foundation in remote areas of Nepal to replace more traditional forms of lighting that cause health problems associated with kerosene lamps or wood fires.

Intermediate technology

Coined by E. F. Schumacher, the term **intermediate technology** is similar to appropriate technology. It refers specifically to tools and technology that are significantly more effective and expensive than traditional methods, but still an order of magnitude (one tenth) cheaper than developed world technology. Proponents argue that such items can be easily purchased and used by poor people, and according to proponents can lead to greater productivity while minimizing social dislocation. Much intermediate technology can also be built and serviced using locally available materials and knowledge. This intermediate technology is conducive to decentralization, compatible with the laws of ecology, gentle in its use of scarce resources, and designed to serve the human person instead of making him the servant of machines.

Appropriate hard and soft technologies

According to Dr. Maurice Albertson and Faulkner, appropriate hard technology is “engineering techniques, physical structures, and machinery that meet a need defined by a community, and utilize the material at hand or readily available. It can be built, operated and maintained by the local people with very limited outside assistance (e.g., technical, material, or financial). it is usually related to an economic goal.” Some have explored the use of classroom projects for university-level physics students to research, develop and test appropriate hard technology.

Albertson and Faulkner consider Appropriate soft technology as technology that deals with “the social structures, human interactive processes, and motivation techniques. It is the structure and process for social participation and action by individuals and groups in analyzing situations, making choices and engaging in choice-implementing behaviors that bring about change.”

Appropriate technology in developed countries

The term *appropriate technology* is also used in developed nations to describe the use of technology and engineering that results in less negative impacts on the environment and society. E. F. Schumacher asserts that such technology, described in the book *Small is Beautiful* tends to promote values such as health, beauty and permanence, in that order.

Often the type of appropriate technology that is used in developed countries is "Appropriate and Sustainable Technology" (AST); or appropriate technology that, besides being functional and relatively cheap (though often more expensive than true AT), is also very durable and lasts a long time.

Determining a sustainable approach

Features such as low cost, low usage of fossil fuels and use of locally available resources can give some advantages in terms of sustainability. For that reason, these technologies are sometimes used and promoted by advocates of sustainability and alternative technology.

Besides using natural, locally available resources (e.g. wood or adobe), waste materials imported from cities using conventional (and inefficient) waste management may be gathered and re-used to build a sustainable living environment. Use of these cities' waste material allows the gathering of a huge amount of building material at a low cost. When obtained, the materials may be recycled over and over in the own city/community, using the cradle to cradle design method. Locations where waste can be found include landfills, junkyards, on water surfaces and anywhere around towns or near highways. Organic waste that can be reused to fertilise plants can be found in sewages. Also, town districts and other places (e.g. cemeteries) that are subject of undergoing renovation or removal can be used for gathering materials as stone, concrete, or potassium.

City construction

In order to increase the efficiency of a great number of city services (efficient water provisioning, efficient electricity provisioning, easy traffic flow, water drainage, decreased spread of disease with epidemics, ...), the city itself must first be built correctly. In the developing world, many cities are expanding rapidly and new ones are being built. Looking into the cities design in advance is a must for every developing nation.

Building construction

- Adobe (including the variation called Super Adobe),
- Rammed earth,
- Compressed earth block,
- Dutch brick,
- Animal products,
- Cob
- and/or other green building materials could be considered appropriate earth building technology for much of the developing world, as they make use of materials which are widely available locally and are thus relatively inexpensive.

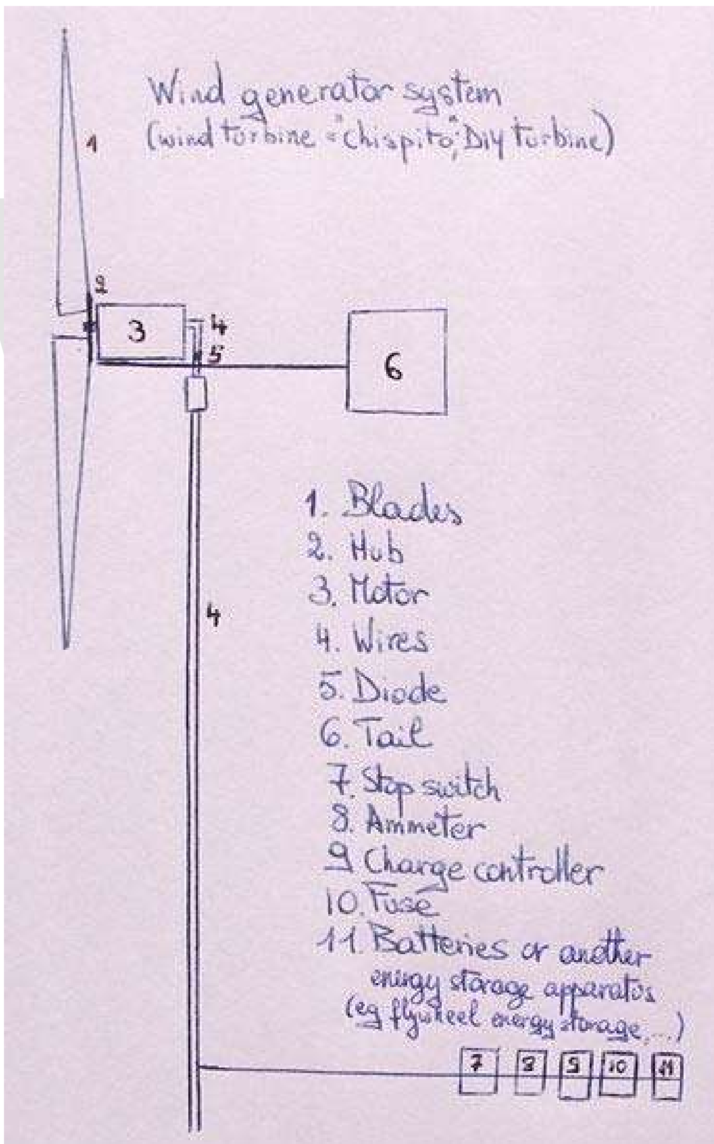
The local context must be considered as, for example, mudbrick may not be durable in a high rainfall area (although a large roof overhang and cement stabilisation can be used to correct for this), and, if the materials are not readily available, the method may be inappropriate. Other forms of natural building may be considered appropriate technology, though in many cases the emphasis is on sustainability and self-sufficiency rather than affordability or suitability. As such, many buildings are also built to function as autonomous buildings (e.g. earthships, ...). One example of an organisation that applies appropriate earthbuilding techniques would be Builders Without Borders.

The building structure must also be considered. Cost-effectiveness is an important issue in projects based around appropriate technology, and one of the most efficient designs herein is the public housing approach. This approach lets everyone have their own sleeping/recreation space, yet incorporate communal spaces e.g. mess halls, Latrines, public showers, ...

In addition, to decrease costs of operation (heating, cooling, ...) techniques as Earth sheltering, Trombe walls, ... are often incorporated.

Organizations as Architecture for Humanity also follows principles consistent with appropriate technology, aiming to serve the needs of poor and disaster-affected people.

Energy



Small-scale (DIY) generation system

The term soft energy technology was coined by Amory Lovins to describe "appropriate" renewable energy. "Appropriate" energy technologies are especially suitable for isolated and/or small scale energy needs. Electricity can be provided from:

- Photovoltaic (PV) solar panels, and (large) Concentrating solar power plants. PV solar panels made from Low-cost photovoltaic cells or PV-cells which have first been concentrated by a Luminescent solar concentrator-panel are also a good option. Especially companies as Solfocus make appropriate technology CSP plants which can be made from waste plastics polluting the surroundings.
- Solar thermal collector
- wind power (home do-it yourself turbines and larger-scale)
- micro hydro, and pico hydro
- human-powered handwheel generators
- other zero emission generation methods

Some intermediate technologies include:

- Biobutanol,
- biodiesel,
- and straight vegetable oil can be appropriate, direct biofuels in areas where vegetable oil is readily available and cheaper than fossil fuels.
- Anaerobic digestion power plants
- Biogas is another potential source of energy, particularly where there is an abundant supply of waste organic matter. A generator (running on biofuels) can be run more efficiently if combined with batteries and an inverter; this adds significantly to capital cost but reduces running cost, and can potentially make this a much cheaper option than the solar, wind and micro-hydro options.
- Feces (e.g. cow dung, human, etc.) can also be used. For example DEKA's Project Slingshot stirling electricity generator works this energy source to make electricity.
- Biochar is another similar energy source which can be obtained through charring of certain types of organic material (e.g. hazelnut shells, bamboo, chicken manure, ...) in a pyrolysis unit. A similar energy source is terra preta nova.

Finally, urine can also be used as a basis to generate hydrogen (which is an energy carrier). Using urine, hydrogen production is 332% more energy efficient than using water.

Electricity distribution could be improved so to make use of a more structured electricity line arrangement and universal AC power plugs and sockets (e.g. the CEE 7/7 plug). In addition, a universal system of electricity provisioning (e.g. universal voltage, frequency, ampère; e.g. 230 V with 50 Hz), as well as perhaps a better mains power system (e.g. through the use of special systems as perfected single wire earth returns; e.g. Tunisia's MALT-system, which features low costs and easy placement)

Electricity storage (which is required for autonomous energy systems) can be provided through appropriate technology solutions as deep-cycle and car-batteries (intermediate technology), long duration flywheels, electrochemical capacitors, compressed air energy storage (CAES), liquid nitrogen and pumped hydro. Thanks to Daniel Nocera, low-cost hydrogen storage is now also possible as a mid to short-term storage solution. Many solutions for the developing world are sold as a single package, containing a (micro) electricity generation power plant and energy storage. Such packages are called remote-area power supply

Water supply and treatment

Hand-operated, reciprocating, positive displacement, water pump in Košice-Tahanovce, Slovakia (walking beam pump)

As of 2006, waterborne diseases are estimated to cause 1.8 million deaths each year while about 1.1 billion people lack proper drinking water.

Water generally needs treatment before use, depending on the source and the intended use (with high standards required for drinking water). The quality of water from household connections and community water points in low-income countries is not reliably safe for direct human consumption. Water extracted directly from surface waters and open hand-dug shallow wells nearly always requires treatment.

Appropriate technology options in water treatment include both community-scale and household-scale point-of-use (POU) designs.

The most reliable way to kill microbial pathogenic agents is to heat water to a rolling boil. Other techniques, such as varying forms of filtration, chemical disinfection, and exposure to ultraviolet radiation (including solar UV) have been demonstrated in an array of randomized control trials to significantly reduce levels of waterborne disease among users in low-income countries.

Over the past decade, an increasing number of field-based studies have been undertaken to determine the success of POU measures in reducing waterborne disease. The ability of POU options to reduce disease is a function of both their ability to remove microbial pathogens if properly applied and such social factors as ease of use and cultural appropriateness. Technologies may generate more (or less) health benefit than their lab-based microbial removal performance would suggest.

The current priority of the proponents of POU treatment is to reach large numbers of low-income households on a sustainable basis. Few POU measures have reached significant scale thus far, but efforts to promote and commercially distribute these products to the world's poor have only been under way for a few years.

On the other hand, small-scale water treatment is reaching increasing fractions of the population in low-income countries, particularly in South and Southeast Asia, in the form of water treatment kiosks (also known as water refill stations or packaged water producers). While quality control and quality assurance in such locations may be variable, sophisticated technology (such as multi-stage particle filtration, UV irradiation, ozonation, and membrane filtration) is applied with increasing frequency. Such microenterprises are able to vend water at extremely low prices, with increasing government regulation. Initial assessments of vended water quality are encouraging.

Whether applied at the household or community level, some examples of specific treatment processes include:

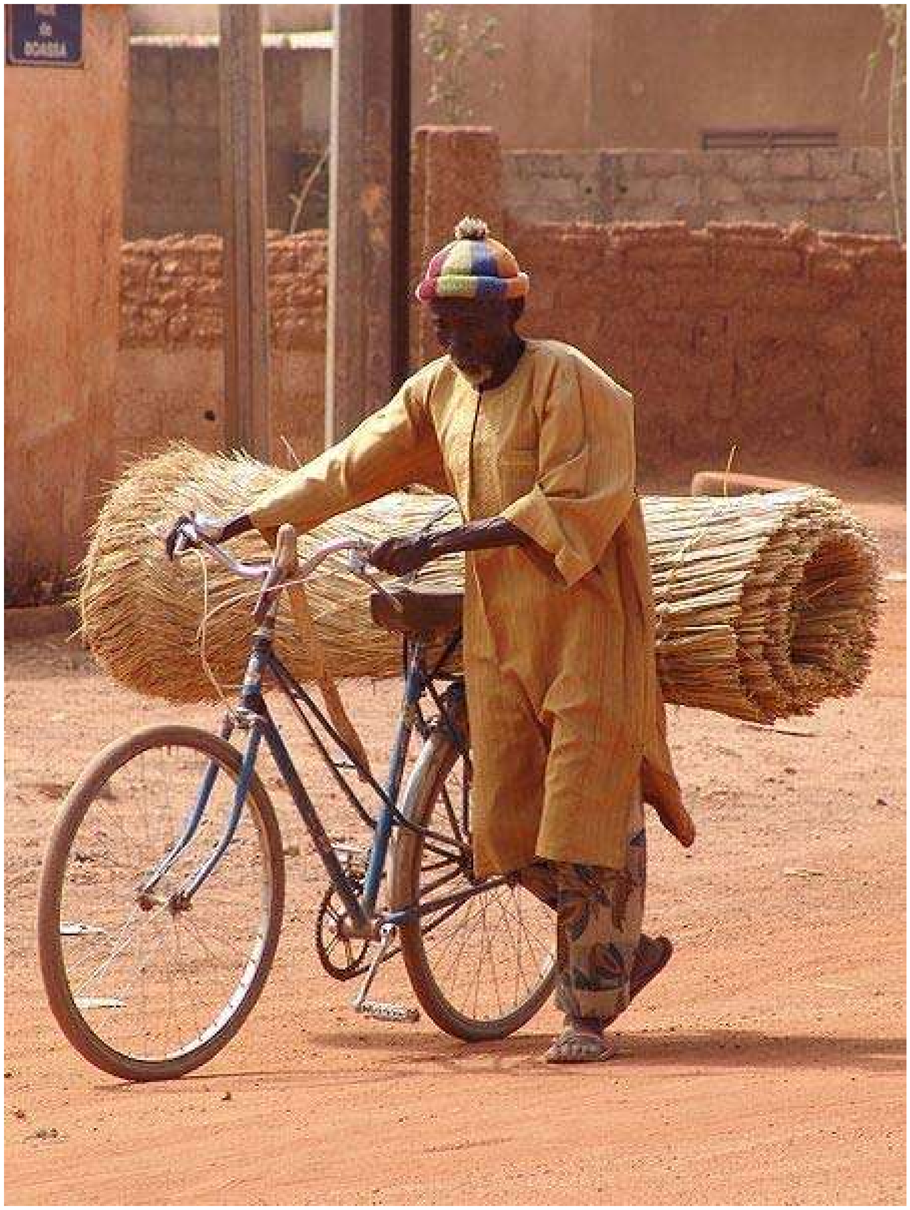
- Porous ceramic filtration, using either clay or diatomaceous earth, and oriented as either cylinder, pot, or disk, with gravity-fed or siphon-driven delivery systems. Silver is frequently added to provide antimicrobial enhancement
- Intermittently operated slow-sand filtration, also known as biosand filtration

- Chlorine disinfection, employing calcium hypochlorite powder, sodium hypochlorite solution, or sodium dichloroisocyanurate (NaDCC) tablets
- Chemical flocculation, using either commercially produced iron or aluminum salts or the crushed seeds of certain plants, such as Moringa oleifera
- Mixed flocculation/disinfection using commercially produced powdered mixtures
- Irradiation with ultraviolet light, whether using electric-powered lamps or direct solar exposure
- membrane filtration, employing ultrafiltration or reverse osmosis filter elements preceded by pretreatment

Some appropriate technology water supply measures include:

- Deep wells with submersible pumps in areas where the groundwater (aquifers) are located at depths >10 m.
- Shallow wells with lined walls and covers.
- rainwater harvesting systems with an appropriate method of storage, especially in areas with significant dry seasons.
- Fog collection, which is suitable for areas which experience fog even when there is little rain.
- Air well, a structure or device designed to promote the condensation of atmospheric moisture.
- Handpumps and treadle pumps are however only an option in areas is located at a relatively shallow depth (e.g. 10 m). For deeper aquifers (>10 m), submersible pumps placed inside a well) need to be used. Treadle pumps for household irrigation are now being distributed on a widespread basis in developing countries. The principle of Village Level Operation and Maintenance is important with handpumps, but may be difficult in application.
- Condensation bags and condensation pits can be an appropriate technology to get water, yet yields are low and are (for the amount of water obtained), labour intensive. Still, it may be a good (very cheap) solution for certain desperate communities.
- The hippo water roller allows more water to be carried, with less effort and could thus be a good alternative for ethnic communities who do not wish to give up water gathering from remote locations, assuming low topographic relief.
- The roundabout playpump, developed and used in southern Africa, harnesses the energy of children at play to pump water.

Transportation

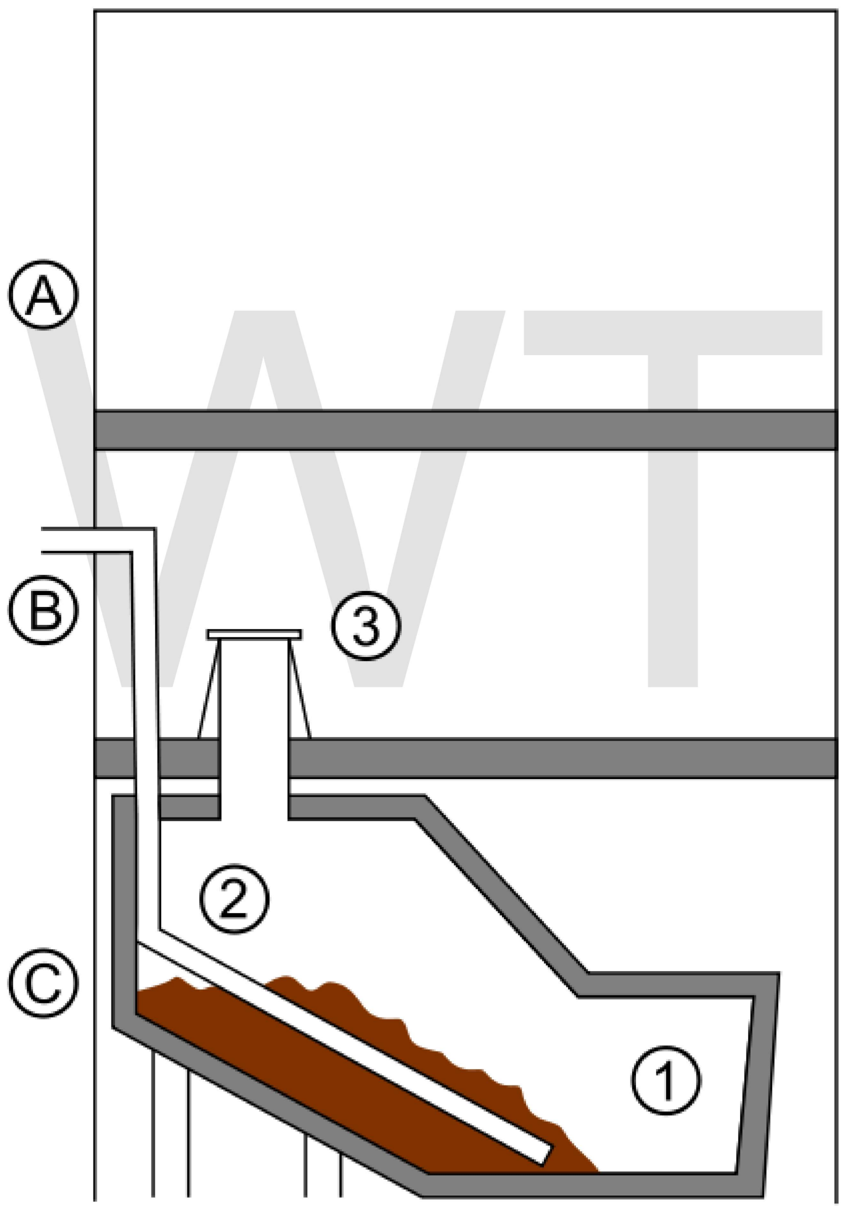


A man uses a bicycle to cargo goods in Ouagadougou, Burkina Faso (2007)

Human powered-vehicles include the bicycle, which provides general-purpose, human-powered transportation at a lower cost of ownership than motorized vehicles, with many gains over simply walking, and the whirlwind wheelchair, which provides mobility for disabled people who cannot afford the expensive wheelchairs used in developed countries. Animal powered vehicles/transport may also be another appropriate technology. Certain zero-emissions vehicles may be considered appropriate transportation technology, including compressed air cars, liquid nitrogen and hydrogen-powered vehicles. Also, vehicles with internal combustion engines may be converted to hydrogen or oxyhydrogen combustion.

Bicycles can also be applied to commercial transport of goods to and from remote areas. An example of this is Karaba, a free-trade coffee co-op in Rwanda, which uses 400 modified bicycles to carry hundreds of pounds of coffee beans for processing. Other projects for developing countries include the redesign of cycle rickshaws to convert them to electric power. However recent reports suggest that these rickshaws are not plying on the roads.

Sanitation



A clivus Multrum composting toilet
A. Second floor, B. First floor, C. Ground floor, 1. Humus compartment, 2. Ventilation pipe, 3. Water closet.

As of 2006, waterborne diseases are estimated to cause 1.8 million deaths each year, marking the importance of proper sanitation systems. It is clear that the developing world is heavily lacking in proper public sanitation and that solutions as sewerages (or alternatively small-scale treatment systems) need to be provided.

Ecological sanitation can be viewed as a three-step process dealing with human excreta: (1) Containment, (2) Sanitization, (3) Recycling. The objective is to protect human health and the environment while limiting the use of water in sanitation systems for hand (and anal) washing only and recycling nutrients to help reduce the need for synthetic fertilizers in agriculture.

Small scale systems include:

- Composting toilets are the most environmental form of excrement disposal systems. In addition, the toilets design allows the nutrients to be reused (e.g. for fertilising food crops). Also, DIY composting toilets can be build at a very low cost.
- BiPu is a portable system suitable for disaster management, while other forms of latrine provide safe means of disposing of human waste at a low cost. The Orangi Pilot Project was designed based on an urban slum's sanitation crisis. Kamal Kar has documented the latrines developed by Bangladeshi villagers once they became aware of the health problems with open defecation.
- Treatment ponds and constructed wetlands can help to purify sewage and greywater. They consist mostly of plants (e.g. reed, ...) and therefore require only little power, and are hugely self-sufficient.
- Certain other options as Slow sand filters, UV filters, ... may also be employed

Lighting

LED Lamp with GU10 twist lock fitting, intended to replace halogen reflector lamps.

- White LEDs and a source of renewable energy (such as solar cells) are used by the Light Up the World Foundation to provide lighting to poor people in remote areas, and provide significant benefits compared to the kerosene lamps which they replace. Certain other companies as Powerplus also have LED-flashlights with imbedded solar cells.
- Organic LEDs made by roll-to-roll production are another source of cheap light that will be commercially available at low cost by 2015.
- Compact fluorescent lamps (as well as regular fluorescent lamps and LED-lightbulbs) can also be used as appropriate technology. Although they are less environmentally friendly then LED-lights, they are cheaper and still feature relative high efficiency (compared to incandescent lamps).
- The Safe bottle lamp is a safer kerosene lamp designed in Sri Lanka. Lamps as these allow relative long, mobile, lighting. The safety comes from a secure screw-

on metal lid, and two flat sides which prevent it from rolling if knocked over. An alternative to fuel or oil-based lanterns is the Uday lantern, developed by Philips as part of its Lighting Africa project (sponsored by the World Bank Group).

- The Faraday flashlight is a LED flashlight which operates on a capacitor. Recharging can be done by manual winching or by shaking, hereby avoiding the need of any supplementary electrical system.
- HID-lamps finally can be used for lighting operations where regular LED-lighting or other lamps will not suffice. Examples are car headlights. Due to their high efficiency, they are quite environmental, yet costly, and they still require polluting materials in their production process.

Food production

Food production has often been included in autonomous building/community projects to provide security. Skilled, intensive gardening can support an adult from as little as 15 square meters of land. Some proven intensive, low-effort food-production systems include urban gardening (indoors and outdoors). Indoor cultivation may be set-up using hydroponics with Grow lights, while outdoor cultivation may be done using permaculture, forest gardening, no-till farming, Do Nothing Farming, etc. In order to better control the irrigation outdoors, special irrigation systems may be created as well (although this increases costs, and may again open the door to cultivating non-indigenous plants; something which is best avoided). One such system for the developing world is discussed here.

Crop production tools are best kept simple (reduces operating difficulty, cost, replacement difficulties and pollution, when compared to motorized equipment). Tools can include scythes, animal-pulled plows (although no-till farming should be preferred), dibbers, wheeled augers (for planting large trees), kirpis, hoes.

Greenhouses are also sometimes included. Sometimes they are also fitted with irrigation systems, and/or heat sink-systems which can respectively irrigate the plants or help to store energy from the sun and redistribute it at night (when the greenhouse starts to cool down).

Food preparation

According to proponents, Appropriate Technologies can greatly reduce the labor required to prepare food, compared to traditional methods, while being much simpler and cheaper than the processing used in Western countries. This reflects E.F. Schumacher's concept of "intermediate technology," i.e. technology which is significantly more effective and expensive than traditional methods, but still an order of magnitude (10 times) cheaper than developed world technology. Key examples are:

- the Malian peanut sheller
- the fonio husking machine
- the screenless hammer mill

- the ISF corn mill
- the ISF rice huller
- all other types of electrical or hand-operated kitchen equipment (grinders, cutters, ...) Special multifunctional kitchen robots that are able to perform several functions (e.g. grinding, cutting, and even vacuum cleaning and polishing) are able to reduce costs even more. Examples of these devices were e.g. the (now discontinued) Piccolo household appliance from Hammelmann Werke (previously based in Bad Kissingen.) It was equipped with a flexible axis, allowing a variety of aids to be screwed on.

Cooking

In Ghana, Zouzugu villagers use solar cookers for preparing their meals

- Solar cookers are appropriate to some settings, depending on climate and cooking style. They are emission-less and very low-cost. Hybrid variants also exist that incorporate a second heating source such as electrical heating or wood-based.
- Hot plates are 100% electrical, fairly low cost (around 20€) and are mobile. They do however require an electrical system to be present in the area of operation.
- Rocket stoves and certain other woodstoves (e.g. Philips Woodstove) improve fuel efficiency, and reduce harmful indoor air pollution. The stoves however still make use of wood. However, briquette makers can now turn organic waste into fuel, saving money and/or collection time, and preserving forests.

Refrigeration

- Solar, special Einstein refrigerators and thermal mass refrigerators reduce the amount of electricity required. Also, solar and special Einstein refrigerators do not use haloalkanes (which play a key role in ozone depletion), but use heat pumps or mirrors instead. Solar refrigerators have been built for developing nations by Sopology.

- The pot-in-pot refrigerator is an African invention which keeps things cool without electricity. It provides a way to keep food and produce fresh for much longer than would otherwise be possible. This can be a great benefit to the families who use the device. For example, it is claimed that girls who had to regularly sell fresh produce in the market can now go to school instead, as there is less urgency to sell the produce before it loses freshness.

Ventilation and air conditioning

Chunche, naturally ventilated sheds for drying raisins in Xinjiang

- Natural ventilation can be created by providing vents in the upper level of a building to allow warm air to rise by convection and escape to the outside, while cooler air is drawn in through vents at the lower level.
- Electrical powered fans (e.g. ceiling fans) allow efficient cooling, at a far lower electricity consumption as airconditioning systems.
- A solar chimney often referred to as *thermal chimney* improves this natural ventilation by using convection of air heated by passive solar energy. To further maximize the cooling effect, the incoming air may be led through underground ducts before it is allowed to enter the building.

- A windcatcher (*Badgir*; بادگیر) is a traditional Persian architectural device used for many centuries to create natural ventilation in buildings. It is not known who first invented the windcatcher, but it still can be seen in many countries today. Windcatchers come in various designs, such as the uni-directional, bi-directional, and multi-directional.
- A passive down-draft cooltower may be used in a hot, arid climate to provide a sustainable way to provide air conditioning. Water is allowed to evaporate at the top of a tower, either by using evaporative cooling pads or by spraying water. Evaporation cools the incoming air, causing a downdraft of cool air that will bring down the temperature inside the building.

Health care

According to the Global Health Council, rather than the use of professionally schooled doctors, the training of villagers to remedy most maladies in towns in the developing world is most appropriate. Trained villagers are able to eliminate 80% of the health problems. Small (low-cost) hospitals - based on the model of the Jamkhed hospital – can remedy another 15%, while only 5% will need to go to a larger (more expensive) hospital.

- Before being able to determine the cause of the disease or malady, accurate diagnosis is required. This may be done manually (through observation, inquiries) and by specialised tools.
- Herbalist medicines (e.g. tinctures, tisanes, decoctions, ...) are appropriate medicines, as they can be freely made at home and are almost as effective as their chemical counterparts. A previous program that made use of herbal medicine was the Barefoot doctor program.
- A phase-change incubator, developed in the late 1990s, is a low cost way for health workers to incubate microbial samples.
- Birth control is also seen as an appropriate technology, especially now, because of increasing population numbers (overpopulating certain areas), increasing food prices and poverty. It has been proposed to a certain degree by PATH (program for appropriate technology in health).
- Jaipur leg was developed by Dr. P. K. Sethi and Masterji Ram Chander in 1968 as an inexpensive prosthetic leg for victims of landmine explosions.
- Natural cleaning products can be used for personal hygiene and cleaning of clothing and eating utensils; in order to decrease illnesses/maladies (as they eliminate a great amount of pathogens).

Note that many Appropriate Technologies benefit public health, in particular by providing sanitation and safe drinking water. Refrigeration may also provide a health benefit. (These are discussed in the following paragraphs.) This was too found at the Comprehensive Rural Health Project and the Women Health Volunteers projects in countries as Iran, Iraq and Nepal.

Information and communication technology

Netbooks as the Eee PC allow low cost information sharing and communication

- The OLPC XO, Simputer, Eee PC, and other low cost computers are computers aimed at developing countries. Besides the low price, other characteristics include resistance to dust, reliability and use of the target language.
- Eldis OnDisc and The Appropriate Technology Library are projects that use CDs and DVDs to give access to development information in areas without reliable and affordable internet access.
- The Wind-up radio and the computer and communication system planned by the Jhai Foundation are independent from power supply.
- There is also GrameenPhone, which fused mobile telephony with Grameen Bank's microfinance program to give Bangladeshi villagers access to communication.
- Mobile telephony is appropriate technology for many developing countries, as it greatly reduces the infrastructure required to achieve widespread coverage. However, mobile phone network may not always be available (it depends on the location) and may not always provide both voice and data services.
- Loband, a website developed by Aptivate, strips all the photographic and other bandwidth-intensive content from webpages and renders them as simple text, while otherwise allowing one to browse them normally. The site greatly increasing the speed of browsing, and is appropriate for use on low bandwidth connections as generally available in much of the developing world.
- An increasing number of activists provide free or very inexpensive web and email services using cooperative computer networks that run wireless ad hoc networks. Network service is provided by a cooperative of neighbors, each operating a router as a household appliance. These minimize wired infrastructure, and its costs and vulnerabilities. Private Internet protocol networks set up in this way can operate without the use of a commercial provider.
- Rural electrical grids can be wired with "optical phase cable", in which one or more of the steel armor wires are replaced with steel tubes containing fiber optics.
- Satellite Internet access can provide high speed connectivity to remote locations, however these are significantly more expensive than wire-based or terrestrial wireless systems. Wimax and forms of packet radio can also be used. Depending on the speed and latency of these networks they may be capable of relaying VoIP

traffic, negating the need for separate telephony services. Finally, the Internet Radio Linking Project provides potential for blending older (cheap) local radio broadcasting with the increased range of the internet.
- satellite-based telephone systems can also be used, as either fixed installations or portable handsets and can be integrated into a PABX or local IP-based network.

Money lending and finance

Through financial systems envisioned especially for the poor/developed world, many companies have been able to get started with only limited capital. Often banks lend the money to people wishing to start a business (such as with microfinance). In other systems, people for a Rotating Savings and Credit Association or ROSCA to purchase costly material together (such as Tontines and Susu accounts). Organisations, communities, cities or individuals can provide loans to other communities/cities (such as with the approach followed by Kiva.org, MicroPlace and LETS). Finally, in certain communities (usually isolated communities such as small islands or oases) everything of value is shared. This is called gift economy.

Chapter- 9

Assistive Technology

Hearing aid

Assistive technology or **adaptive technology** (AT) is an umbrella term that includes assistive, adaptive, and rehabilitative devices for people with disabilities and also includes the process used in selecting, locating, and using them. AT promotes greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing, by providing enhancements to or changed methods of interacting with the technology needed to accomplish such tasks.

Likewise, disability advocates point out that technology is often created without regard to people with disabilities, creating unnecessary barriers to hundreds of millions of people. Even the makers of AT technologies will often still argue that universal design is preferable to the need for AT and that universal design projects and concepts should be continuously expanded.

Assistive technology and universal accessibility

Universally Accessible Street Cross at Evanston, Illinois

Universal (or broadened) accessibility, or universal design means greater usability, particularly for people with disabilities.

Universally accessible technology yields great rewards to the typical user as well; good accessible design *is* universal design. One example is the "curb cuts" (or dropped curbs) in the sidewalk at street crossings. While these curb cuts enable pedestrians with mobility impairments to cross the street, they also aid parents with carriages and strollers, shoppers with carts, and travelers and workers with pull-type bags.

As an example, the modern telephone is inaccessible to people who are deaf or hard of hearing. Combined with a text telephone (also known as a TDD Telecommunications device for the deaf and in the USA generally called a TeleTYpewriter or TTY), which converts typed characters into tones that may be sent over the telephone line, a deaf person is able to communicate immediately at a distance. Together with "relay" services, in which an operator reads what the deaf person types and types what a hearing person says, the deaf person is then given access to everyone's telephone, not just those of people who possess text telephones. Many telephones now have volume controls, which are primarily intended for the benefit of people who are hard of hearing, but can be useful for all users at times and places where there is significant background noise. Some have larger keys well-spaced to facilitate accurate dialing.

Also, a person with a mobility impairment can have difficulty using calculators. Speech recognition software recognizes short commands and makes use of calculators easier.

People with learning disabilities like dyslexia or dysgraphia are using text-to-speech (TTS) software for reading and spelling programs for assistance in writing texts.

Computers, with their hardware extensibility, editing, spellchecking and speech synthesis software are becoming the cornerstone of assistive technologies, improving quality of life for those with learning disabilities and visual impairments. Spell assist programs and voice-recognition facilities are also bringing the text reading and writing experience to the wider public.

Toys that have been adapted to be used by children with disabilities might have advantages for non-disabled children as well. The Lekotek movement assists parents by lending assistive technology toys and expertise to families.

Many health professionals may be certified by RESNA (RESNA.org) to serve assistive technology needs: occupational therapists, physical therapists, speech language pathologists/audiologists, orthotists and prosthetists, educators, and rehabilitation and health professionals.

Assistive technology products

Personal Emergency Response Systems

This voter with a manual dexterity disability is making choices on a touchscreen with a head dauber.

Personal Emergency Response Systems (PERS), or Telecare (UK term), are a particular sort of assistive technology that use electronic sensors connected to an alarm system to help caregivers manage risk and help vulnerable people stay independent at home longer. An example would be the systems being put in place for senior people such as fall detectors, thermometers (for hypothermia risk), flooding and unlit gas sensors (for people with mild dementia). Notably, these alerts can be customized to the particular person's risks. When the alert is triggered, a message is sent to a caregiver or contact center who can respond appropriately.

Technology similar to PERS can also be used to act within a person's home rather than just to respond to a detected crisis. Using one of the examples above, gas sensors for people with dementia can be used to trigger a device that turns off the gas and tells someone what has happened.

Designing for people with dementia is a good example of how the design of the interface of a piece of AT is critical to its usefulness. People with dementia or any other identified user group must be involved in the design process to make sure that the design is accessible and usable. In the example above, a voice message could be used to remind the person with dementia to turn off the gas himself, but whose voice should be used, and what should the message say? Questions like these must be answered through user consultation, involvement and evaluation.

Accessible computer input

This is a sip-and-puff device which allows a person with substantial disability to make selections and navigate computerized interfaces by controlling inhalations and exhalations.

Sitting at a desk with a QWERTY keyboard and a mouse remains the dominant way of interacting with a personal computer. Some Assistive Technology reduces the strain of this way of work through ergonomic accessories with height-adjustable furniture, footrests, wrist rests, and arm supports to ensure correct posture. Key guards fit over the keyboard to help prevent unintentional key presses.

Alternatively, Assistive Technology may attempt to improve the ergonomics of the devices themselves:

- Ergonomic keyboards reduce the discomfort and strain of typing.
- Chorded keyboards have a handful of keys (one per digit per hand) to type by 'chords' which produce different letters and keys.
- Expanded keyboards with larger, more widely spaced keys.
- Compact and miniature keyboards.
- Dvorak and other alternative layouts may offer more ergonomic layouts of the keys. There are also variants of Dvorak in which the most common keys are located at either the left or right side of the keyboard.

Input devices may be modified to make them easier to see and understand:

- Keyboards with lowercase keys
- Keyboards with big keys.
- Keyboards with less and big keys, or multifunctional keys, such us the special keyboard PiTech, with only five big rounded keys, which is used with a special software for writing
- Large print keyboard with high contrast colors (such as white on black, black on white, and black on ivory).
- Large print adhesive keyboard stickers in high contrast colors (such as white on black, black on white, and black on yellow).
- Embossed locator dots help find the 'home' keys, F and J, on the keyboard.
- Scroll wheels on mice remove the need to locate the scrolling interface on the computer screen.
- Footmouse — Foot-operated mouse.

More ambitiously, and quite crucially when keyboard or mouse prove unusable, AT can also replace the keyboard and mouse with alternative devices such as the LOMAK keyboard, trackballs, joysticks, graphics tablets, touchpads, touch screens, foot mice, a microphone with speech recognition software, sip-and-puff input, switch access, and vision-based input devices, such as eye trackers which allow the user to control the mouse with their eyes.

Software can also make input devices easier to use:

- Keyboard shortcuts and MouseKeys allow the user to substitute keyboarding for mouse actions. Macro recorders can greatly extend the range and sophistication of keyboard shortcuts.

- Sticky keys allows characters or commands to be typed without having to hold down a modifier key (Shift, Ctrl, Alt) while pressing a second key. Similarly, ClickLock is a Microsoft Windows feature that remembers a mouse button is down so that items can be highlighted or dragged without holding the mouse button down throughout.
- Customization of mouse or mouse alternatives' responsiveness to movement, double-clicking, and so forth.
- ToggleKeys is a feature of Microsoft Windows 95 onwards. A high sound is heard when the CAPS LOCK, SCROLL LOCK, or NUM LOCK key is switched on and a low sound is heard when any of those keys are switched off.
- Customization of pointer appearance, such as size, color and shape.
- Predictive text
- Spell checkers and grammar checkers

Durable Medical Equipment (DME)

- Seating products that assist people to sit comfortably and safely (seating systems, cushions, therapeutic seats).
- Standing products to support people with disabilities in the standing position while maintaining/improving their health (standing frame, standing wheelchair, active stander).
- Walking products to aid people with disabilities who are able to walk or stand with assistance (canes, crutches, walkers, gait trainers).
- Advanced technology walking products to aid people with disabilities, such as paraplegia or cerebral palsy, who would not at all able to walk or stand (exoskeletons).
- Wheeled mobility products that enable people with reduced mobility to move freely indoors and outdoors (wheelchairs/scooters)
- Vehicles modified with Height adjustable suspension, to allow wheelchair entry to the vehicle
- Robot-aided rehabilitation is a sensory-motor rehabilitation technique based on the use of robots and mechatronic devices

Learning difficulties

- Age-appropriate software
- Cause and effect software
- Switch accessible software
- Hand-eye co-ordination skills software
- Diagnostic assessment software
- Mind mapping software
- Study skills software
- Symbol-based software
- Text-to-speech
- Touch typing software

Mobility impairment

- Crutches, including assistive canes
- Walkers
- Wheelchairs

Visual impairment

Choice of appropriate hardware and software will depend on the user's level of functional vision.

- RIAS (Remote Infrared Audible Signage) has the potential to help both low vision and the blind navigate outside and indoors.

Hardware

- White canes
- Large monitors can be used with increased DPI for ease of electronic text reading.
- E-book readers, such as the Amazon Kindle, which offer text-to-speech and adjustable font size features.
- Adjustable task lamp, using a fluorescent bulb, shines directly onto the paper and can be adjusted to suit.
- Bank note reader
- Copyholder holds printed material in near vertical position for easier reading and can be adjusted to suit.
- Closed circuit television (CCTV) or video magnifiers. Printed materials and objects are placed under a camera and the magnified image is displayed onto a screen.
- Modified cassette recorder. To record a lecture, own thoughts, ideas, notes etc.
- Desktop compact cassette dictation system. To allow audio cassette playback with the aid of a foot pedal.
- Fusers produce tactile materials, for example diagrams and maps, by applying heat to special swell paper.
- Scanner. A device used in conjunction with OCR software. The printed document is scanned and converted into electronic text, which can then be displayed on screen as recognizable text.
- Standalone reading aids integrate a scanner, optical character recognition (OCR) software, and speech software in a single machine. These function together without a separate PC.
- Refreshable Braille display. An electronic tactile device which is placed below the computer keyboard. A line of cells which correspond to Braille text move up and down to represent a line of text on the computer screen.
- Electronic Notetaker. A portable computer with a Braille or QWERTY keyboard and synthetic speech. Some models have an integrated Braille display.
- Braille embosser. Embosses Braille output from a computer by punching dots onto paper. It connects to a computer in the same way as a text printer.

- Perkins Brailler. To manually emboss Grade 1 or 2 Braille.
- Mountbatten Brailler. An electric braille writing machine.

Software

- Customization of graphical user interfaces to alter the colors and size of desktops, short-cut icons, menu bars and scroll bars.
- Screen magnifiers
- Screen readers
- Self-voicing applications
- Optical character recognition. Converts the printed word into text, via a scanner.
- Braille translation. Converts the printed word into Braille, which can then be embossed via a Braille embosser.
- Text-to-speech and Speech-to-text
- Spell checkers and Grammar checkers

Augmentative and Alternative Communication (AAC)

Augmentative and alternative communication is a well defined specialty within Assistive Technology. It involves ways of communication that either enhance or replace verbal language. AAC devices vary widely with respect to their technological sophistication:

- Low-tech systems. Simple paper or object based systems, i.e. do not require a battery (e.g., Talking Mats, Dry Erase Boards, Clipboards, 3-Ring Binders, Manila File Folders, Photo Albums, Laminated PCS/Photographs, Highlight tape).
- Light-tech systems. Typically consisting of a digitized speech recorder with a touch-sensitive display pad and sometimes switch access. Lite-tech systems require a battery (e.g., Tape Recorder, Language Master, Overhead Projector, Timers, Calculators).
- High-tech systems. Computerized VOCAs that vary from single purpose appliance-like systems to multipurpose computer-based communication aids. Typically high-tech systems require training and ongoing support to operate the devices (e.g., Video Cameras, Computers and Adaptive Hardware, Complex Voice Output Devices).

When combined with Applied Behavior Analysis (ABA) teaching methods, AAC has improved communication skills in children with Autism.

Deafness and hearing loss

- Audiometer
- Fire alarm paging system
- Loop system (portable and fixed)
- Radio aids
- Telecommunications device for the deaf

- Teletext
- Video cassette recorders that can read and record subtitles (Closed Captioning).
- Vibrating fire alarm placed under pillow when asleep.
- Door bell lighting system.

Others

- Wakamaru provides companionship, reminds users to take medicine and calls for help if something is wrong.
- Telephone Reassurance: community based program that calls seniors at home ensuring their well-being.
- Cosmobot is part of a play therapy system designed to motivate children to participate in therapy.
- General User Interface for Disorders of Execution (GUIDE) is an interactive verbal prompting system that talks people with cognitive impairment through daily routine tasks.

Claims Since children with autism process visual information easier than auditory information, when utilizing assistive technology claims that any time we use these devices with these children, we're giving them information through their strongest processing area (visual). Therefore various types of technology from "low" tech to "high" tech, should be incorporated into every aspect of daily living in order to improve the functional capabilities of children with autism.

Benefits Regarding comprehension skills, increasing comprehension of tasks/activities/situations is essential in addressing skill areas such as organization, attending, self help, following directions, following rules and modifying behavior. As a result, the child becomes more independent. The following "low" tech visual support strategies can be created and used to benefit and assist the child in increasing his comprehension skills and thus decreasing the occurrence of challenging behaviors.

Consistent daily use of an individualized visual schedule will increase a child's organization skills and independent functioning throughout all aspects of his life and will ease transition through adulthood. There are numerous ways to present visual schedules for example an object schedule, 3-ring binder schedule, clipboard schedule, manila file folder schedules, and dry erase board schedules are all beneficial to increase a child's organization skills and independent functioning.

The use of a weekly/monthly calendar at both home and school can provide the child with important information regarding up-coming events/activities, rather than relying on auditory information. When the child asks when a particular event will occur, he can easily be referred to the visual calendar. Use of a visual calendar can also be helpful in assisting the child to understand when regularly scheduled events may not occur.

Outcomes In a pilot study, Researchers Lacava, Golan, Baron-Cohen, and Myles explored the use of assistive technology to teach emotion recognition to eight children with Autism and the results indicated that after intervention, participants improved on face and voice emotional recognition for basic and complex emotions that were in the software. As well as for complex voice emotional recognition for emotions not included in Mind Reading.

Chapter- 10

Business Technology Management

Business Technology Management (**BTM**) is a management science that seeks to unify business and technology decision-making at every level in an enterprise. BTM delivers a set of guiding principles, known as BTM Capabilities. These capabilities are combined to form BTM solutions, around which a company's practices can be organized and improved. BTM also defines the expected characteristics of an organization according to five levels of a maturity model.

BTM builds bridges between previously isolated tools and standards for business technology management by strategically incorporating both operational and infrastructure levels of technology management to ensure that an enterprise's business strategy can be realized by the technology it deploys. This structured approach is used by enterprises to align, synchronize and even converge technology and business management for the purpose of ensuring better execution, risk control and profitability.

Where does Business Technology Management (BTM) fit?

Most companies employ a number of methodologies and techniques to improve business and technology alignment. While many of these methods have acknowledged strengths, they typically represent piecemeal solutions. Disparate islands of practice exist within the technology management domain, particularly in the areas of operations and infrastructure. These range from the Project Management Body of Knowledge (PMBOK) and Balanced Scorecard to the Software Engineering Institute's Capability Maturity Model (CMM). However, none of these approaches focuses on integrating and enabling the capabilities necessary to achieve strategic business technology management and the sustainable value that follows. The danger of relying solely on "downstream" technology management methodologies is that by the time alignment problems become apparent, they may be irreversible. Furthermore, when methodologies are borrowed from the business domain, there are often deficiencies with respect to focus, goals/objectives and adaptability. For example, Balanced Scorecard is a performance measurement methodology originally designed for the HR function, and Six Sigma is a quality improvement methodology first applied to the manufacturing function. These methodologies are often applied to technology operations with varying degrees of success, but they may not be comprehensive enough to address the unique needs of business-technology integration.

BTM addresses this challenge by providing a set of guiding principles around which a company's practices can be organized and improved. It harmonizes and integrates and elevates previously isolated tools and standards for "IT" management to deliver a seamless strategic management approach that begins with the concerns of Board and CEO and connects that all the way through business technology investment and implementation.

BTM alignment, synchronization and convergence

Many enterprises perceive the alignment of business technology with the business to be a sort of management "Holy Grail". From a BTM perspective, alignment can be defined as a state where technology supports, enables, and does not constrain the company's current and evolving business strategies. It means that the IT function is in tune with the business thinking about competition, emerging threats and opportunities, and the business technology implications of each. Technology priorities, investments, and capabilities are internally consistent with business priorities, investments, and capabilities. When that's the case, the company has reached a level of BTM maturity that relatively few have achieved to date. Alignment is a good thing, and sometimes sufficient to serve a particular business situation.

There are other higher states to consider however, and for some enterprises, synchronization of technology with the business is the right goal. At this level, business technology not only enables execution of current business strategy but also anticipates and helps shape future business models and strategy. Business technology leadership, thinking, and investments may actually step out ahead of the business (that is, beyond what is "aligned" with today's business). The purpose of this is to seed new opportunities and encourage far-sighted executive vision about technology's leverage on future business opportunities. Yet the business and technology are synchronized in that the requisite capabilities will be in place when it is time to "strike" the strategic option.

Finally, there is the state of convergence, which assumes both alignment and synchronization, with technology and business leadership able to operate simultaneously in both spaces. Essentially, the business and technology spaces have merged in both strategic and tactical senses. A single leadership team operates across both spaces with individual leaders directly involved with orchestrating actions in either space. Some activities may remain pure business and some pure technology, but most activities intertwine business and technology such that the two become indistinguishable.

BTM supports and guide enterprises to any of these three states. Whether the appropriate level for a company is alignment, synchronization or convergence, effective BTM is the source of dramatic competitive successes in today's and tomorrow's marketplace.

Dimensions of BTM

BTM addresses four critical dimensions that serve as integrated building blocks supporting improvements across the enterprise:

Process

The first dimension for institutionalizing BTM principles is set of robust, flexible and repeatable processes. Simply defining these processes is insufficient though, to effectively implement BTM requires that processes be defined and consistently optimized evaluated to ensure:

- General quality of business practice—Doing the right things
- Efficiency—Doing things quickly with little redundancy
- Effectiveness—Doing things well.

Organization

Management processes are more likely to succeed when they are supported by appropriate organizational structures based on clear understanding of roles, responsibilities, and decision rights. Such organizational structures generally include:

- Participative bodies—involving senior-level business and technology participants on a part-time but routine basis
- Centralized bodies—requiring specialized, dedicated technology staff
- Needs-based bodies—involving rotational assignments, created to deal with particular efforts

The right set of structures will vary according to an enterprise's value discipline, its primary organizational structure, and its relative BTM maturity. Centralized bodies, such as an Enterprise Program Management Office (EPMO) or an Enterprise Architecture function, tend to require specialized, dedicated staff. Participative bodies, such as a Business Technology Investment Board, are ongoing, part-time assignments for their participants— the key stakeholders. Needs-based bodies—functionally specialized groups such as project teams—tend to be rotational assignments created in response to particular needs.

Information

Valid, timely information is a prerequisite for effective decision making. This information must be delivered in a way that is comprehensible to non specialists and, at the same time, actionable in terms of informing choices that matter. Useful information does not just happen. It depends on the interaction of two related elements: data and metrics. Data must be available, relevant, accurate, and reliable. Metrics distill raw data into useful information. Thus, metrics need to be appropriate and valid for strategic and operational objectives. Internally, they should be comparable across the enterprise and across time; and externally across industries, functions, and extended-enterprise partners.

Technology

Effective technology, (that is, management automation tools) can help connect all the other dimensions. Appropriate technology helps make processes easier to execute, facilitates timely information sharing, and enables consistent coordination between elements and layers of the organization. It does this through the following:

- Automation of manual tasks
- Reporting
- Analytics for decision making
- Integration between management systems

The simple addition of technology to automate existing processes leaves most of its potential value untapped. The largest gains result from the optimization of processes, organizational structures, and information flows. The complexity of managing the business technology function and increasing demands of an ever-evolving business climate require more information transparency and operational synchronization than basic computing tasks can provide. The appropriate use of technology should not only ease the development and reporting of information needed to fuel management processes across the organization, but also to achieve consistent horizontal and vertical management integration.

BTM capabilities

A BTM Capability is defined as a competency achieved by combining each dimension and creating well-defined repeatable management processes that are executed through appropriate organizational structures, using an effective information architecture that is supported by the right level of automation and technology. BTM defines 17 of these specific capabilities, and each is grouped into one of four functional areas.

The first area is Governance and Organization is focused on enterprise CIOs and business executives concerned with enterprise-wide governance of business technology. The capabilities that must be developed to support this functional area ensure that required decisions are identified, assigned, and executed effectively. Necessary capabilities also include the ability to design an organization that meets the needs of the business, manages risk appropriately and gives proper consideration to government, regulatory and industry requirements.

The second area is Managing Technology Investments. This functional area focuses on the Enterprise Program Management Office (EPMO) and other technology and business executives who are concerned with ensuring selection and execution of the right business technology initiatives. The capabilities that must be developed to support this functional area ensure that the organization understands what it owns from an IT standpoint, what it is working on, and who is available. The organization must make certain that business technology investment decisions are closely aligned with the needs of the business and that technology initiatives are executed using proven methodologies and available technology and IP assets.

The third area is Strategy & Planning. This functional area focuses on enterprise CIOs, divisional CIOs, and business executives who are responsible for the efforts to synchronize business technology with the business. The capabilities that must be developed to support this functional area ensure that a target set of applications will meet the needs of the business and reduce overall complexity. In addition, annual planning and budgeting must incorporate elements of business technology strategy and other evolving needs of the business.

The fourth area is Strategic Enterprise Architecture. This functional area focuses on the Office of the Chief Technology Officer and business and technology executives who are concerned with the overall architecture and standards for the enterprise. The capabilities that must be developed to support this functional area ensure that appropriate information and documentation exists to describe the current and future-state environments. Also, it is necessary to verify that business and technology people can implement strategies and plans and make recommendations simplifying the existing business technology environ

The BTM Maturity Model

A maturity model describes how well an enterprise performs a particular set of activities in comparison to a prescribed standard. In this case, the BTM Maturity Model defines five levels of maturity, scored across the four critical dimensions—process, organization, information and technology and assists in levying a grade based on objective, best practice characteristics. The maturity model also makes it possible for an enterprise to identify anomalies in performance and benchmark itself against other companies or across industries. The measurement of BTM capabilities through the BTM Maturity Model identifies areas most in need of improvement, fixes the starting point for the enterprise, and specifies the path for change. A growing body of research shows that at level 1, enterprises typically execute some strategic business technology management processes in a disaggregated, task-like manner. A level 2 organization exhibits limited BTM capabilities, attempts to assemble information for major decisions, and consults IT on decisions with obvious business technology implications. Enterprises at level 3 are "functional" with respect to BTM, and those at level 4 have BTM fully implemented. Organizations achieving level 5 maturity are good enough to know when to change the rules to maintain strategic advantages over competitors who themselves may be getting the hang of BTM.

The evidence also shows that enterprises at lower levels of maturity will score lower for business technology productivity, responsiveness, and project success than enterprises at higher levels. As BTM maturity extends past level 3, the resulting synchrony of business strategy and technology delivery makes the enterprise more agile and adaptable. For such companies, changes in the business landscape impel appropriate adjustments to strategy and corresponding action without major disruptions or anguish. Emerging opportunities are sensed and addressed more quickly. Project execution to deliver new capabilities is more sure-footed. As joint management of business and technology improves, the maturity of the enterprise is reassessed to focus the next set of priorities. As gains result from BTM, remaining weaknesses become more obvious and the business case for addressing them becomes more compelling.by:kristaline patrick

Summary

A business strategy identifies target markets and the value proposition that will win in those markets. To implement the business strategy, the enterprise requires particular operational capabilities; for example, a high tech company pursuing a low-cost strategy may need the ability to build entirely to order and limit inventory risk. The most successful companies will craft their business strategies with full regard for any gaps or misalignments between current and required enterprise capabilities—including, of course, its technology capabilities.

The building blocks of the BTM Standard work together as a management system to clarify required enterprise business needs. BTM fulfills these needs through the application of 17 BTM capabilities that are grouped into the functional areas of Governance & Organization, Managing Technology Investments, Strategy & Planning, and Strategic Enterprise Architecture.

These capabilities are defined and created by four critical dimensions—processes, organization, information and technology. The BTM Maturity Model is used to identify areas most in need of improvement, to fix the starting point for the enterprise, to specify the path for change, and to measure progress. As a result, technology is governed in consonance with business requirements, with very measurable benefits.

Smart enterprises today are rightfully pursuing alignment of technology with the business, and that in itself is no small achievement. But for some, the right level is really synchronization, where technology shapes (not just enables) strategic choices. And at the highest level of achievement, business and technology leadership actually converges, reflecting an executive and management team that has achieved an extraordinary level of cross-understanding and vision for the future.

The BTM standard supports enterprises at all three levels. Assembling the components of Business Technology Management yields unprecedented capacity and opportunity for success in a marketplace where competitive advantage is increasingly defined through technology.

BTM is a major part of a Business-Agile Enterprise and forms the core of the Business Agile Enterprise Framework.