# TECHNOLOGY

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**Contents**





**Summary**

This entry critically examines the central significance of technology in our world. Technology is here defined as objects, activities, knowledges and modes of organisation. The point of technologies is stressed, that they act, that they extend our forces and senses, and that they mediate our presence in the world. Because we relate to, with and through technologies the argument is advanced that they ultimately make society possible, that is to say they are a fundamental element of our humanity. The increased scale and interdependence of technologies is noted, conceptualised as the rise of socio-technical systems. Here the argument is made that there is no single trajectory for a technology, rather technology is positioned as ongoing encounter. Technological success will depend upon the culture of use and the context of its operation. Some of the consequences of the development of more complex, interdependent and open technologies are also discussed in relation to concepts of expertise and risk. In addition to being ongoing encounters, might not our technologies also be ongoing experiments?

## 1. What is Technology?

Fernand Braudel, arguably the twentieth century's greatest historian, wrote: 'In a way, everything is technology'. He also felt that it was everywhere, present in all our endeavours, be they exceptional or everyday. Braudel noted technology's role in humanity's great revolutionary moments: gunpowder, the machine, navigation, the printing press. He also saw the part technology has played in those slow accretions which modify what we already know and do (the sailor in the rigging, the peasant following the plough), the gradual transformations of tools and techniques which add to the stock of accumulated knowledge. Technology helps elucidate history and vice versa. But as the great historian warned, we should not collapse the history of technology to

the level of crude materialism. Artefacts affect history, but they do not necessarily drive it, and they are never divorced from human desires, needs and passions.

Braudel alerts us to the difficulty of defining technology and determining what it does, given its ubiquity. Leo Marx has even referred to it as a "hazardous" concept. In doing so he has taken issue with Braudel's way of defining it as the term is drained of any useful meaning. Donald MacKenzie and Judy Wajcman articulate the same concerns. They call technology a "slippery" term. In trying to give it some determinacy they draw attention to three separate levels of meaning, the first being technology as physical things. MacKenzie and Wajcman note that few theorists are content to settle for such a restrictive "hardware" definition, a point which finds agreement from Bruno Latour: 'The word "technology" is unsatisfactory because it has been limited for too long to the study of those lines of force that take the form of nuts and bolts'. Such objections have only intensified across time. These days many of our technologies are virtual, and we must reckon with the salience of software in our world. In Western societies these codes command ever-greater aspects of social life. Software has spread into communication devices, toys, domestic appliances, automobiles, elevators, traffic light and surveillance systems, to name but some. Society is populated with various animated smart devices, so much so that Nigel Thrift regards software as an important actor in the modern world. Computerisation has radically altered the 'technical substrate' of society. While we are still confronted with fixed, stable and bounded things, we increasingly interact with intangible products, and with things in transition. Software gives us time-restricted rights to access content streams, ongoing development, openness and upgrading possibilities. Saskia Sassen also identified transformations in the nature of things. For her, digitisation is the main driver. It has increased those capacities that make possible the liquefying of what is not liquid …. [it] raises the mobility of what we have customarily thought of as mobile or barely mobile. At its most extreme, this liquefying de-materializes its object. Once dematerialized, it gains hypermobility – instantaneous circulation through digital networks with global span.

We need to be mindful of important in what Thrift calls 'shifts in the nature of materiality'. As Michael Khoo puts it: 'Technologies aren't what they used to be'. New media technologies especially stress interactivity and convergence. They seem to metamorphosize. Mobile phones were once just that, senders of disembodied voices across distance. While it remains a communication device it is clearly also a computational one. Now they also send text, capture and store images, download and play music, access and surf the web. What will they be capable of next? Khoo notes that this is becoming a general feature of technology: 'a friend's fake log gas fire has a remote control with menus and settings, a fireplace with an operating system. Rather than closing and stabilising into familiar configurations, many technologies are changing, mutating, and expanding'.

MacKenzie and Wajcman supplement the definition of technology as objects (which we have upgraded to actual or virtual objects, fixed or in flux) with two others: technology as human activities, and technology as knowledge. Technologies are normally produced to create certain effects. In order for these to be realised we need to know how to use them. This takes us into the realm of technique. It entails what Raymond Williams once said of culture – right knowing and right doing. Even a simple tool is useless in the

hands of an untutored user. While MacKenzie and Wajcman identify three different levels of technology that all combine in use. For example, you are currently consulting this encyclopedia entry. To do so requires an object (a computer), an activity (reading), and knowledge (of the English language). Should any of these three technological levels be removed, the enterprise will fail.

MacKenzie and Wajcman argue that part of the slipperiness of technology is that its meaning has changed across time, as has its perceived relationship to terms like science. This argument is elaborated by Marx. Marx observes the origins of the word technology in the Greek root *techne*, relating to art or craft (with '-ology' referring to knowledge about *techne*). When technology came into English usage in the seventeenth century it was tied to a type of learning, that of the mechanical arts. Even with the Industrial Revolution and well into the nineteenth century "technology" referred to a type of book. It was only with the dawn of the twentieth century that sociologists like Thorstein Veblen began to use technology to refer to the whole of the mechanical arts. Marx suggested 'The fact is that this key word – designator of a pivotal concept in contemporary discourse – is itself a surprisingly recent innovation'. Marx identifies ideological and substantive drivers for this: changing conceptions of the mechanical arts and changing organizational structures. These social changes resulted in the deployment of the word "technology" in the sense that we understand it today.

The ideological spur came from the perception of new connections between science and the mechanical arts, married to a powerful belief in progress. That belief in progress, while ushered in by Enlightenment thinkers, was given a massive boost by the scale of scientific and technological advance. Refrigeration, steam power, the power printing press, the telegraph and scientific medicine had profound effects in the West. So great were the changes that by the 1890s the US of America's Chief Patent Officer offered his resignation. He believed that there was simply nothing left to invent. Here we see the emergence of a particular (and particularly common) understanding of technology, as applied science. There are some objections to this. In the broad sweep of history ,science and technology have had separate trajectories. Moreover, the causal chain is just as easily reversed: science itself is produced by technologies. They are required to facilitate experiments and to measure outcomes. These days the word "technoscience" is often used to denote their mutual constitution. Marx singles out the chemical and electrical industries as particularly important sites of scientific and technological convergence at the turn of the twentieth century. John Lukacs provides further historical details of the lived consequences of these advances. He asks us to consider the period from the American Civil War up to the Great War: in the West life expectancy leapt by a third, infant mortality was quartered, living in pain became a rare exception rather than an expected development, mass education and - through it - mass literacy flowered, and the home comforts of heating, electricity, and plumbing were extended to almost all. He concluded that 'living conditions, for large numbers of people, changed more radically during the fifty years before 1914 than at any other time in recorded history before or after'. This period, which ushered in air travel, automobility, electrification, photography, film, radio, and the telephone, is often labeled the Second Industrial Revolution.

Marx also notes the growing range and effects of various technologies in addition to

their increased scale and interdependence. While the early phases of the Industrial Revolution were marked by individual machines (the spinning jenny, the power loom) across time isolated devices lost in significance to socio-technical systems, of which the mechanical component may only constitute a small proportion. His example is the railroad, the epitome of modernity, a statement that finds agreement from Walter Benjamin: 'the most striking alterations to the globe in the previous century were all in some way or other connected with the railway'. Here we can revisit our three definitions of technology. To be sure the railroad involves a physical object, the steam train. But to operate it requires many other objects, activities and knowledge-sets. The first necessary physical thing was the track itself. Englishman George Stephenson built the first locomotive in 1814, but it was only with the mass manufacture of iron rails from 1820 onwards that the rail*way* was a possibility. Other necessary objects included bridges, tunnels, rolling stock, signals, and stations. As to activities, there are numerous skilled workers involved in the construction, operation and maintenance of railroads. These activities entail specialist knowledge such as railroad engineering and telegraphy. The scope and complexity of these new systems necessitated a new 'organizational matrix of the mechanic arts' according to Marx : for the American railroads to be possible large corporate business structures with significant capital investment needed to be in place. The institutional framing of railroad operations also included standardisation of track gauges and of time zones. Once again we see that the different levels of technology combine in practice, and their result is a socio-technical system. Marx adds a fourth useful definition of technology, here, technology as a mode of social organisation.

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**Bibliography**

Baudrillard, Jean (2005 (1968)) *The System of Objects*, trans. James Benedict, London & New York: Verso. [An analysis of the object (commodity) in consumer society, and a broad meditation of the meaning of things in our time buy one of the late twentieth century's best known social theorists.]

Berger, Peter (1968) *Invitation to Sociology: A Humanistic Perspective*, Harmondsworth: Penguin. [An accessible and useful introduction to sociological thinking, now considered a classic.]

Braudel, Fernand (1985) *Civilization & Capitalism 15th-18th Century: The Structures of Everyday Life: The Limits of the Possible*, Vol. 1, trans. Siân Reynolds, London: William Collins Sons & Co. [A comprehensive account of global history from the Middle Ages to the Industrial Revolution by one of the twentieth century's great historians.]

Callon, Michel and Bruno Latour (1992) 'Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley', in Andrew Pickering (ed.) *Science as Practice and Culture*, Chicago: University of Chicago Press, pp. 343-368. [An article concerning current technological theorising by two of the leaders in the field. ]

Cowan, Ruth Schwartz (1979) 'From Virginia Dare to Virginia Slims: Women and Technology in American Life', *Technology and Culture*, 20 (1): 51-63. [A classic feminist take on technological

theorising which critiques mainstream (read "male stream") social thought. ]

David, Paul (1985). 'Clio and the Economics of QWERTY', *The American Economic Review*, 75 (2): 332-337. [A useful account of the importance of path dependency in technological selection made with reference to the humble typewriter.]

De Landa, Manuel (1997) *A Thousand Years of Nonlinear History*, New York: Swerve Editions. [Historical interpretation in terms of the interactions of complex systems (non-human ones included)]

Derrida, Jacques & Stiegler, Bernard (2002). *Echographies of Television: Filmed Interviews*, trans. J. Bajorek, Malden, MA.: Polity. [A series of interviews with two of Continental Europe's leading philosophers, the underlying theme of which is concerned with the consequences of the acceleration of technical innovation.]

The International Baby Food Action Network (IBFAN) 'How Breast Feeding is Undermined', Available: http://www.ibfan.org/site2005/Pages/list2.php?parent=2&cat_id=17&iui=1 [Accessed: 17/04/09] [The website for a world-wide organization devoted to the reduction of infant mortality through breast feeding.]

Khoo, Michael (2005) 'Technologies Aren't What They used to Be: Problematising Closure and Relevant Social Groups', *Social Epistemology*, 19 (2-3): 283-285. [An article noting the ways in which contemporary technologies tend to be more open and fluid than they are generally supposed.]

Latour, Bruno (2000). 'When Things Strike Back: A Possible Contribution of "Science Studies" to the Social Sciences', *British Journal of Sociology*, 51 (1): 107-123. [An important article framed largely as a challenge to conventional sociology (which tends to see only technology's symbolic value). Latour urges us to reckon with the fundamental materiality of things.]

MacKenzie, Donald & Judy Wajcman (eds) (1985) *The Social Shaping of Technology*, Milton Keynes: Open University Press. [An important early collection espousing the social construction of technology line, in other words a book focusing our attention on the politics of artefacts.]

Marx, Leo (1997) 'Technology: The Emergence of a Hazardous Concept,' *Social Research*, 64 (Fall): 965-988. Available: http://findarticles.com/p/articles/mi_m2267/is_n3_v64/ai_19952020/print [Accessed: 4/6/2008] [A brief and useful introduction to the concept of technology as it tends to be used today.]

McLuhan, Marshall (2005) *Understanding Me*, Toronto: MIT Press. [A helpful introduction to the thinking of one of the best known scholars in the field of communications studies.]

Michael, Mike (2000) *Reconnecting Culture, Technology & Nature*, London & New York: Routledge. [A comprehensive and accessible account of current technological theorising. Michael exemplifies the current STS (Science and Technology Studies) approaches which take the notion of non-human agency seriously.]

Schivelbusch, Wolfgang (1986) *The Railway Journey: The Industrialization of Time and Space in the 19th Century*, Berkeley & Los Angeles: The University of California Press. [A highly regarded account of the social significance of the railway and its role in making us modern.]

Spitz, David & Hunter, Starling (2003) 'The Social Construction of Napster', MIT Sloan School of Management, MIT Sloan Working Paper No. 4444-03, November. Available: http://ssrn.com/abstract=469283 [Accessed: 4/6/2008] [A case study of the invention of the file-sharing programme Napster. Technology is theorised as a collective achievement and as an "ongoing encounter". ]

Sterling, Bruce (1994) *The Hacker Crackdown*, London: Penguin. [A broad overview of cyberspace from its very origins, paying particular attention to the manifold motivations of the hacker.]

Tenner, Edward (1996) *Why Things Bite Back: Technology and the Revenge Effect*, London: Fourth Estate. [A very readable account of the unintended consequences of technology, which is to say the ways in which technological solutions are themselves freighted with problems.]

Thrift, Nigel (2005) *Knowing Capitalism*, London: Sage. [An analysis of our economic system, used here for its commentaries on "the new materiality" and non-human agency.]

Verbeek, Peter-Paul (2005). *What Things Do*, trans. R. Crease. Pennsylvania: The Pennsylvania State University Press. [A useful work by a philosopher of technology looking at what material artefacts do,

foregrounding the role of mediation.]

Virilio, Paul (2003) 'Foreword', *Fondation Cartier*, trans. Chris Turner, Available: http://www.onoci.net/virilio/pages_uk/virilio/all_avertissement.php [Accessed: 27/1/05][Focuses on the acceleration of social life thanks to technological innovation. The inevitable downside of this is the accident. Advances have been such that now we live in an era of the "Generalised Accident" about which we all feel anxious.]

World Health Organization (2009) 'Water-related Diseases', Available:

http://www.who.int/water_sanitation_health/diseases/diarrhoea/en/ [Accessed: 17/04/2009] [As the title suggests, information about water-borne diseases taken from the WHO's Water sanitation and Health section.]

Wynne, Brian (1988) 'Unruly Technology: Practical Rules, Impractical Discourses and Public Understanding', *Social Studies of Science*, 18 (1): 147-167. [An important study of today's socio-technical systems. Wynne concludes that experts work under less informed positions than are commonly supposed, thus shedding new light on concepts of risk and blame.]

**References**

Arendt, Hanna (1958) *The Human Condition*, Chicago: University of Chicago Press.

Baudrillard, Jean (2005) *The System of Objects*, trans. James Benedict, London & New York: Verso, 1968.

Bauman, Zygmunt (1993) *Postmodern Ethics*, Cambridge, MA: Blackwell.

Benjamin, Walter (1999) *Selected Writings*, vol. 2, trans. Rodney Livingstone et al, Cambridge, Mass.: The Belknap Press of Harvard University Press.

Berger, Peter (1968) *Invitation to Sociology: A Humanistic Perspective*, Harmondsworth: Penguin.

Braudel, Fernand (1985a) *Civilization & Capitalism 15th-18th Century: The Structures of Everyday Life: The Limits of the Possible*, Vol. 1, trans. Siân Reynolds, London: William Collins Sons & Co.

Braudel, Fernand (1985b) *Civilization & Capitalism 15th-18th Century: The Structures of Everyday Life: The Perspective of the World*, Vol. 3, trans. Siân Reynolds, London: William Collins Sons & Co.

Callon, Michel and Bruno Latour (1992) 'Don't Throw the Baby Out with the Bath School! A Reply to Collins and Yearley', in Andrew Pickering (ed.) *Science as Practice and Culture*, Chicago: University of Chicago Press, pp. 343-368.

Collingridge, David (1980) *The Social Control of Technology*, New York: St. Martin's Press.

Cowan, Ruth Schwartz (1979) 'From Virginia Dare to Virginia Slims: Women and Technology in American Life', *Technology and Culture*, 20 (1): 51-63.

David, Paul (1985). 'Clio and the Economics of QWERTY', *The American Economic Review*, 75 (2): 332-337.

De Landa, Manuel (1997) *A Thousand Years of Nonlinear History*, New York: Swerve Editions.

Derrida, Jacques & Stiegler, Bernard (2002). *Echographies of Television: Filmed Interviews*. Trans. J. Bajorek, Malden, MA.: Polity.

Droit, Roger-Pol (2005). *How Are Things? A Philosophical Experiment*, trans. Theo Cuffe, London: Faber & Faber.

Du Gay, Paul et al (1997) *Doing Cultural Studies: The Story of the Sony Walkman*, SAGE: London.

The International Baby Food Action Network (IBFAN) 'How Breast Feeding is Undermined', Available: http://www.ibfan.org/site2005/Pages/list2.php?parent=2&cat_id=17&iui=1 [Accessed: 17/04/09]

Khoo, Michael (2005) 'Technologies Aren't What They used to Be: Problematising Closure and Relevant Social Groups', *Social Epistemology*, 19 (2-3): 283-285.

Latour, Bruno (2000). 'When Things Strike Back: A Possible Contribution of "Science Studies" to the Social Sciences', *British Journal of Sociology*, 51 (1): 107-123.

Latour, Bruno (1995) 'A Door Must Be Either Open or Shut: A Little Philosophy of Techniques', in Andrew Feenberg and Alastair Hannay (eds) (1995) *Technology and the Politics of Knowledge*, Bloomington: Indiana University Press, pp. 272-281.

Latour, Bruno (1988) *The Pasteurization of France*, trans. Alan Sheridan & John Law, Cambridge, Mass: Harvard University Press.

Law, John & Bijker, Wiebe (1992) (eds) *Shaping Technology/Building Society*, Cambridge, MA: MIT Press.

Lemonnier, Pierre (ed) (1993). 'Introduction', *Technological Choices: Transformation in Material Cultures since the Neolithic*. London & New York: Routledge: 1-35.

Lukacs, John (1985) *Historical Consciousness*, New York: Schoken.

MacKenzie, Donald & Judy Wajcman (eds) (1985) *The Social Shaping of Technology*, Milton Keynes: Open University Press.

Marx, Leo (1997) 'Technology: The Emergence of a Hazardous Concept,' *Social Research*, 64 (Fall): 965-988. Available: http://findarticles.com/p/articles/mi_m2267/is_n3_v64/ai_19952020/print [Accessed: 4/6/2008]

McLuhan, Marshall (2005) *Understanding Me*, Toronto: MIT Press.

Michael, Mike (2000) *Reconnecting Culture, Technology & Nature*, London & New York: Routledge.

Schivelbusch, Wolfgang (1986) *The Railway Journey: The Industrialization of Time and Space in the 19th Century*, Berkeley & Los Angeles: The University of California Press.

Serres, Michel (1991) *Rome: The Book of Foundations*, trans. Felicia McCarren, Stanford: Stanford University Press.

Spitz, David & Hunter, Starling (2003) 'The Social Construction of Napster', MIT Sloan School of Management, MIT Sloan Working Paper No. 4444-03, November. Available: http://ssrn.com/abstract=469283 [Accessed: 4/6/2008]

Sterling, Bruce (1994) *The Hacker Crackdown*, London: Penguin.

Tenner, Edward (1996) *Why Things Bite Back: Technology and the Revenge Effect*, London: Fourth Estate.

Thrift, Nigel (2005) *Knowing Capitalism*, London: SAGE.

Verbeek, Peter-Paul (2005). *What Things Do.* Trans. R. Crease. Pennsylvania: The Pennsylvania State University Press.

Virilio, Paul (2003) 'Foreword', *Fondation Cartier*, trans. Chris Turner, Available: http://www.onoci.net/virilio/pages_uk/virilio/all_avertissement.php [Accessed: 27/1/05]

Wajcman, Judy (2002) 'Addressing Technological Change: The Challenge to Social Theory', *Current Sociology*, 50 (3): 347-363.

Williams, Raymond (1975) *Culture and Society 1780-1950*, Harmondsworth: Penguin, 1958.

World Health Organization (2009) 'Water-related Diseases', Available: http://www.who.int/water_sanitation_health/diseases/diarrhoea/en/ [Accessed: 17/04/2009]

Wynne, Brian (1988) 'Unruly Technology: Practical Rules, Impractical Discourses and Public Understanding', *Social Studies of Science*, 18 (1): 147-167.

**Biographical Sketch**

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