A Contextualising, Socio-technical Definition of Technology: Learning from Ancient Greece and Foucault*

DAVID ROONEY

ABSTRACT *The task of defining technology has had an unhappy history. It seems that agreement about what technology is—and even if a definition should be sought at all—has not been reached. This article argues that a definition is possible and should be sought. The etymology of the word technology suggests that it has long had a socio-technical meaning and, furthermore, Foucault's definition of four types of technologies suggests a framework in which a socio-technical definition of technology can be usefully detailed. In this case the definition helps to provide a broad and deeply contextual understanding of what technology is (in its tangible and intangible forms), the processes which it influences and the processes which influence it.*

Keywords: assemblage of technologies, socio-technical systems, technologies of power, technologies of production, technologies of sign systems, technologies of the self.

Introduction

Over the last 10 or more years researchers have had difficulty in coming to terms with the task of defining technology. As far back as 1977 Langdon Winner thought a historically grounded definition could only reveal technology as something which, since the late 19th century, had moved from being 'something relatively precise, limited, and unimportant to something vague, expansive and highly significant'.[1] This glib and inaccurate view of the history of technology elicits no useful insights for those in pursuit of an understanding of the role of technology in society. However, more recently leading scholars such as Bijker, Hughes and Pinch[2] have made the observation that it is 'unnecessary to devote much effort to working out precise definitions'. They argue that the search for a precise definition is destined to fail because technology has no single meaning.

By 1989 however, Thomas Hughes, whilst not changing his position, was more specific in arguing that a general definition of technology would only serve to obscure necessary complexity, thus limiting the contextual panorama in which technology is situated.[3] In broaching the subject of complexity, Hughes was helping set the stage for research to proceed and, along with Bijker and Pinch, was in the vanguard of the complexity approach. Their views of socio-technical systems from which, for example,

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the seamless web[4] and the actor-network[5] approaches have emerged led them to be cautious of any general decontextualising definition of technology. More recently, Peter Allen's[6] nonlinear and evolutionary view of socio-technical systems—a view in which interconnectedness is central to understanding and analysis—is also attractive with its rich analytical potential. These systems approaches have proved to be fertile ground for the development of knowledge about technology in society. But is the aversion to setting out a definition of technology justified? Such an aversion is justified only if technology does indeed have a limiting meaning.

In an attempt to discover if this aversion is justified and to learn a little more about what technology can mean—and its contextual situation—I would like to turn, briefly, to ancient Greece. The Greek root of technology, *techné*, means belonging to the arts, crafts or skill, and is also related to tactics. Therefore, to the ancients, technology was more than 'gadgets', it was also (perhaps mostly) to do with skills, know-how, and the art of doing things; it was knowledge, actions and 'gadgets'. A further linguistic probing reveals that Weber[7] used the German word *technik* to mean both technology (machines and tools) and technique. He saw technology as including both physical products and ideas (or intellectual devices). This view of technology is well summarised by Ellul,[8] who used the French word *technique* in the same way as Weber used *technik*:

> The machine represents only a small part of *technique* ... we could say not only that the machine is the result of a certain *technique*, but also that its social value and economic applications are made possible by other technical advances.

Schmookler[9] also enters this paradigm by stating that: 'A method of producing a given good or service is a *technique*.'

The word *techné* and the views of Weber, Ellul and Schmookler all indicate that the technical or technological elements of the production process are a diverse set of variables and can include cultural and intellectual elements. If this is the case, then it is necessary to develop a system for identifying these variables, while at the same time, as Hughes and Allen suggest, taking into account the possibility that the variables may have complex and unpredictable relationships with each other. What must also be avoided is the tendency, common to dystopian accounts of technology such as Weber's, to separate technology and society (even if they do not discount the social influences on technological change). Accounts like these argue that technology is dehumanising or denaturing because society is not seen as technological and technology is not seen as social. We require a framework which goes beyond the technological versus social binary opposition and deals in a more nuanced way with the real complexity of the history of technology.

The following discussion will show how technology can be better understood and defined if we see technology and things such as aesthetics, politics, institutions and economics as indissoluble partners in an assemblage of technologies. To do this I will examine Foucault's[10] four types of technology—(1) technologies of production, (2) technologies of sign systems, (3) technologies of power and (4) technologies of the self. What is important about the assemblage of technologies approach is that it reinforces the socio-technical system approach; it broadens the meaning of *techné*, *technik* and *technique*; and that it provides a definitional framework for understanding the rich contextual complexity in which technology is situated. It is a framework which can help researchers to better identify patterns, structures, relationships and the key dynamics of change in a socio-technical system.

An Assemblage of Technologies

By using Foucault's four types of technology as an assemblage of technologies I am able to show not only that the interrelationships between technology and culture are complex and subtle, but also that technology and any element of a social system are, by definition, not mutually exclusive entities. Indeed, the Foucauldian definition of technology is a socio-technical definition. Technology, knowledge, government and economics, for example, are inseparable and interdependent parts of the infrastructure of production; an infrastructure which consists of an assemblage of technologies and which requires that each of Foucault's four elements be present for production to occur on any level. Creating a dichotomy between society and technology is avoided in this approach because, for example, know-how or policy are not privileged or rarefied, but can be seen as technological too. The assemblage of technologies approach seeks to reinforce an analytical framework which is more structured than the seamless web or actor-network approaches. It allows us to talk about 'hardware' technology as a special entity which is not separate from society because it does not invest the term technology with any non-social meaning. In addition, the language of the assemblage of technologies approach makes more explicit than current research does the notion that not only is technology at times socially shaped but also socially shaping.

The following discussion focuses on the relationships between technology and music. This is a useful 'case study' because the music economy depends on complex and often obscure interactions between technology, culture, business, consumers and government.

Technologies of Production

Technologies of production are the implements or tools used to transform or manipulate elements in any production process.[11] In the music production and reproduction process this would include obvious things such as an analogue to digital converter, which as the name suggests can transform an analogue signal from an old master tape to digital code, to be stored on a hard disk recorder; digital recording software used to manipulate (edit) a recording by performing tasks such as cutting out unwanted parts and replacing them with sections from other recordings, or other parts of the same recording; correcting timing or tempo errors; or even changing the verse, chorus, and bridge structure of a song. One must also include traditional musical instruments in this type of technology because they transform the finger, lip and foot movements of a musician into music. Electronic musical instruments, records, CDs and radios are all examples of technologies of production.

Technologies of Sign Systems

Technologies of sign systems, which we might also call semiotic technologies, are symbols which offer meanings and significations in a society.[12] In the realm of understanding music and music technology these would include the lyrics of songs. However, also included in sign system technologies are the various forms of music notation such as guitar tablature, waveform and piano rolltype audio editors in computer programs, and the standard music notation system. Equally important are the semiotic technologies of performance that include gestures, postures, light shows, pyrotechnics and fashion which have become increasingly important since the 1960s. It is also possible to see an electric guitar not only as a functional instrument, or technology of production, but also a powerful symbol of rock music. Another example of a semiotic technology is the 'sound',

or the overall sonic style that is presented in a particular recording to signify its genre to the listener as being funk, heavy metal, acid jazz and so on. These semiotic systems can be seen as technologies because they involve learned techniques and enable forms of production.

This classification of technology also provides a framework for the understanding of some of the semiotic organisations of music and music technology. This is an important area because the semiotics of 'sound', fashions, music subcultures and the ways in which technologies of sign systems can be used and interpreted are key markers of such things as affiliations with a particular group. It is important, for example, to examine the ways in which commercial interests have identified how technologies of production can contribute to the organisation of these subcultures. One example of this kind of this approach can be seen in the 1960s when record companies recognised that particular kinds of recording studio techniques and recording technologies were appropriate for psychedelic rock, and that a different set of technologies and techniques might be appropriate for pop or folk rock. In this way the record companies and producers could identify different types of demand in different subcultures or markets and provide them with specific kinds of 'sounds'.

Technologies of Power

Technologies of power are the technologies that have the potential to influence the conduct of individuals. According to Foucault[13] they are the types of technologies that 'objectivise the subject' or make individuals submissive to the conditions of domination by the hegemony. Technologies of power are a set of technologies (or practices) for the administration or regulation of a society. This is, at least in part, what Foucault has elsewhere called 'governmentality'. For the purposes of this article the socio-technical system can be seen to have three general sub-categories under the umbrella of technologies of power: governmental technologies, consumer technologies and organisational technologies. I shall discuss each of these in turn.

Governmental technologies make up much of the superstructure of the music industry, and they include the central regulatory devices in any nation or any industry. In Australia some examples of governmental technologies are the Trade Practices Act and the Copyright Act. The importance of copyright is highlighted by the fact that the music industry is often referred to as one of the copyright industries. Copyright, by imbuing the economic status of ownership of music in individuals, companies, or other groups, makes it possible to commodify music and provides an environment in which a marketplace can form. Superimposed on the Copyright Act is the more general industry regulation device of the Trade Practices Act which is intended to place ethical restraints on the conduct of trade. The Trade Practices Act seeks to prevent unethical commercial practices such as false advertising and anti-competitive practices like price fixing. Of course, other governmental technologies like patent law, and even regulations such as customs and excise tariffs have played important organisational roles in the music industry too.

Consumer administration technologies, which are closely related to sign technologies, are technologies through which producers seek to control the behaviour of consumers in terms of how much they buy, what they buy, where they buy and even why they buy certain products. Consumer administration technologies are the technologies of marketing, public relations and advertising which can be undertaken by businesses, industry advocates such as chambers of commerce and so on, and even government departments. The general purpose of these technologies is to organise the market or markets to provide

the economic base that sustains or even expands the industry, or an individual business's share of the market. These technologies can be seen as the means by which cultural activity in a society is financially underwritten and, therefore, given wide social distribution. The level of sophistication of these technologies is highly variable, ranging from the selling or giving away of T-shirts to television advertising.

Organisational technologies are the technologies that allow a business to administer itself. Included in these technologies are the practices of applying technology management techniques in manufacturing businesses, financial accounting, inventory control, human resources management, sales forecasting, quality control and price analysis. Without these kinds of administrative practices, businesses would be dysfunctional: they would have poor cash flow, be prone to under- or over-production, be unaware of unpaid debts, be unable to identify potentially bad capital investments, tend to have inappropriate staffing levels and so on. In short, organisations would be unable to monitor their own situation in relation to issues such as solvency, market conditions such as consumer spending habits, and the activities of their competitors.

Technologies of the Self

Technologies of the self are those practices that allow individuals, usually with the help of others, to function in a society by using their bodies and minds to regulate and facilitate their own conduct.[14] This technology of self-regulation is also an aspect of Foucault's 'governmentality' and is closely related to the technologies of power. The main distinguishing feature between technologies of power and technologies of the self lies in whether the objective of the technology is in regulation of others relative to a hegemonic system (technology of power) or in self-regulation (technology of the self). Accounting, for example, could be practiced as either a technology of power or as a technology of the self. In the music industry, examples of technologies of the self are found in cognitive and motor skill activities such as learning to sing, learning the coordination necessary to facilitate the left hand in making rapid chord changes on the guitar, knowing how and when to use a variety of computer programs, and being able to imagine (through experience gained in the field) what the effects of the signal modification will sound like when they are used in a specific recording. Bourdieu[15] claims that these conducts, or technologies of the self, can be learned, in a formal institutional setting, or by informal means such as oral transmission, or through everyday trial and error.

Simply put, technologies of the self give us the ability to know how to behave in specific circumstances. In the context of the music economy, an individual knows how to act as an audience member at a heavy metal concert, which may be different from how that person would act at a jazz performance. Technologies of the self enable band members to behave appropriately on stage (which may involve a different set of behaviours for the bass player and the lead singer), or in a recording studio and in the offices of a record company. Individuals might also know that while it is appropriate to improvise exclusively in a minor pentatonic scale at a blues jam session, the same practice might be frowned upon, or even ridiculed, at a jazz jam session where a modal, diatonic approach might be more appropriate.

Returning to ancient Greece for a moment, an examination of the ways in which the Greek Stoics prepared for a verbal improvisation, by learning helpful terms and arguments through rehearsal, enabled Foucault[16] to show that even a technology of the self such as the ability to improvise is a learned skill. It is interesting to note that rock and jazz musicians often regard improvisation as a skill that cannot be taught, yet clearly

it is a skill that is developed through practice and experience, and is often based around well-known riffs (or ostinati). The Stoics' education could be likened to a musician knowing how to use various interval distances, scales, modes, chord substitutions and extensions, and standard chord progressions. As Bourdieu suggests, it matters little whether these are learned formally or informally. In fact, in popular music most learning does not occur in an institutional setting, but through oral transmission and by the 'prestigious imitation'[17] of successful recordings. The notion of 'prestigious imitation' refers to the copying by a person of the successful behaviours of others, who in the eyes of that person have achieved both authority in that area and the confidence of that person. Importantly, there is in this conception no need for the prestigious role model to be a 'star' performer; the role model may in fact be a teacher, a friend, or even a colleague.

Another technology of the self of particular interest to popular music, which is discussed by Foucault, is the confession, the ability to 'show the truth about oneself,'[18] or, in popular music, at least giving the illusion of showing the truth about oneself. Frith[19] argues that 'rock fans have ... the belief that listening to someone's music means getting to know them, getting access to their souls and sensibilities'. Here we might argue that a successful rock performer is seen to confess the truth about him or herself to the audience, and in doing so makes it possible for the audience to believe that it has come to know the performer.

Technologies of the self can also influence the way we listen to music at home, in contrast to the more public listening space we occupy while listening to the car radio in peak hour traffic. Here, we might consider Adorno's[20] categories of listening, expressive-dynamic and rhythmic-spatial modes, to understand that listening can be done in different ways to meet different ends. Hence, these are constructed modes of listening, or listening techniques. Adorno argues that great music incorporates both of these modes of listening. It is probable that many more modes of listening could be distinguished than the two mentioned by Adorno and that restricting those categories to functions of expression (namely singing in Adorno's formulation) and rhythm ignores much of the environment in which music is heard.

Also of concern are the technologies of scientific know-how and of theory that have been developed during the 20th century. These devices are the schematic and systemic intellectual technologies that guide scientists and engineers. In the broadest sense, these devices are elements of scientific methodologies. Of relevance here is the adoption in the 20th century in the physical sciences of mathematical modelling of theory, particularly in electronics. Constructs like Ohm's law and quantum theory have enabled research and development to move quickly and efficiently because of the disciplined and systematic approach that individuals and groups of scientists can bring to their work.

The Assemblage of Technologies in the Recording Studio

Foucault's definition of four types of technology is important not just because it includes hardware, techniques, practices and knowledge as related elements of a system, and because it treats technology as being distributed throughout the whole processes of production. Of paramount importance is the recognition that each type of technology depends for its existence on specific modes of learning, training and modification of people (i.e. technologies of sign systems, power and the self) and therefore we can say that each element of the assemblage can only ever be meaningfully analysed in relation to each of the other elements.[21] This definition is important to the development of an analytical framework because it reflects the highly contingent social and historical

relationships in which 'machine' technology exists, and because it puts forward a language that avoids narrow determinism. It also complements the systems approaches—the seamless web, actor-network theory, complexity theory and evolutionary theory—provides a language which is non-reductionist, helps isolate the key variables in technological change and maintains a non-teleological approach.

It is useful to draw together the four types of technologies and present them as an integrated system. A hypothetical example of the social contextualisation of a technology of production will briefly demonstrate the inter-connectedness and interdependence of the technological assemblage of the popular music industry, and how the role and effect of technology in popular music might usefully be charted. It would be impossible to chart every possible connection and contingent relationship, therefore we simply need to regard this description as a road map which charts only the main roads.

Let us take the case of a recording engineer at the end of a recording session with a band which has just signed its first contract with a record company and which has been recording a rock-abilly track for release as a single. The drums, bass, guitar and vocals have been recorded, seemingly to perfection, but the 'sound' is not representative of the rock-abilly genre. The engineer, who has been in the recording industry for 20 years, realises that there is no 'slap' or 'slap-back' echo in the mix and so adds in 50 milliseconds of delay through an effects processor to the overall mix and suddenly the track sounds as if the band were playing in a bathroom: the sound is thicker and there is a 'periodic and repetitive echo.'[22] Everyone now agrees that the sound is right for rock-abilly and that the record company will agree to the song's release.

The hypothetical case demonstrates the successful application of a technology of production tool to translate a recording into a recognisable rock-abilly song. But an analysis of the role of the production tool, as described above, would be superficial unless a comprehensive, detailed and contextualised description of what occurred in the recording studio was made by also asking what roles the technologies of sign systems, power and the self played in that process.

We can ask ourselves why the engineer felt compelled to take responsibility for helping the band to find the right sound, or rather how the technologies of the self and power influenced this situation. The answer is that the engineer knew that it was appropriate behaviour for engineers to take on a significant amount of responsibility for the quality of the recording, especially for a relatively inexperienced band and this notion has been reinforced often during 20 years of the engineer's work experience. The engineer knows that there are economic advantages for the record company that result from this behaviour and that it makes the recording process more efficient. This situation may be so well understood that it may even be the case that this role is legally formalised in a standard contractual agreement, an example of a technology of power being imposed by the hegemony. The engineer had also learned that 50 milliseconds of delay produces a sound regarded in the industry as a standard for slap echo, whereas 25 milliseconds of delay produces a different sound called 'chorus' and so on,[23] this knowledge is a technology of the self and the sound a technology of sign systems. The engineer also knew how to operate the effects unit, a skill that has been learned through reading the unit's users' manual and through the experience of using that unit and others similar to it regularly for a long time, another example of the influence of a technology of the self. Finally, the engineer works on the assumption that minimum standards of production quality exist, and that record companies will not employ an engineer who is not a consistent producer of high quality results, a further but more subtle form of a technology of power. These standards equate (more or less) to the standards of the anticipated audience, or at least the record company's measurements of those standards,

thus providing some guarantees of the commercial viability of the 'product': a technology of power.

Clearly the technologies of sign systems, power and the self are central components in shaping how and why certain technologies of production are used in the production of popular music. To account for technologies of sign systems, power and the self is to provide a more sharply defined social dimension to an analysis than can be derived from explanations based on linking technologies of production and sign systems only. It is also clear in this example of technologies of sign systems, power and the self how difficult it can be to clearly separate them from each other. This lack of clear distinction highlights how technological artefacts in the assemblage can appear as different types of technology at the same time. As I have shown with the electric guitar, which is a technology of production, it can also be a symbol of rock music, so that it is also a technology of sign systems.

Of course, a hypothetical scenario could just as easily be made up for an executive in a music technology manufacturing company or a similar person in an importing or retail business endeavouring to find the next product to produce or stock. Similarly, a sketch could also be made for a CD, guitar or stereo system customer. The purpose here is to illustrate the diffuse and interactive nature of variables that affect the final outcome of the use of a technology of production. It is also essential to see the technologies of production as inseparable from the creative elements of music.

It would, of course, be an ambitious task to do all that this analytical framework promises in just one research project. However it is still possible, by refining the scope of the analysis, to make a useful contribution to the understanding of the relationships between technology and society.

Conclusion

I have shown that the study of technology needs to be based on a broad understanding of what technology is. Such an understanding must deal with a wide and diffuse set of intersecting and heterogeneous contingencies, thus avoiding not only teleological analysis, but also the temptation to look only for simple cause–effect relationships. The assemblage of technologies provides us with a socio-technical, and therefore deeply contextualising understanding of what technology is.

Foucault's definition of technology illustrates the point that technologies of production cannot be considered as separate and autonomous from society or culture. I have shown that different modes of organising and ways in which individuals conduct themselves are also examples of or depend on technology. It is possible to see music theory, playing technique, composition and singing as technological too. The point of this scenario is that it is possible to recognise an assemblage of technological components that pervades the production process. This situation reinforces the systems models of analysis and the need to treat all the elements in this assemblage (at least at the start of the analysis) with equal regard in an intellectual schema that does not necessarily privilege any one part over any other part of the assemblage. Therefore, the meaning of technology set out above does not just place music and technology as parts of a web of contingent variables, but as parts of an assemblage which makes dichotomous treatments of society and technology impossible. I have, therefore, set out a socio-technical framework consisting of four socio-technical elements, each of which are elements set in a co-dependent inter-relationship with each of the other elements.

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