

PUTTING "SCIENCE, TECHNOLOGY, AND SOCIETY" (STS) ON ITS FEET AGAIN

Manfred E.A. Schmutzer

Vienna University of Technology

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STS, Science, Technology and Society, incorporates already in its name an ideology. It adheres to the widely held view cherished till recently, but becoming increasingly challenged, that science is the one and only endeavour in knowledge production which is clean and pure in its conceptions, intentions and practices¹. The numberless studies on scientific practices in laboratories as much as colleges, scientific societies and military or industrial relations uncovered a different image. This should therefore not be put to discussion here.

However one aspect which escaped notice until recently is the dogma inherent in the mere sequence of the three words, science, technology and society. This sequence is overtly not chosen by random, but heralds a view dear to a tradition of scientists coming to the fore in the course of WW II and after. (Traweek, 2000)

The imminent message is familiar: Scientific research sparkles insights which in turn stimulate thereafter engineers and technicians to subdue those insights to useful applications which finally impact – usually in beneficial ways – on society. This causal chain is unidirectional and the indirect message of the phrase.

This perspective can be challenged in at least three different directions:

- From history we know a sufficient number of cases showing, that technologies and instruments are the cause for scientific investigations and explanations.
- Without social standards and norms, in particular norms of industrial procedures, instruments will hardly be able to manufacture data sufficiently accurate for posing in scientific comparative research. Hence scientific reliance and repetitivity results from social standards.
- Instruments are themselves technologies which are massively influenced in the process of their genesis by an imagery which results from cultural traits.

In what follows we will concentrate on this last point in an attempt to demonstrate how technologies and culture interact such, that we may propose an immediate dependency of technologies on cultures. Where this is not the case cultures will get subdued and injured, if not destroyed or technologies fail to become an integral part of everyday-life .

¹ For brevity the meaning of the term “pure” will not get analysed any further as its various connotations are well-known.

CULTURAL DEPENDENCE

The meaning of the term "culture" varies widely. I will abstain from adding another definition but lay emphasis on one aspect only by referring to daily practices ²We simply focus on this particular aspect.

Another point deserves mentioning too. From the point of view of a vast majority cultures are attached to certain regions and to history. Many tend to think of an Italian, Chinese or an American way of life, which quickly gets to be taken as a synonym for culture.

This perspective is oversimplifying. Anyone familiar with Italy distinguishes without much arguments between various version of Italian culture, according to regional differences or else, according to social strata. We distinguish between working class cultures or upper class for example. Adhering to such distinctions would quickly force us to abolish the category "culture" as such, as its explanatory value progresses slowly towards zero, if we start chopping up cultural differences as sketched above. When speaking of the peculiarities of Sicilian upper class, Roman, Venetian etc. than we will have to do the same for the working class, the middle class etc..

In the long run we will hardly find a point where to cease differing further so we will end by having individualised cultures. This result is less than satisfying.

What is needed is some consensus on a set - or even less – of variables constitutive for distinguishing cultures.

R. Williams (1958) writes in his book on „Culture and Society“ the following illuminating phrase:

" a culture is not only a body of intellectual and imaginative work; it is also and essentially a whole way of life. (whereby...) The *crucial distinguishing element* is (...) between alternative ideas of *the nature of social relationship*" (*italics mine*; R. Williams (1958), p.325).

He then goes on by distinguishing between bourgeoisie and working class cultures, or their varied types of social relations. Although his differentiation between these two classes is certainly founded in empirical evidence particularly in Great Britain, one should for linking cultures and technologies find more general ways of classifying cultures.

This constitutes the purport of Cultural Theory as originally developed by M. Douglas (1966). There are many ways of explicating this approach but one of the most direct ways of presentation is presenting it as a kind of a systems theory. In a comparable manner as Williams did, M. Douglas takes the Durkheimian position of understanding social relations as prime cause for social and cultural phenomena. Having taken this initial step it seems nearby to come to similar results as system-theory which regards the following two variables as basic for the constitution of systems:

The demarcation of the system against the environment and

The internal structure.

From this distinction one receives a two-dimensional scheme which is a complete and all encompassing classification, as I have shown elsewhere (Schmutzer,1994). This

² Which is not to say that rituals etc. should be excluded from culture.

scheme comprises four clearly distinguishable patterns, the main properties of which are existence (or lack) of boundaries to the outside and internal structures allowing exchange between any member of the web – egalitarian structure - or restricting it to some prefixed direction of flows – unidirectional structure.

From this result four types of social relations if we choose for convenience to speak of open or closed systems. The adherents of this theory agreed to label the results in the following way: Hierarchies for the unidirectional, closed case.

Egalitarians or Clans for the egalitarian, closed case.

Markets for the unbounded, egalitarian case.

Isolates for the unbounded case of zero relations.

The link to cultures is thrown by M. Douglas' demonstration that the constituent qualifications of cultures are intrinsically connected to these types of social relations. Value judgements, visions of the good, perceptions of risk or nature, thought styles or cosmologies all are subservient to the enhancement and maintenance of the existent and proclaimed social structure.

Values are means to control not only the affective loading of things but more importantly to control actions. Certain things are held in esteem, certain actions are shunned. Values thus make possible a specific form of social co-operation and coexistence. They are not spurious results of an individual attitude, but **preconditions for successfully interacting with one's social environment.** They thus **legitimise existing social institutions and relations.** (P.Berger, T.Luckmann, M.Douglas).

Like automobiles or conveyor belts, values are important for successfully meeting the demands of the environment. **They generate communality** (Tenbruck, 1989, p.70) in the social world and in the world of things by selecting actions and means which are similar and related.

CULTURES AND THEIR TECHNOLOGIES

When keeping in mind that "all technologies have been developed and improved to help with known human practices or with foreseen and desired practices" (Williams, 1974, p.129), and keeping in mind that the **most essential part of human practices are the types of social relations pertinent to them**, it will be difficult to avoid the idea that technologies must correspond to the intrinsic properties of these relations.

A similar approach is taken by M. Callon and B. Latour in their "actors-network-theory", where they lay emphasis on the fact that the "analyst is usually faced with **assembles of human and non-human actants**, where the competences and performances are distributed (Akrich, Latour, 1992, p.259) "

Thus we arrive at the result that technical systems materialised by the world of things may have the **same rank as social institutions**, these understood as stable norms of social behaviour. Institutions generate a characteristic form of social intercourse and of conforming technical systems. They are more or less the alphabet of a culture consisting of ideal and material objects. This is the reason why technical artefacts are equated with social institutions and why the term technical institutionalisation has been coined.

This means that, like social institutions, **technologies exert a normative influence** on the social actors **via the rules that regulate their use**. In a literal sense, even more so than social institutions, they are "the moulds into which we have to pour our actions" (Durkheim, 1895, p.126).

The same idea may be formulated differently, as e.g. J. C. Pitt (1995) does this in his advocacy for a Philosophy of Technology, when saying :

"...everything we do and think humans can and should do to **our technologies**, i.e., to **our ways of making the world conform to our visions of the good**. In this sense, then, **our technologies embody our aspirations, as well as our accomplishments**. " (Pitt,1995)

As "**visions of the good**" result, as stated above, once more from the **visions of preferable social relations**, Pitt's statement corresponds to what my previous remark expressed.

Technology is "at once an intention and an effect of a particular social order. " (Williams, 1974, S.128).

This shall be demonstrated in the reminder of this brief presentation. For demonstrative purposes two examples of very common technologies are chosen, the railway and the car.

Iron Rules for Iron Rails

Most people think that railways emerged when someone had the splendid idea of putting a steam engine on wheels. This does however not correspond to facts. Railroads existed long before the steam engine. They were in use already in medieval mines.

The absolute novelty of the steam engine was that it combined for the first time in history the source of power with the vehicle, becoming so the first true „automobile“. **In contrast however to automobiles, having the liberty to move freely, this new technology was chained to rails and deprived of this liberty.**

The steam locomotive **incorporated all the desirable qualities of a slave**. It owned in comparison to horses submissiveness and endurance, utmost modesty in supply and was in demand of detailed elaborate control. This principal reliability made it a most welcome partner to various enterprises, e.g. as it was also superior to water-transport which was subject to seasonal imponderables.

Chaining the source of power to the vehicle and the vehicle to rails made a complete **system emerge subdued to control**.

Contrary to other systems of transport railroads demand much more than just proper attendance of power source and vehicle. Animal transport is in these respects more or less self-sufficient. Wheeled transport requires in contrast to animal transport already roads, but they are still comparatively undemanding. Their qualities may vary widely and their maintenance can easily be provided by a large number of different agents representing a wide range of standards of quality and performance.

This is different with railroads. Many aspects of the distinct properties of railway transport result from the engineering peculiarities of this technology. Due to low friction it is not capable to climb a steep ascent. This requires tunnels, bridges and a number of other peculiarities of the infrastructure. The rails must exhibit high precision in their gauge or their coupling if vehicles should not drop from rails. Overtaking is impossible as long as no alternative trails exist. The same is true for transport in the opposite direction.

All these properties of railed transport require a high degree of standards and control for making the technology effective. Contrary to other forms of ground transport railroads demand for their handling an elaborate management in their background, which exhibits all the known qualities of bureaucracies: Command and elaborate control structures, hierarchical levels of management, control of boundaries in time, space and membership etc.

Chandler's detailed case-studies (1977, 1990) provide all the necessary empirical evidence of these requirements. So one may conclude that this particular technology creates and demands social relations of a particular kind: Hierarchies. This does not mean that railways express preferences. But it is save to say that without hierarchical organization railways would simply not function. The proof for this provides G.B. where many small companies tried to avoid this kind of structure at first, as Chandler shows too. Their intentions were in vain however. In the long run also British enterprises had to succumb to the requirements of this particular technology forced by detrimental experiences.

If this case demonstrates that a certain technology demands a specific kind of social relations, this does not yet demonstrate the opposite case, that a certain social structure develops its appropriate technology. For showing his I briefly refer to an other historical case study.

Putting Technologies in Uniforms

It goes without saying that the military constitutes an exemplary case of hierarchical relations. It is strictly bounded to the outside in membership as much as in spatial arrangements and it observes a rigorous, internal hierarchical order. Uniformity and standardisation constitute a common feature. The army exposes an elaborate command and control structure and a highly developed prescriptive language. Apart from this the military relies on strategic thinking and detailed planning which demands not only foresight but also the capability of transforming foresight into practice.

Smith M. Roe (1985) provides a detailed account of the emergence of the "American system" of massproduction. Beginning with an analysis of the unsatisfactory results of the war in 1815 it became obvious that massive deficiencies in supply and logistics were one prime cause of a near-debacle. Not only transport posed problems, but in addition the fact that replacement parts of broken weaponry tended to have not the necessary fitting.

This insight created a new demand for guns and artillery with exchangeable parts, such that two broken pieces could be re-assembled to provide a functioning third weapon. For achieving this aim the entire process of production had to be altered. Up to this point in time rifles and canons were the product of more or less individual craftsmanship. Every single piece was the output of one highly competent trained person producing and fitting the individual parts by himself. The quality was

controlled by a master assessing the weapon by inspection and personal use. The results of this process were high quality weapons, lacking however the desired uniformity. For achieving uniformity the entire process of production had to be changed. This took about thirty years in total.

At the end of this process emerged a top-down line production process exhibiting all the properties of industrial production. Not only gauges and measuring had to be developed, but also new ways of supervision, control of material and workforce even during their past-time, schedules and book-keeping devices were essential ingredients of the new process of production.

In other words the requirement of uniformity and standardization did not produce better firearms, but an absolutely new method of production. Workers were submitted to rigorous discipline not dissimilar to the one of the army itself. But not even this was the final point of the adaptation-process. When the process was expanded to the production of artillery it became clear that even the properties of the alloys had to be standardized and submitted to a rigorous discipline. Metallurgy became in this context a novel scientific discipline.

One may conclude that from the innermost psychological properties of workers and their cultural traits down to the qualities of molecules and crystals everything had to be integrated into the grand scheme of uniformity. It was not so much the appropriate functioning of firearms which was subjected to standardization, but their management in great numbers.

Smith concludes his essay saying that this mode of production of arms became in the sequel the standard model of industrial production in areas such as sewing machines, bicycles, telegraphy etc.

The command of vast stretches of space, time and number make it tantamount to develop disciplinary structures of uniformity not in some, but in every aspect. We may conclude from this that a hierarchical culture seems to be prerequisite for large organizations, but at the same time, that these organizations must devise systems of social relations subject to uniformity, which does include technology. This example demonstrates also how a particular kind of technology destroys a different previous culture, in this case the one of craftsmanship, which represents what Cultural Theory calls "egalitarian". Beyond this insight we also learn that social relations - and hence culture - incorporate material agents as integral parts of the web, i.e. they must be made to correspond to the essential features and claims of that culture.

Having shown by now how not only technologies demand their adequate type of social organization, but also how such organizations devise appropriate technologies to fit their basic requirements, I will offer an additional case representative for an other cultural type, i.e. markets.

The Automobile

Günter Burkart (1994) points out the mutual influence between technology and culture. He asks which were the needs that were served by the invention of the automobile and how did it react on culture and on the way of life. "Automobilism" in his understanding combines as essential values autonomy, mobility and individuality. The image of the automobilist at the beginning of the 20th century, in his view is a mixture of audacity, skilfulness, individual supremacy and technical adventurousness. Flexibility in space, autonomy in time, social independence determined behaviour and decisions.

The automobile enhanced the cultural value of individuality and mobility, as proposed by Cultural Theory for individualistic "market-cultures".

This fundamental tendency was aided by a new spatial organization of life:

The novel modal way of life brought the spatial separation of work and leisure by abolishing the old "Whole Household".

Historically we find that the automobile was a success at first in France and then above all in the United States. Germany lagged behind.

At the root lay a strong connection between social and geographical mobility in the USA. This connection is an expression of the American Dream of individual mobility, whose central values are to be young, free, successful and prosperous. Buying a car was of course also made easier in the U.S. by a generally higher level of income.

It did not take long for the automobile to become a basic item in the turnout of "a full-fledged member of society", which at that time meant: a male member of the middle class. Sportsmen, businessmen, engineers, medical doctors in the USA and in Europe celebrated their liberation from the necessity to use the railroad with its attendant loss of exclusiveness, independence and freedom.

A certain gain in social distinction for the upper classes also was to be derived from the automobile: the first to buy a car were of course the well-off. Distances between workplace and home, between the locations for shopping and for leisure increased. In the USA car-ownership remained a privilege of the upper and middle classes until the nineteen-fifties, only from then onwards did it gain entrance into the urban working class.

Williams (1958) distinguishes bourgeois and working-class cultures by ascribing solidarity and mutual reliance to the former while the latter is characterised by self-reliance and independent self-interest. These attitudes create very different social relations and are at the same time products of these relations.

Social relations create in addition value-attitudes in general, since values may encourage or discourage certain types of actions. "Conspicuous consumption" for instance will under the solidarity mode be seen as a threat to social structures and thus as a challenge, while under the individualistic mode it will be welcome to demonstrate self-reliant independence.

We saw that at the beginning of the 20th century values like audacity, resourcefulness, individual supremacy and a certain technical adventurousness kindled the interest in the automobile. Flexibility in space, autonomy in time, social independence created a chance for the upper classes to gain in distinction. Obviously this was Williams' bourgeois layer of society with its penchant for self-interest, self-reliance and demonstrative consumption. This set of values is not only the result of an experienced social situation but at the same time the precondition for successfully mastering a given social context. Changing coalitions are part of this type of social intercourse and require a high degree of mobility and suitable means of self-presentation. This was the prevalent situation for the upper and middle classes up to the 1950's even in the USA.

A car for everybody

Diffusion of the car into urban working classes of the U.S. began only around the nineteen-fifties.

In Germany this process took place even later. Only as late as the seventies car-ownership could be found in roughly 50% of working class households. For the present study it might be even more interesting to note that in Germany in the sixties 77% of working class households did not have a car, only 20% planned to buy one in the future, while 57% had no such intention. Only a third of the households thus owned a car, with the rest apparently not even wanting one. A massive change in attitude obviously has occurred: Let us see what might have caused it.

"A car for everybody" became a reality for the working classes of western Europe - and for women - only in the late nineteen sixties. This was the result of a subtle strategy of the automobile industry, which aimed at divesting the car from the social prestige it had enjoyed. "Volkswagen" was no longer a status symbol, but rather a concession to necessities of increased mobility and individualisation due to developments in the labour-markets. We shall soon see whence these necessities arose.

W. Canzler (1997) contributes an important observation to our picture by pointing out that in Germany the development of the automobile situation might have been fundamentally different, if "the political, economic and cultural west-integration of the FRG" had not caused the trend-setting example of the U.S. to be followed, with the government supporting this by legal measures in taxation³ and by funding the building of roads.

Only a third of working-class households had a car, the rest apparently did not want one. This is a clear sign of a different cultural orientation. "Volkswagen"-cars were then no longer perceived as symbols of distinction but as a necessary adaptation to newly created needs for mobility. Under the new conditions of life subject to a new order of space and time owning a car became simply "practical".

Labourers, similar to rural people, tend to an "egalitarian" culture⁴, individual distinction, even today, is not one of their aims. But they value highly everything that may be "practically" applied in coping with the necessities of their everyday life (see P. Bourdieu). Volkswagen has succeeded in exploiting the chance arising from this attitude, the reasoning behind the success being of course not culture specific but plainly economical.

The "car for everybody" came into being by a clever strategy of the manufacturers which divested the automobile of its prestige and took into account the solidarity-oriented canon of working class values. The success of this strategy was substantially assisted by West-German politics as Canzler demonstrates. Without the various political initiatives and measures the "practical utility" of the automobile would not have been longlived.

A Hierarchy of Cars

³ P. Bourdieu's approach demonstrates how tastes and values derive from objective preconditions, i.e. capital resources. Governmental supporting measures as described by Canzler would thus go a long way to explain the change in attitude towards the automobile. What they do not explain is sustained scepticism still prevalent in some groups.

⁴ As witness the importance of "solidarity" in the union movement.

For the automobile industry this new image of the car as primarily a means of transportation posed the problem that it displeased that customer segment which still was using the car as a symbol of distinction. The strategy for winning the old group of distinction-minded customers was "Sloanism"⁵, i.e. the coupling of social with spatial mobility. A change in the brand of automobile was to signify a step up in society. This expansion into a hierarchy of symbols completed the cultural development process of the automobile⁶ and signalled to the superficial observer the acceptance of the automobile by all walks of society. All the cultures used it, all called it their own.

The automobile became a universally accepted, society-integrated means of conquering spatial distance, because it presented itself to the different cultures within the societies in a way which was on the surface in accordance with their respective systems of values and thus with patterns of culture. By this variability the value-attitudes and social relations of a majority could, for the time being and superficially, be attended to.

Traffic jam

But this development also meant setting out on the path to monoculture. Railroads were abandoned, pedestrians and bicycles disappeared, even the motorcycle became rare. Instead super-highways and car-parks proliferated across the country and in the cities, whose great aim became to be "car-adapted". This meant that space- and time-structures were fundamentally changed and made to comply with a single type of culture.

Cultural Theory's four basic cultural types are however to be found in any modern society. There are: hierarchies, markets, clans, and isolated individuals, all of which have their specific life-styles, i.e. cultures, and their characteristic demands. Their value-attitudes are as different as their views of the world and their ideas concerning the best way of living together. The structure of space and time is incorporated in these world-pictures in a fundamental way.

Frequency and distribution of the four types differ between societies. The essential point is how successful one of the types is in attaining hegemony.

Or, to use another word, in becoming "Mainstream Culture". If mainstream culture becomes monoculture problems⁷ are sure to arise.

⁵ Alfred Sloan of General Motors had introduced this strategy in the U.S. already in the twenties. In Germany its wide-scale use took place from the sixties onwards.

⁶ This does of course not say that the process of change for the whole of society had found its end. Needs and value-structures were adapted to the new technical possibilities. Trends of urbanisation and suburbanisation were enhanced, albeit primarily concerning the lifestyle of the upper- and middle classes.

⁷ Monocultures cannot be sustained, neither in nature nor in society. The different cultures not only have differing value-attitudes, but on account of these, also take care of very different sets of chores in a society with division of labour, and thus all the cultural types together are needed to guarantee the functioning of society.

The success of the automobile, due to clever cultural adaptation, established also a starting point for resistance.

The demands for pedestrian zones, more public transport, bicycle paths etc. demonstrate that colonisation of cultures cannot be the recipe for sustained success. Mainstream culture will of course also influence the thinking of adherents of other cultures, simply because "objective constraints"⁸ make this unavoidable. In general however these "colonialised" minds will not attain a level of competence and identification comparable with that of proper representatives of the mainstream culture secure in their very own lifestyle. Above all, social relations become endangered to get changed in their cultural foundations and this will generate sustained resistance.

Thus a more suitable diversification of products becomes necessary. This also implies a return to more diversified societies based on differing principles of spatial organisation and time-management, in other words it implies the end of monoculture.

To summarise: The example of the automobile shows the encounter of three cultures⁹, which together made possible the acceptance of the automobile by the whole of society, or to use sociological jargon, its institutionalisation.

In the beginning there was the individualistic automobile of enterprising citizens, thereafter came the inconspicuous car of egalitarian and solidarity oriented persuasion, and finally we found a model of detailed and hierarchical differentiation. But after all, this horseless carriage, despite its chameleon-like adaptation to all the essential cultural shades of society, cannot deny its origin, as the statistical data of the year 2000 (loc. cit.) demonstrate. The decrease in car-registrations of 11-12% is in Germany not distributed equally over all brands. While products such as Porsche, Jaguar or Mercedes even showed an increase in sales and BMW and SAAB incurred only slight setbacks, "practical" cars like Opel, Fiat, or Ford suffered disproportionate losses of up to 25%. These are the inconspicuous practical cars of the egalitarian clan cultures. The adherents of these cultures not only were subject to minimal or even negative increases of income, they are also those who were not since childhood reared on the culture of mobility.

The automobile is and will be the child of love of its individualistic begetters, who did not have in mind buses or lorries, but primarily the spontaneous satisfaction of their individualistic drives. With this genealogy the automobile represents more than a means to conquer spatial distance. It also turns out to be a vehicle of social mobility and the agent of the corresponding ideology. But its seductive powers seem to have reached the turning point and the process seems to be on its way back to the beginnings.

CONCLUSION

⁸ These are constraints originating from objects (inter alia) and eliminating other possibilities.

⁹ The fourth type being, according to M. Douglas, basically inactive and therefore unlikely to articulate demands.

At the beginning I argued that the sequence Science, Technology and Society is the expression of an ideology. A turning-around of the terms "science" and "society" would seem to be more appropriate.

This paper demonstrated how social relations and cultures determine structure and success of technologies. It would need another essay to demonstrate the second step, the impact of technologies on science. This case is insofar more complex as there are sciences which hardly rely on technologies – although in the age of computer-dominance in most sciences even this will be difficult to maintain. But it is not yet long ago that e.g. mathematicians maintained that they need nothing but a piece of paper and a pencil for their work. But there, where technologies find application we may be certain that new phenomena put to investigation result from their applications.¹⁰ Insofar it seems valid to state, technology is prior to science. But it would be wise in general to retreat from any linear causal relationship between the three concepts, giving instead preference to some kind of circular feedback process.

¹⁰ I assume that J.C. Pitt (1995) has the same idea in his mind when writing: "...looking at the extent to which the technological infrastructure of science not only affects theory, but commits us to certain courses of action, thereby providing a basis for a new theory of both technological and scientific change, which is **at bottom a theory of social change.**" (J.C. Pitt ,1995,p.5)

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