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## **IRON RULES RULE IRON RAILS**

Cultures and Their Technologies

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### **Clarifying Terms**

Speaking of “Cultures and their Technologies“ requires a clarification of terms. Neither “culture“ nor “technology“ is a term whose meaning is self-evident.

Culture:

Culture is, according to J. Alexander (1990), “the ‘order‘ corresponding to meaningful<sup>1</sup> action.“ (p.2). Cultural phenomena include legal codes, religious ritual, art, and intellectual ideas.

There exist some realms usually not included in “culture”, among them economic and political institutions and other phenomena normally seen in the context of society. Although a not insignificant branch of anthropology is concerned with material culture, technology is also not infrequently excluded from the focus of cultural studies<sup>2</sup>. The work of Alexander cited above provides ample evidence of this fact. While a consideration of technologies is largely missing, much attention is given to two topics: The autonomy of culture from society and the significance of religion.

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<sup>1</sup> “Meaning“ is itself a problematic term . This becomes evident, when it is translated into German, Germany being not only the place where cultural studies originated ( Williams, 1958 ), but imbuing them also with a very specific flavor. Generally “meaning” is translated as “Sinn“, an ambiguous term connoting both, the content of a term (Bedeutung) as also the ultimate rationale of existence (Sinn des Lebens). In contrast to the majority of Anglo-Saxon writers Germans tend to ignore investigations of symbolic universes and their interrelations with social structures. But on the slightest pretext German social scientists will switch to a discussion of ultimate values, of religion and of Weber’s theodicy (Tenbruck, 1975).

<sup>2</sup> This constitutes no real surprise as other social sciences show similar shortcomings. The disregard in anthropology is insofar a little more disconcerting, as at least in paleo-anthropology consensus exists that the absence of tools at archeological sites disqualifies osseous finds as being human.

We shall define the term „culture“ with the following <sup>3</sup>:

Culture is a way of life simultaneously creating a distinction between groups of persons, but allowing at the same time a definition of equality, similarity and consensus and the capability to co-operate with others within a group of persons.

P. Bourdieu (1984) explains this correspondence by the availability of material and symbolic capital, hence as a result of the mode of distribution of resources.

Distinguishing cultures has hardly ever been a topic of dispute although the line of demarcation is usually drawn along geographical borders or between religious confessions. Reference to regions is unsatisfactory, as they simultaneously contain quite dissimilar groups with respect to their particular life styles. At the same time similarities between groups locally far apart can be made manifest. Therefore the necessity arises to define the concept of culture more clearly by attaching it to some more appropriate sociological variable.

This contradicts the manifest intention articulated by many writers (as Alexander (ibid.) demonstrates) to keep Society and Culture apart, be it for methodological reasons, as Parsons suggests, or for more substantial ones.

Some authors, who hardly find recognition in Alexander's reader, would object to such a separation.

N. Elias (1970), himself no adherent of Parsonian Theory, shows with rich historical evidence that social and cultural developments are intrinsically linked.

P. Bourdieu proceeds in the same manner even if his arguments and empirical material are quite distinct.

F.H. Tenbruck (1989) enriches this perspective by stressing the trivial observation that societies are not homogeneous, but in themselves divided by division of labour. This points once more to a plurality of lifestyles within one particular society and destroys at the same time the meaningfulness of regional differentiation.

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<sup>3</sup> "Culture": the concept relates to the care of that which has been handed down, which has been raised through the years, of that which has been shared and groomed within a dedicated space. Thus the concept of "culture" is meant to signify:

Away of life shared with others, which not only expresses a shared treasure of potent images and symbols, but is the very precondition of such a treasure.

"Culture", one might say, is that which constitutes difference and distinction between human beings while at the same time also forming the base for consensus, cooperation, equality and similarity.

If culture is defined as a shared way of life, this creates the necessity to establish marked differences by ourselves, since gradual distinctions are present even in the most routinely performed acts of individuals. Despite gradual transitions it is customary to postulate the existence of different cultures, languages and classes. Very often simple geographical criteria are used to define such differences, from which the spatial segregation of ways of life follows *eo ipso*. Empirical evidence pro and contra may be cited. ( Translation from: Schmutzer, 1999)

The sociology of science and of knowledge adds evidence by rediscovering the work of L. Fleck (1935), who demonstrated the cultural and social loadedness of cognition and theories even in scientific research.

Quite independently of these scholars M. Douglas in the sixties and seventies developed her grid-group analysis which was enriched by Cupertino and others and is nowadays marketed under the label of Cultural Theory.

In Douglas's own words the content of this approach may be characterised in the following manner:

“The guiding assumption is that judgments of value emerge as justifications of distinctive forms of organization... Furthermore, that there is only a limited number of possible organizations, and also that each develops its own cultural set, a cognitive and moral bias that contributes to reflexivity to the social organization, affects conceptions of time and space, and the functioning of memory.” (Douglas, gridgroup.listserv, March 10, 1998)

Cultural Theory surpasses most of the previously mentioned contributions insofar, as it aims at a reduction and classification of possible factions resulting from the division of labor. It achieves this by doing what system-theorists of any brand – from biology to mathematics – do when characterizing systems: They focus attention on two variables, on the control of external borders and on internal structure.

The first of these variables is labeled “group” and the second one “grid“. Invoking thus the principle of parsimony a fourfold scheme results, which was surprisingly often independently rediscovered by other researchers (Ouchi, Fiske, Polanyi etc.)<sup>4</sup>.

Cultural Theory is thus an approach which conforms to basic scientific standards and provides a means to compare societies and their cultures in a consistent manner.

A weakness of Cultural Theory exists however, resulting less from an internal flaw than from certain preoccupations of its adherents.

As can be seen from the above quotation itself, Cultural Theorists show a preoccupation with ideational topics, cognition, moral issues etc.

Willy-nilly the material basis drifts out of sight. Many of this school of thought seem to find it hard to pay attention to issues raised by P. Bourdieu or similar proponents of a more materialistic stance. This deficiency is not necessarily accidental, the bias could possibly be explained by Cultural Theory itself.

However this flaw can be mended. One attempt in this direction is the present contribution.

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<sup>4</sup> Multiple, independent, but contemporaneous discoveries may serve as an indicator for an ubiquitous demand and consequential search in scientific activity.

Technology:

Although the original meaning of „technology“ refers to the scientific study of fine and applied arts, it has changed to mean „the pursuit of results, especially useful results of scientific research“. In the 20<sup>th</sup> century „it had become a global term connoting not only the **tangible products of science** but also the attitudes, processes, **artifacts and consequences** associated with it.“ (The New Encyclopedia Britannica, Vol. 11)

Briefly we deduce from this that artifacts and other tangible and intangible products of science, such as software, but also the processes of manufacturing them, must be dyed in the wool by cultural traits, just as scientific results themselves are tinged by culture.

To demonstrate this I choose the case of railway transport.

### **Cultural Foundations of the Railway**

Although the term technology in everyday practice signifies predominantly material artifacts the above quotation already indicates that it means much more. The history of the railway provides a striking illustration of this statement. Most people think that railways emerged when someone had the splendid idea of putting a steam engine on wheels. This however is not borne out by the facts.

Railroads existed long before the steam engine. They were in use in medieval mines where trolleys were pushed or pulled by men or animals and sometimes even by cable winches.

These railroads expanded from the mines to rivers some time before steam-engines were used for locomotion. Horses provided the necessary “horsepower“ to pull tons of coal to the boats. The logic behind this was at least twofold: the first reason was that transport could in this manner proceed without repeated unloading and reloading, the second reason that railroads permitted relatively frictionless transport compared to unpaved roads.

The advent of the steam-engine changed this scene quickly. To be precise: not the steam-engine as such, but a particular type of engine, the high-pressure engine as developed by O. Evans. This engine, small enough to be put on wheels, at first served to transport coal in the Newcastle area.

The driving force behind the move was not only steam but also economic rationality. The exuberant prices of feed for horses in comparison to the negligible ones of coal, particularly in the mines themselves, paved the way away from animal traction of the carriages. This idea must be conceded absolute novelty as it combined for the first time in history the source of power with the vehicle, thus creating the first true „automobile“.

In contrast however to what we usually associate today with automobiles, i.e. liberty of unconstrained movement, the railroad was chained to rails and deprived of this liberty for reasons pointed out above. Not only because of this the steam locomotive had all the desirable qualities of a slave. In comparison with horses it offered submissiveness and endurance, its running costs were modest and it was relatively easy to control. This principal submissiveness made it a most welcome partner for enterprises in many respects, as e.g. it outdid also water-transport which was tied to seasonal imponderables.

Chaining the source of power to the vehicle and the vehicle to rails made a complete system emerge which was subject to control.

Clearly this system did not spring fully equipped, like the goddess Athena, from the head of its creator, but developed its properties fully only in the course of time. It also took time to discover the necessary accompanying techniques which made the slave perform optimally. One such addition was the telegraph, developed a little later.

### **Prometheus Re-bound**

It is a Hegelian insight that the master is bound to his slave or, to use a less derogatory phrase, that a system requires obedience to the principal rules of its working by every part, regardless of where the parts are located. But not even this is sufficient, the system demands adaptation of the entire environment along and beyond its borders.

When the railway outgrew the coal-mines, interest in the novel manner of transport developed not in a uniform way, although or because this system requires uniformity to a very high degree.

In the sequel we emphasize two aspects intrinsic to the concept of culture, and equally decisive for the foundations, i.e. the substructure of transport: attendance and conservation<sup>5</sup>. The ancient invention of the wheel for example made the “cultivation” of roads necessary.

Another historic example also provides evidence of this requirement: the disappearance of wheeled transport in the Near East during the early Middle Ages. The political and military disruptions of late Antiquity did not allow sufficient maintenance of the extensive system of high-quality roads established by the Romans. The explosively expanding Islam, incapable of materializing a system of roads at the same speed, dispensed with such a system and replaced it by another novelty, the camel. This animal, able to carry loads of up to half a ton, was not

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<sup>5</sup> A culture is the product of some cultivation, requiring attendance and maintenance.

only most enduring, but in addition required almost no maintenance infrastructure. The rapid expansion of Islam would have been unthinkable without the camel (Applied History Research Group, 2000). Small wonder that the camel replaced wheeled transport in a large context. Thus lack of attendance and conservation disrupted the entire system of wheeled transport and brought a different system to the fore.

For expanding wheeled transport adequate roads had to be provided. This constitutes a basic requirement of any wheeled transport. In the European Middle Ages the construction and maintenance of this infrastructure was provided by certain associations, monasteries, the military or private enterprises charging tolls for their services at the turnpike. Often two separate associations cooperated by providing two distinct services, maintenance of the substructure and vehicle transport.

The advent of the railway disrupted this division of labor, as railways constitute a closed and hence intolerant system. Rails obviously do not permit bypassing, neither when going in opposite directions nor when two different speeds are present in the same direction. While the first defect could in principle be eliminated by doubling the number of rails, to permit arbitrary speeds would require an infinite number of rails, which is, of course, impossible.

This insight was supported by empirical evidence. Various experiments promoting public use of railroads ended in exuberant chaos.

Early suggestions put forward to liberalize the restrictive system of railroads by various technologies were conceived for advancing democracy and free trade.

A project suggested by R.L. Edgeworth in England in 1802 (Schivelbusch, 1977) intended to equip public roads with rails at least in the neighborhood of larger cities where massive transport occurred. One argument of the proposal was the reduced friction of rail movement. The improvement was to be provided by placing ordinary road vehicles on wheelchairs running on rails being pulled however by the same horses which had drawn the carriages in the first place<sup>6</sup>.

Edgeworth realized the above mentioned impossibility of different velocities on a single pair of rails and, to mend this deficiency, suggested four parallel pairs of rails which would allow a differentiation between slow bulk transport and fast personal traffic in both directions. But on each of the four rails velocity had to be uniform. Edgeworth's conception found as little

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<sup>6</sup> The concept is in some respects comparable to present attempts experimenting with concepts of making various means of public transport, busses, streetcars and railways compatible with each other.

response as other similar ones. The lack of acceptance seems to indicate a deep seated desire for individual liberty of mobility at the time. This longing was in accord with the contemporaneous quest for political and economic independence and hence as much ideologically as rationally motivated.

Contrary to the individualistic spirit of the age (*Zeitgeist*), the railway demanded the realization of an opposite mode of organization. Railway technology was based on a basic contradiction of the “*zeitgeist*“, which carried individualism and free enterprise on its banner.

### **Adapting the Social Backdrop**

The potential conflict finally ceased when a nationwide structure satisfied the demands of this unified technology, i.e. a hierarchical and bureaucratic pattern of organization.

The outcome of the process is familiar. It was skillfully researched and documented by the work of A.D. Chandler (1977, 1990). Some results of his monumental work will be briefly summarized here.

According to his presentation, American railroads became the pioneers in modern management in the 1850s.<sup>7</sup> Because of the complexities of their operations they formed for their internal organization smaller operating groups and appointed middle managers to supervise, monitor, and coordinate the different functional activities. Railroad managers devised a line-and-staff system of administration acting on one line of authority. This included among other requirements the setting of standards in materials, pricing, service, workloads and salaries. Unavoidably, managerial hierarchies emerged from these requirements. For strategic reasons railroad companies had not only to cooperate with other companies to ship goods and passengers across the continent in good time, but also had to expand their own enterprise across the North American continent. The spatial expansion was unavoidably followed by an expansion in terms of management and capital, resulting in very large enterprises. These again required more control, more uniformity and more standardization in many respects. To put the result in Chandler’s words:

“The corporations operating them remained for many years the world’s largest business enterprises, administered by the world’s largest managerial hierarchies.“ (Chandler, 1990, p.57)

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<sup>7</sup> This presentation is not undisputed. M. R. Smith (1985) presents a somewhat different line of argument, as we shall see below. However both place the outcome roughly in the same period, so that the dispute becomes rather one of priority, an issue notoriously difficult to decide.

## **Cultural and Technological Traits in Conflict**

It is of great interest for our argumentation to compare these developments with the analogous ones in Europe. Comparing for example Germany to Britain one aspect seems particularly instructive; although – or possibly because – the British were the first to have invented and developed railways and steam engines, they did not submit easily to the intrinsic requirements of this technology. Contrary to Germany and the US, Britain maintained for a long time its individualistic patchwork of small predominantly family owned enterprises<sup>8</sup>. In contrast to this „German entrepreneurs were more ready than the British and, in most cases, than the French to give up, in Ludwig Stollwerck’s words, “patriarchalisch-familienegozentrische Auffassungen”, and instead to recruit teams of managers, to give those managers wide responsibility, and to share top-level decision-making with them.“ (ibid., p. 500)

It is well known that Britain could not maintain its idiosyncrasies over time and was finally forced to succumb to the requirements of technology as well as to the rules of competition as evidenced by economies of scale and scope.

Still, it is of much interest to our argument, that Chandler explains these differences in terms of inclinations, which are inherited and thus inherent in culture, rather than by rational or economic considerations.

One of his arguments draws on the long tradition of German bureaucratic management which became thus internalized and allowed at the same time a different and higher social status for “Privatbeamte“, the label attributed to industrial managers. This stands in strong contrast to a “company servant“, the title given to them in England.

Even more compelling however is a second point he makes; he traces some of the roots of these manifest differences back to the traditions of the respective legal systems. These differences are ancient and passed on by way of cultural traits although their consequences regulate societal interrelations. The above argument criticizing the inappropriateness of separating culture and society is here again corroborated. Germans, accustomed to ample protection of private agreements by courts of law, are, due to this juridical protection, more ready to subscribe to such agreements and even to accept vertical integration of various firms, than companies subject to Anglo-Saxon law. Lacking comparable legal security the latter preferred acquisitions and mergers – and still do so - which guarantee absolute control. This belligerent basic attitude makes strategic cooperation unlikely and was in general responsible for the German superiority in industry over Britain before the first world war.

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<sup>8</sup> It should be noted that T. Hughes comes to identical results in his study of electrical power systems in Britain.

The influence of culture is of course not restricted to differences in legal systems. Another often neglected fact is the culture-dependence of the very notions of space and time as was already pointed out above.

A railway is a one-dimensional technology of transport due to the fact that the steering system is externalized in contrast to boats or cars which for a long time had an externalized power system. From this perspective it becomes clear that the entire system of rails and power supply is but one single mechanism spread out over space<sup>9</sup>. Mobility thus became enchained, directed and industrialized.

### **The Emergence of New Space and Time**

The basic advantage of the comparatively low friction of rail transport at times becomes a disadvantage. Because of this railways are restricted in their capability to ascend steep elevations. The deficiency is usually overcome by planning railroads accordingly. Tunnels, bridges and long serpentines result from this.

Railroads are also not very flexible when taking turns. This requires much space for serpentines and makes straight lines by all means preferable. For safety reasons the joining of rails must be very precise, in order to eliminate severe bumps and similar discontinuities. From all this results a distinct experience of spatial transfer. The contemporaries of the railways' adolescence accumulated due to these peculiar properties' novel perceptions and experiences of space and of time. This new mode has not yet found its final form, as high-speed "Shinkansen"s and "TGV"s are still capable to provide new experiences for those using them for the first time.

The characteristics of railways mentioned above dissected the environment, lifted the passenger above the irregular surfaces and secluded him from the natural surroundings. Contrary to the experiences of previous times the traveler found himself in a new spatial environment separated from the natural one. This closed space possessed very specific qualities different from the usual ones, being filled with fumes and smoke, accompanied by the rhythmic sounds of the minor bumps where rails combine and recurrent swings of the

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<sup>9</sup>Cars are different to this mode of organization. Here power and steering become encased in one object.

wires of the telegraph when looked at through the windows. Novel velocities and segregation, smoothness and linearity created a unique experience of space. This newly segregated space was soon re-designed and re-furnished inside the coaches to cater to the requests of the wider social system.

One obvious outcome of this development was the need to standardize time, which particularly in Europe heretofore was a colorful patchwork of local clocks. Time zones result from railway necessities as well as standardized track gauges, the system of signals, couplers, air brakes etc.

Culture, as we argued above, is closely linked to the cherished idols of social structure. And social structure is embedded in technologies. It becomes re-presented and re-enforced also by shaping and furnishing space, as H. Lefebvre (1974) has shown in detail.

### **Escape Routes**

The period of the expansion of the railway systems, i.e. the later two thirds of the 19<sup>th</sup> century, was marked by a radical difference of political systems in Europe and in the US. The continent, France and Germany, was driven to re-establish and strengthen monarchical rule, the US moved on to the peak of democratization, liberalism and free enterprise<sup>10</sup>.

Comparing the impact of this political difference with respect to the development of passenger carriages also sheds some light on our theme. A distinct class system, - up to four different classes of carriages -, developed quickly in continental Europe, in which the fourth class, that for the lower social strata, sometimes resembled cars for animal transport.

Generally lower class-coaches were highly uncomfortable, equipped with bare wooden seats only. Segregation of classes was so severe that in many cases coaches were not just divided into a number of small compartments, but each compartment could be entered only by a separate door from outside. A more luxurious furnishing of seats etc. was reserved exclusively for the upper classes. In contrast to this, American coaches were uniformly comfortable for all passengers. The one and only distinction made was between women and men, which in practice also served to separate smokers from non-smokers (Giedion, 1948). The basic principle was that every passenger should have access to the same kind of comfort at the same price, i.e. no distinction according to social status or income was tolerated. Blacks were, as one should expect, not included in this egalitarian principle.

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<sup>10</sup> I am grateful to the anonymous reader of this essay for the following remark: "But controlled by the states: e.g. by giving concessions for building & operating".

The original American attitude also found its expression in another most telling detail. In the early period compartments were unknown even in sleeping cars, and coaches were connected such that one could move from one car to the next. Giedion explains this by pointing to the widespread American practice of the time to leave doors open and to have no or as little as possible separation of rooms within a house. European practices were and still are opposite. Segregation and seclusion were common standards, doors were to be closed and curtains drawn. These different standards found their duplication in train carriages again on both sides of the ocean<sup>11</sup>.

After the Civil War American standards changed together with alterations in demographic distribution and the distribution of wealth. As certain factions of the population acquired considerable gains of material capital they strove for symbolic capital too. It is of additional interest to observe how the basic equality was gradually eroded by this trend. In the sixties of the 19th century a wealthy middle class developed, able to pay higher prices and prone to express distinctiveness. This trend culminated in the practice of wealthy industrialists to reserve entire coaches exclusively for themselves, thus coming close to aristocratic practices in Europe. This tendency undermined the original principles aiming at the democratization of aristocratic luxury.

The abolition of equality at first found its expression in the establishment of a two class system on trains. Not much later the automobile (Burkart, 1994) allowed to cultivate a preference for individual transport and uncoupled the new upper class from the lower as well as from the regimentation by a hierarchical technology, i.e. the car granted to the upper class now individual distinction allowing at the same time an escape from the rigidity of schedules.

### **Technologies and Cultures**

Cultural Theory provides four distinct types of cultures with distinct qualities rooted in overt differences of social relations. One of the four types, called hierarchy, exhibits the same traits which we found to be characteristic of the railway system.

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<sup>11</sup> My reader points to the fact, that Schivelbusch (1977) explains these differences in another way. Here I am not able to agree with my reader's comments. For social reasons were American coaches neither accepted in Europe nor would it have been impossible to divide larger rooms on steam boats or railway coaches alike into smaller ones, if desired. Schivelbusch himself mentions e.g. separated rooms for nursing mothers (p. 94).

INSERT GRAPH OF  
CULTURAL THEORY HERE

The expansion of railroads brought their intrinsic properties peculiar to a hierarchical and closed system to the foreground. Characteristic for such systems is their tendency to control their borders in space and time and to control membership. The immanent compulsion allows neither leeway nor inexact practices. Timetables are necessary prerequisites for the running of such organizations as are barriers at level crossings. Rigid adherence to rules is imposed on employees and also on passengers. Passengers cannot be allowed to choose their departing times at free will but are forced to succumb to discipline, for example, when entering or leaving the car. The same holds for the engine drivers, conductors, and the personnel at the stations, who are obliged to execute commands forwarded by telegraphy, telephone or the like.

One cannot deny that this particular technology exhibits all qualities characterizing hierarchical order: control structures, control of borders, creation of additive and thus linear time-structures, standardization of thousands of details in material structures as well as in performance, expansionism in space, manpower and capital, but also in time by conquering the nights and winter seasons for traveling and transport.

As Chandler argues, the railways formed the hotbed of hierarchical civil management<sup>12</sup>. One might say, that a technology reproduced its adequate culture.

This argument gains additional support from Chandler stressing the autonomy of the accompanying, aforementioned social innovations.

As a first conclusion, we can state that these technologies, as do many others too, take command of social structures.

The advent of the car lured the upper classes away from the railway by offering a means of transport more in keeping with their individualistic desires of independence and self-determination. This seems to show that superficial adaptations, such as introducing luxury cars and second class carriages in the US, are unable to neutralize intrinsic qualities of technologies. Intrinsic qualities become manifest in space and time structures, which

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<sup>12</sup> Chandler (ibid.) stresses repeatedly that this constitutes an independent social invention and is no copy of military structures.

corresponds to - or counteracts - the peculiarities of lifestyles of a culture. If these structures run counter to a certain culture, the representatives of this culture opt for technologies more in accordance with and conducive to their lifestyles as soon as more appropriate options become available.

The introduction of techniques of massproduction of firearms (M.R. Smith, 1985) demonstrates how an organization, in this case the army, develops with considerable efforts a standardized technology adequate to its own hierarchical structure. But this is another story which would require another essay. Alluding to it helps, however, to answer a pertinent question:

Who takes command? Technology over culture or culture over technology?

Actor-network-theory tells us that social organizations are myths, if artifacts are not taken as equally important partners in the web. What is required is conformity of both elements – people and machines - to the guiding principles of such multi-actor fabrics. Technologies impregnate, penetrate and coin lifestyles and social structure, social organizations select, shape, and adapt technologies to accord to their lifestyles.

But this is precisely what the definition of culture by J.Alexander (1990), quoted at the very beginning of this paper, predicates, for whom culture is. It is “the ‘order‘ corresponding to meaningful action“.

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