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The three-dimensional Evolution of Human Work:

Some Methodological Consequences for Social and Historical Research[1]

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Abstract
The threefold evolutions of human work in the technological, social and cybernetic dimensions all contribute to the same two major epistemological and methodological consequences: 1) First Order problems result from the increasing difficulty of interpreting any historical remains and data (artifacts, texts, figures, pictures, videos, software programs and everything else), because ever more contextual information has to be added in order to understand what such data effectively mean. This demands a shift from "atomistic" to "holistic-systemic" perspectives insofar as knowledge about very encompassing technological and social systems is necessary in order to assess the meaning and function of concrete empirical objects or events. 2) Second order epistemological problems arise from the fact that the social actors are themselves confronted with the same cognitive complexities as any outside observers who do social research. Future researchers will have extreme difficulties to reconstruct the cognitive mind set of past actors, because no adequate and consensual subjective perceptions and interpretations can be assumed.

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While the historical sciences predominantly aim at idiographic descriptions, they are nevertheless dependent on the nomothetic sciences like sociology insofar as they have to base their methodology on reliable lawful regularities that govern human behavior.
When dealing with *organigrams of defunct organizations*, for instance, historians have to use organizational theories which assert under what conditions and to what extent such organigrams are mirroring factual relations of power; and when analyzing *historical demoscopic data*, they have to rely on socio-psychological theories for assuming that most survey respondents have told the truth.
Consequently, historians have to take care that they don't accept laws on the methodological level which they at the same time deny on the level of the substantive historical reality.

A ready "compromise" is to assume that there are a small number of different periods each governed by its own "historical laws". Thus, we find a widespread usage of surprisingly simplicistic periodical divisions whose problematic status is not sufficiently reflected: e. g. the binary divisions between handicraft and industrial production, or between the age of mechanic technology and the age of computerized digitalization. In such a perspective, it may be that even the most descriptive historians sometimes want to listen to a sociologist, because they think that there is something to learn from the most theoretical of all social sciences.

In the following, these two core questions shall be addressed:
1) How is the world of human work evolving, especially in the era of computers and digitalization?
2) What impact do these developments have on the epistemological and methodological challenges with which historical labor research is confronted?

As we may all agree, the world of human work is an extremely multifaceted and dynamically changing field of study. Thus, any endeavor to grasp it scientifically has to take recourse to highly abstract concepts and propositions.
In a first, most simplified approximation, we may model the long-term historical development of human labor as a two-dimensional evolution:

1) *A **Technological Evolution,*** characterized by the mergence of human artifacts of ever higher complexity and functional capacities: starting with hand tools, continuing with industrial mechanization and culminating in contemporary systems of computers and other digital devices. In the course of these advances, relationships between work behavior and its outcomes become ever more fundamentally mediated by increasingly complex technical structures: so that the same behavior (like pushing a button or moving a computer mouse) can have an indefinite range of effects.
In a methodological perspective, this implies that there is an an ever widening gap between the specific concrete artifacts and work processes that can be empirically observed (or which will be identified in future historical remains like photographs, machineries or role descriptions), and the ever larger and more complex macro-technological systems in which they are (or have been) embedded. In other words: empirical observations are less and less informa-

tive because the really decisive context of the technology is invisible: either because it is miniaturized (e. g. within ever smaller electronic devices), or because it resides in larger, translocal systems like electricity grids or computer networks.

2) A ***Social Evolution*** that includes the increasing expansion, differentiation and organization of human society on all its levels. On the *micro level,* we see the growing sophistication of interpersonal communication and teamwork cooperation; on the *meso level,* a growing scale and complexity of formal organizations and interorganizational systems; and on the *macro level,* the emergence of wide ranging labor division and monetary exchange relationships as well as the rise of political systems and legal regulations, increasingly on an international or even planetary scale.

In a methodological perspective, all these trends similarly imply that there is an ever widening gap between

- the concrete work processes and work productions that can be empirically observed (and which future historians may find documented), and
- the ever increasing range and complexity of contextual knowledge that has to be added in order to understand what is really going on.

Let's illustrate this with Max Webers famous example of observing *a man cutting trees*. In early societies, such an observation has allowed easy inferences about the "meaning" of such an action: somebody was evidently procuring wood for either his personal uses or for selling it on near local markets.

When observing a contemporary operation of *forest clearing*, an adequate interpretation demands that a much wider range of contextual conditions is taken into account. Maybe the causes are found in international tariff regulations that stimulate the production and export of plywood or wood pellets; the specific work procedures may be the result of union contracts or governmental regulations (e. g. about work hours and safety measures), and the wood cutting may be enacted in order to gain ground for building new streets or airfields, or to implement a measure within a national program of ecosystem management.

Thus, both Technological and Social Evolution contribute to making labor research ever more difficult: by increasing the discrepancy between the few things that can be *empirically assessed* and the ever larger range non-observable things that have to be additionally *known* in order to understand what these empirically given items factually mean.

In a most fundamental sense, this implies labor research has to shift from an atomistic "bottom up" process to a holistic "top down" endeavor: because the interpretation of any specific data depends completely on the knowledge of the much wider contextual circumstances from which they derive their meaning.

Evidently, this concept of a two-dimensional evolution is not at all sufficient to model the history of human labor, because it is not able to grasp the most recent developments since the 1970ies that are at the center of our attention: the basic shift from industrial to post-industrial technologies, work organizations and economic systems. Looking at the bewildering manifold of recent changes and current developments, we find that the word

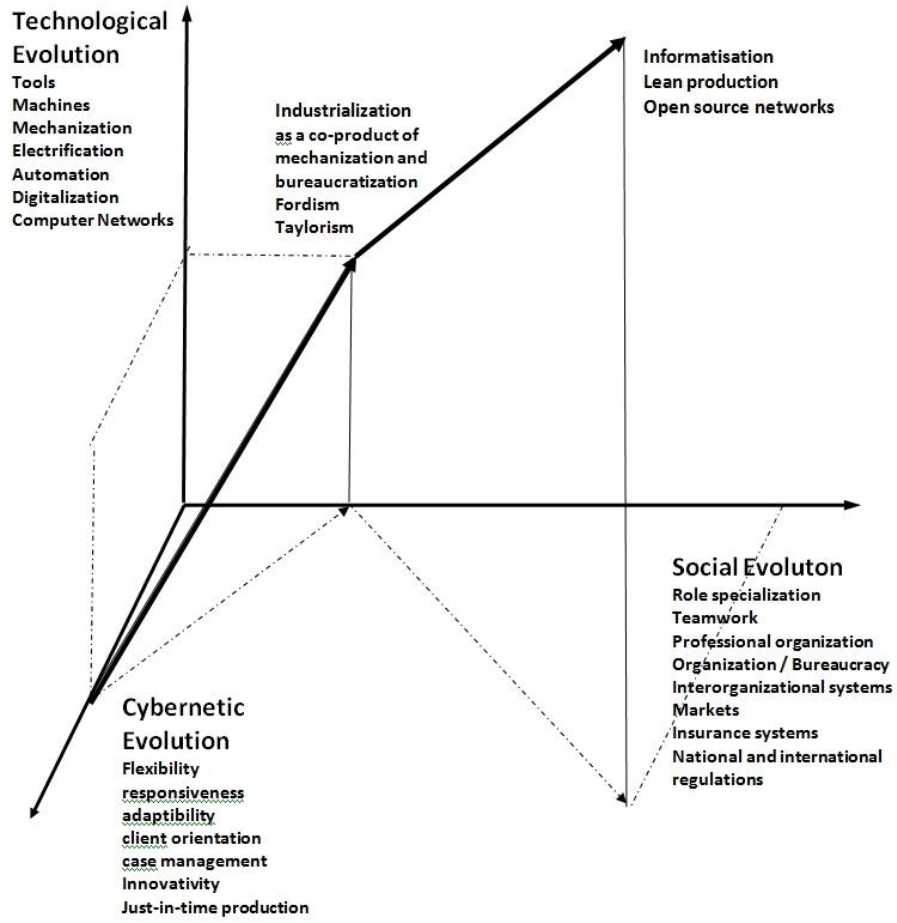
"flexibilization" is most often used to describe such changes: e. g. the change from "Fordist" to "Postfordist" systems of industrial production.
In a more generalized perspective, it seems analytically more fruitful to talk about a "Cybernetic Evolution" because this notion paves the way to integrate machine-machine, men-machine and men-men interactions into a common theoretical frame: thus including Real Time transcontinental bank trading as well as interactive CAD applications, multilateral video-conferencing, individualized case management or the disposition of teachers or social workers to react more responsively to their students or clients. The level of Cybernetic Evolution can be readily measured by the degree to which work behavior is responsive to a large variety of relevant psychological, social, cultural and situational factors: among them particularly the behavior of other actors and the outcomes of one's own precedent behavior.

At the zero level, we find *extremely rigid procedures of mechanical work* where workers are completely determined by prestructured technologies and rules: without any chance to shape the work process by their own perceptions, judgments and skills. The contrary extreme is exemplified by a *surgery team* where work happens in a context of constant feedback on the individual as well as the interindividual level: most often enhanced by biometric devices and imaging technologies that allow doctors to react immediately to changes of heartbeat, blood pressure or any other crucial variables.
Evidently, this third evolutionary dimension also adds to our fundamental methodological problem that empirically observable patterns are less and less informative about what is factually going on. While we get readily informed about the type of work behavior and products when looking at a machinery in current operation, we are at a loss when observing a surgery team because it is guided by sensomotoric processes and man-machine interactions that can hardly be objectively observed (and even less be recorded for future documentation).

In contrast to the the technological and social evolutions that proceed quite monotonically over historical time, the cybernetic evolution shows a completely different, curvilinear pattern.
At its very origin, we find the *naked human hand*: the most cybernetic of all bodily organs because it combines motoric and sensoric capacities on a high level: so that at any moment, I get sensory feedback about what I currently do.
From this starting point, practically all classical technological developments have resulted in a loss of feedback (=reduction of flexibility), because only the motoric capacities of the hand have been externalized: thus isolating the human being (sensorically) ever more from the objects of his work. As a culminating point, we find industrial machinery dedicated to pre-programmed routine action: marginalizing human workers who can no longer influence the work process, and - as in the case of automated chemical plants - may not even be able to touch the raw materials and to observe what is going on.
Likewise, the major developments in Social Evolution lead to a similar loss of cybernetic feedback on the level of social interaction. This is illustrated by ideal-type bureaucratic top down organizations that are designed to translate centralized decisions into operative actions, not to feed information upwards back to the centers. Similarly, conventional mass me-

dia are designed as oneway top-down channels not enabling the recipients to respond by upward communication.

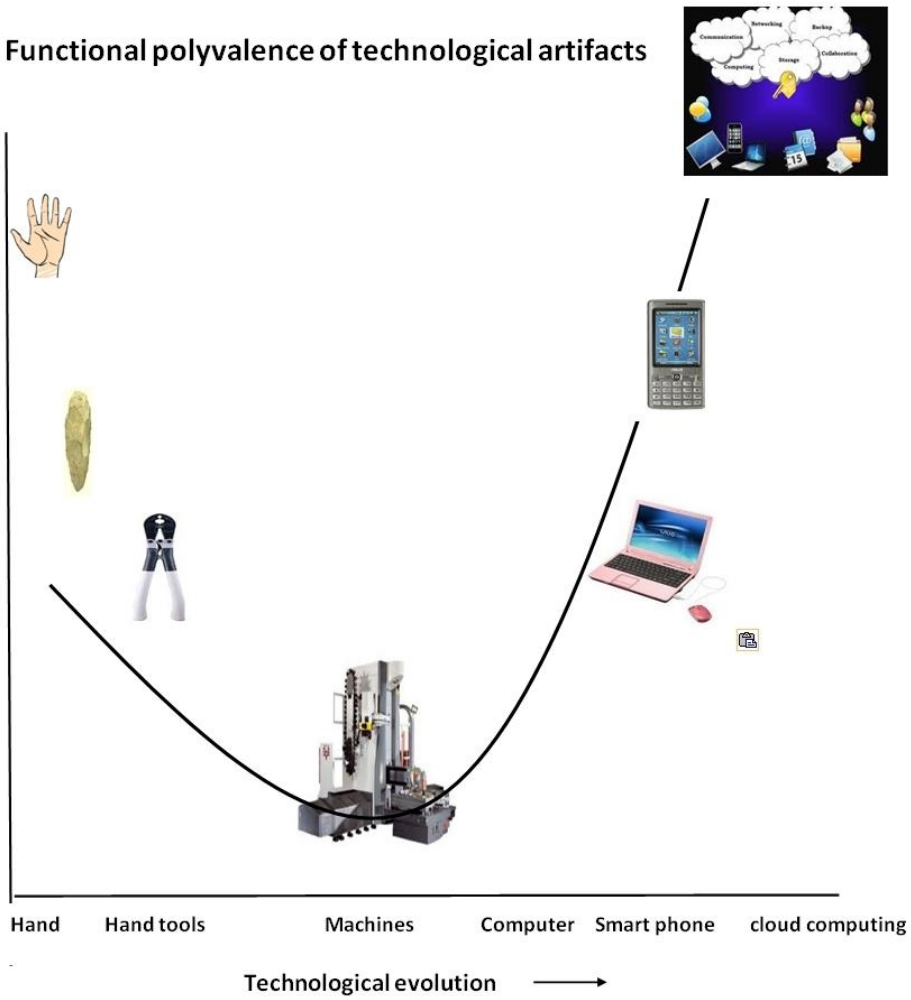
The World of Work in Evolution: a three-dimensional model



The concept of "Industrialization" denotes the fusion of these two trends most vividly exemplified by highly mechanized and formalized ("Fordist") plants. It's a most highly crystallized and objectified world of work that offers most advantageous conditions for labour research and labour history, because all major relevant variables that determine the work process and the work outcomes can be assessed in an objectified form: either as physical artifacts or as written formalized programs and rules.

Given its clear definition and empirical manifestation, the "Fordist plant" can serve as a useful background against which almost all of the more recent developments of "flexibilization" can be contrasted: *social* developments toward "postbureaucratic organization" that have been enacted without much electronic support (concepts of "matrix management" or the Japanese "lean production" concepts), and recent *technological* developments as they are heavily determined by marriage between transistor-based computer hardware and digitalized informatization.

The curvilinear nature of the cybernetic evolution can be highlighted when the versatility (or "polyvalence") of technical artifacts is examined over time:



In the long prehistoric and preindustrial historic periods, we find a predominance of *"hand work"* characterized by a small number of rather simple and polyvalent tools. Evidently, considerable knowledge about the overall living conditions of a prehistoric society is necessary in order to know to what purposes flintstone hand axes have been precisely used, and many artifacts from ancient or Middle-Age settings are not well understood because immense inventories of informally transmitted knowledge (e. g. about the production of colors or the construction of ships and housings) have been lost.

By contrast, future archeologists who hit on *specialized industrial machines* (like punch presses or moulding cutters) will be the most lucky fellows, because such remains will allow very detailed inferences in three directions:

1) What kind of work activity and work role is implied by operating the machine?

2) What contextual conditions (power supply, human skills, repair teams, auxiliary machineries etc.) have been necessary for its functioning and maintenance?

3) What kind of output has been produced by the machinery? And what other machinery has been necessary for executing preceding or subsequent steps of production?

In sharpest contrast to industrial machine technologies which determine human behavior and work outputs by the irreversibly fixed specificities of their material structure and functioning, *computers* are generalized tools for engaging in almost infinite range of different activities and for solving an ever increasing spectrum of tasks. The *stand alone computer* already is a highly polyvalent device empowering each user to exploit the capacities offered by digital data processing for an ever increasing spectrum of tasks and purposes: writing letters, painting or transforming pictures, produce graphical representations, reading e-books, composing music, consulting dictionaries or programming computational procedures. *Networks of interlinked computers and smart mobile phones* are the most universal of human action tools: expanding their functional capacities with breathtaking evolutionary speed, including tasks requiring multilateral cooperation on a global scale.

Contrary to industrial machineries, computers and computer networks cannot primarily be seen as causes that would *determine* any kind of individual or social behavior. To the contrary, they must be considered as factors of *indetermination* that make causal explanations and predictions of all kinds more difficult, because they empower individuals (as well as collective actors) to have more alternatives at hand. Thus it is indispensable to study the specific purposes and goals pursued by the users as well as the particular cultural norms, social constraints and environmental circumstances under which the devices are actually applied. By empowering individuals as well as collectivities, organizations and whole societies to realize their own preferences, *the digital media are likely to amplify any kind of divergences already existing on the psychological, social or cultural level.*

This "uninformativeness" of electronic artifacts is radicalized insofar as hardware and software become separated. Beginning with "numerical programming" where software programming was tightly wired into the specific hardware devices, we find a growing dissociation of software from its electronic bases. Today's computers still have on board their own processing and memory capacities, and conventional mobile phones contain lists of phone numbers, received and sent out SMS, photos taken by the in-built camera etc. Thus, when a archeologist of the 25th century will hit on such a device, he or she may well be able to draw conclusions about its usage and its user (e. g. by analyzing flash memory or hard disk contents).

But evidently, the future seems to be belong to "Cloud Computing": in the sense that individuals draw upon applications, memory and processing power allocated somewhere at unidentifiable place in the Net, so that their own computers can be reduced to simplified terminals no longer needed to store any specific information that would allow future researchers to reconstruct the activities in which their users have been engaged.

The metaphor of the „Cloud" vividly highlights this completely "ahistoric" character of contemporary informational work: Clouds have no history, because no reasonable historical account can be given of objects that constantly change in amorphous ways, and that can evaporate without leaving any visible trace.

The declining information content of physical artifacts is also manifested on many other levels. Thus, future archeologists will also be very frustrated by the fact that the expressiveness of work-related architectural structures has sharply declined since the end of 20th century. Excavations of office buildings up to 1990 will yield detailed information about individual work places as well as about the larger patterns of status orders and interpersonal cooperation. For instance, spacious offices (with antechambers) will indicate social distances between highest and lower status positions; separating walls provide hints about the value of individual privacy and intentional barriers of communication; board rooms will give information about the size of formal decision making bodies - and of course: large open plan offices will reveal a commitment to collectivistic office ideologies: emphasizing unimpeded multilateral interaction.
Since then, however, much less informative "combi offices" and "open space nomadic offices" have gained ground: polyvalent spaces that lend themselves explicitly to highly volatile, self-guided as well as group-guided patterns of usage. Thus, in order to reconstruct social office life occurring in them, historians would have to gather a gamut of hardly available "soft" information on about informal social habits and behavioral styles.

While human work behavior and work organization is less and less determined by materialized technologies, it is evidently more and more shaped by software applications.
In two ways, software can be used as a powerful new tool of formalization:
1) It allows to structure and control not only processes of production, but also all aspects of administrative work (hitherto structured only by written regulations).
2) Control can easily be extended ubiquitously to very specific molecular behavior, and it can be absolute, so that no deviations due to informal norms are possible anymore.
For instance, forms of application (e.g. for union membership or university enrollment) can be structured in a way that application is totally impossible if certain specific information is not given, or certain preconditions (age, certificates) not fulfilled.
In a methodological perspective, it will be essential for future historians to reconstruct the software programs that have been operative in a specific organization, departments and work units at specific periods of time. However, such reconstruction is likely be handicapped because in contrast to stubbornly surviving material artifacts, software is likely to get lost because storage facilitates are eroding and because programs and data can be completely eliminated by simple deletion. In addition, surviving software may no longer be retrievable, readable and editable because the necessary "downward-compatible" programs are no longer at hand.
Apart from such technical problems, software will never be a reliable indicator of sociocultural realities because to an increasing extent, it appears not in the form of *"restraining and controlling software"* that *determines* individual and social behavior, but as *enabling or empowering software* that *indetermines* such behavior by enlarging the spectrum of available options.
In the 1990ies, before the advent of the Internet, the concept of CIM (computer-integrated management) expressed the vision (hope or fear) that software would radicalize centralized managerial control by subjecting the total production process to predetermined, formalized

software procedures. This line of development has not proven viable, because of its contradiction to all exigencies of flexibility, adaptibility and innovation.
By contrast, we have seen a dramatic rise of *dispositive* or *empowering* software that allows all (individual and corporate) computer users to engage in self-determined activities of computation, text and graphic production, file sharing, protective data encryption and uncensored social communication.

Methodologically, this implies that by knowing *what* software has been installed, we know less and less *whether*, in what way and to what effects it is (or has been) used. In fact, most firms and most individual computer users are in possession of identical software programs: but the way how they are applied is completely determined by the motivations and skills of its users or the managerial intentions about which goals shall be pursued. In other words: the difference between a productive and a less productive firm can less and less be grasped in terms of any programs they have implemented, but only by measuring highly subtle, invisible factors like subjective individual skills, motives and intentions or cultural patterns on the level of groups or organizations.

The impact of digital technologies is most vividly seen in their subversive effects on institutionalized communication. In the 1950ies already, the German sociologist Hans Paul Bahrdt has asserted that the telephone is an "anarchic" medium of communication because it allows all sorts of top-down, bottom-up and diagonal contacts within an organization: irrespective of prescribed formal channels.
Especially with the advent of the Internet and particularly the Web 2.0 with Twitter, Facebook and all other social media, with the development of encryption utilities and with the ubiquitous availability of mobile devices allowing worldwide communication at almost all time and locations, the digital sphere has gained a "subversive" potential apt to erode or even destroy formal structures: so that most employers feel the necessity to implement restrictions on their use.
More and more, not only higher managers, but all employees have to seen as rather autonomous centers of communication: switching constantly between different channels, partners and social roles literally within seconds, thus living a life where the main sources of stress are no longer stemming from hierarchical restrictions, but from the permanent necessity to make new decisions and to conform to new (mostly informal) norms of reciprocal communication.
For social and historical research, this all means that the study of any formalized rules, organigrams, plans and procedures is less and less fruitful for getting to know who has interacted with whom at what point of time, who has been in possession of which information at which moment; who has sent files to what group of recipients; and who is not only *formally*, but *factually* responsible for a specific decision.

As a major conclusion, we may contend that the threefold evolutions of human work in the technological, social and cybernetic dimensions all contribute to the same two major epistemological and methodological consequences:

1) First order problems: assessing the objective (but unobservable) contextual conditions

It becomes ever more difficult to interpret any historical remains and data – artifacts, texts, figures, pictures, videos, software programs and everything else – because ever more contextual information has to be added in order to understand what such data effectively mean and how they relate to other such data as well as to any higher-order entities like work groups and work projects, organizational structures and corporate strategies or even interorganizational networks or whole economic and socio-political systems.

This of course has many implications for researchers and for processes of research. One major implication is that all individual research has to situate itself into a larger "vertically integrated" research setting: so that all artifacts, documents, images and other empirical data data can be tightly connected to "systemic information" about the meso level of organizations and the macro level of society, government and culture. There has to be a major shift from "atomistic" to "holistic-systemic" perspectives insofar as the knowledge about very encompassing technological and social systems is decisive whether and to what extent the meaning and function of lower-order objects or processes can be identified.

2) Second order problems: reconstructing the subjective mindset of (individual and collective) actors.

The second order epistemological problems arise from the fact that the workers, enterprises, unions and other actors are themselves confronted with the same cognitive complexities as any outside observers who do social research.

In premodern times, work took typically took place in a narrow sphere of local physical causalities and social relations that were easily and consensually grasped by the workers themselves (workshop, family, local market, personally known clients etc.).

Today, relevant contextual factors are so widespread and complex that it cannot be assumed that average workers know them or interpret them in clear and consensual ways, because by simply doing the job, such information cannot readily be acquired. Thus, workers have to take additional efforts in order to understand their own situation and to grasp what they are really doing and producing, on what raw materials their technologies depend, what effects their technologies have on society and the environment, how they affect the fate of other workers in other regions, how their work conditions compare with those in other firms etc. Apart from schools and media, Labor Unions may evidently have a role in propagating such information.

Of course, future researchers will be confronted with the basic fact that it is extremely difficult to reconstruct the subjective mind set of past actors, especially of those who have not left any written testimonies of their beliefs and expectations. Nevertheless, such reconstructions are essential in order to understand and explain why workers leave or stay, why some revolt and other remain silent, why some are committed and other demotivated, and particularly: why various workers as well as employers differ so much in the way they make use of all the empowering technologies at hand.

Evidently, this implies much more integrated research efforts that may well be supported by the same digital media that are partly responsible for the problem: by using them as tools for interrelating and synthesizing data and for furthering dense and widespread scientific collaboration.