Society – Technology – People

Theory-Interviews on the relationship between societal and technological change.

Interview with Prof. Dr. Hartmut Hirsch-Kreinsen

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Where do we find sources for technological change and social division of labour?

The old “social shaping of technology” formula dates back to the 1980’s. It states that technological developments are to some extent driven by social conditions and this was one of the perspectives adopted in Germany. This was followed by so-called technology genesis research and development, i.e. social conditions in the most general sense of the term. These may be assigned to the level of society itself, to organisations and their structures or to the individual level, but where they occur is actually secondary. Technological development, societal development, and the factors which in turn affect technological development operate in a kind of feedback process. Technological development generates societal structural conditions in the form of institutionalisation processes. In specific terms, new bodies of knowledge are created, for example even to produce curricula for engineer and technician training. In the broadest sense, in the wake of the development of a new technology, a new coordinated area of action emerges for stakeholders who, to put it crudely, previously had very little to do with one another. Behind all of this is the old and in my view ancient basic sociological question of how coordinated action between heterogeneous stakeholders and heterogeneous interests actually comes about. The crucial mechanism in certain areas and under certain conditions, although not always, may be technological development. Certain heterogeneous stakeholders agree on a certain technological objective, towards which they orient themselves. The resultant cooperation development and actions then become established, or institutionalised, so to speak. In the broadest sense, this would be a general perspective of technological development in connection with societal conditions. Scientific research and the stakeholders that operate in this area and, of course, push forward potential development or use or new technologies, thus constitute a driver in this regard. The case of artificial intelligence is really a good example. AI has developed from a somewhat symbol-oriented methodology to neuronal networks. As far as I understand it, this is a completely different type of logic which is what permits a leap to be made towards learning systems and the like in the first place. This happens fully

unquestioningly within the laboratory. A central role is played by the coordination processes I mentioned earlier and by processes of institutionalisation. Innovation and technology research include famous laboratory studies, which describe in detail how agreement and coordination processes work. That is one aspect. But the question of whether what is created experimentally in the laboratory actually becomes reality requires further thought. Here we also have to consider socio-theoretical structure and also action-based connections. There are massive structural changes regarding the ability to innovate in nearly every country, this is described as the emergence of “big science” in innovation studies. Usually, regarding the USA, this is dated to the 1940s, an accelerating process of massive scientification of technology development. This is not just the emergence of universities, but also of research institutes, funded public and sometimes also private, aiming at systematic development of technology. I believe, however, that scientification and indeed “big science” as the real thrust behind this institutionalisation process would have to be dated to the middle of the 20th century. Of course, we are currently in a situation where this is playing a key part in a highly differentiated science and research system under the label of “digitalisation”. Internationally, this is very differently pronounced and has various key focuses. #00:05:12-3#

Who is driving technological change and social division of labour?

This affects the phases which essentially relate to broad dissemination, i.e. whether a technological development or innovative technology is accepted or deployed. It also affects the specific phase of implementation of introduction to users. And this now brings us to the companies which, for example, make use of new production technologies. On an action level this certainly involves conditions affecting decision making processes of users. Naturally there are restricting conditions, conditions of economical rationality for example, determining whether certain technologies are usable or not for a company and at what cost. I also believe that this constitutes a considerable flaw in the most recent debate surrounding digitalisation. There are complementarities here between the potential of a technology and the conditions relating to its use. Although from a completely different area, one example in my view is the development and marketing of the smart phone. The iPhone of eight or ten years ago was a perfect match for the social habits of communication. People were already used to thinking in Internet categories. I think that this is a key condition at the diffusion level. The thing I have constantly encountered whilst investigating various cases is what we would term to be “follow-up costs” which are incurred, for example, when a company installs three new robots on an assembly line. Employee and management representatives are crucial stakeholders who, of course, play a massive role at the application and implementation level in a firm. And then there is the societal level, which represents more of a meso level. The Industry 4.0 Platform is one example here. The influence of the IG Metall trade union—and we are currently on IG Metall premises—naturally plays a major role. Things are different in other countries, where the part played by unions in this regard is very subordinate. In these cases, the employer associations and major firms are to the fore. So, as we have said, everything is a negotiation process at some point. If we take a precise look at the current situation in respect of actual innovation processes, a shift is taking place within

the innovation system. This is certainly happening in Germany, but is occurring internationally, too. If I now relate this to production technology development, then the tradition in Germany was that the innovation system was governed by stakeholder groups. Development was determined by a situation that was mainly aligned to the conventional engineering sciences in conjunction with machine construction and electrical engineering. In other words, this was a system which was application oriented rather than being particularly technology intensive or high tech. The situation is now completely different. Suddenly, computer science and information technology have arrived on the scene. Under this label, Industry 4.0 is providing the main thrust for new opportunities that are now technologically available, and it is in their interest to bring about further changes to this system. #00:08:57-3#

Which consequences will arise from technological change?

This is an exciting topic, which we discuss under the label of human-machine-interaction. I think that it will form a continuous thread over the coming years, especially given the development of autonomous systems and of systems that are based on artificial intelligence. On the other hand, ongoing automation and the role humans play in automated plants are an old issue in the sociology of work. How are humans and human work actions linked to the technical system? In terms of the development, I would say that the first thing to happen is an increasing decoupling of human and automated work actions, or the process which is technologically driven. Secondly, such a decoupling implies that many work tasks are replaced and taken over. This is not only implied by this automation perspective, something which is not new, it also suggests an autonomisation perspective which will see the assumption of tasks which are not structured in a routine way and also of decision making opportunities. This means that humans will continue to retreat. Initially there seems to be less work and substitution will take place. But the third point is that we will then have the phenomenon of a dramatic shift in the “scope” of work actions. A technologically driven dynamic will take effect on the work process. This will provide us with completely new possibilities and necessities for the structuring of work with which we may not be at all familiar yet. We will have new coordination and planning functions which actually did not exist before. In principle, these will be able to mark out an area which can then be used for new forms of work. So the first and general thesis is that work will not disappear. The second thesis would be that work can be redesigned and that completely new perspectives can be opened up. Of course, and this is not something which I have addressed, the whole question of decisions of autonomous systems on the one hand and of human work processes on the other depends on ethical questions which remain to be discussed. I did not really want to get into that. There can be virtually no talk of a causal and deterministic correlation here. We can only revisit the old categories already mentioned. We have innovation, diffusion processes and implementation processes. In implementation, i.e. the decision as to how new technologies are used and applied, social consequences in the widest sense of the term will ultimately be determined. You can ask, at an aggregated level, and this is a

discussion which is now omnipresent, how many job losses will occur if we introduce robots, and what will be the consequences of digitalisation on the labour market. Actually, these are estimates of potential, in any case, the sorts of highly prominent study results that are going around the globe and providing a constant source of annoyance because of their lack of methodological rigour, and as in my view, they are not sufficiently valid empirically. Things become more complicated if we attempt to use all scenarios and methods as a basis for the analysis and postulation of different development tendencies and perspectives. A whole mass of existing structural conditions is then at play, and statements then naturally become more vague and less certain. “What direction are we heading in?” It is easy to see that the stark answer is couched in terms of “versus”. “Versus technology terminism.” We must not make this mistake. Firstly, we are speaking of a scenario which we simply call substitution or automation. This reflects a common argument within current mainstream debate that the introduction of new technologies will lead to the loss of a whole series of jobs, at least in the short term. If we follow the debate and some of our empirical findings, this will mainly affect simple routine tasks although by no means all such tasks. The fact that by no means all such tasks are affected is a very important point. We thus have a situation in which jobs will be lost in the short term whilst some jobs will remain. But I would continue with this scenario. The “common wisdom” of historically oriented labour market research tells us that technology thrusts always set off something like compensation measures with regard to job losses. This means that, in the case of the successful introduction of new technologies, new jobs will be created in the long or medium term, given a series of marginal conditions, which will then compensate for job losses to a certain extent at the macro or aggregated level. That would be one thing. The second scenario is referred to as “upgrading”. This also somewhat reflects the normative or optimistic perspective, mainly the Industry 4.0 debate, which works on this assumption. We can also cite Kagermann, who says that we have not simply operators but we have regulators, controllers, warranty workers, experts and so forth. This scenario thus implies that repetitive simple tasks will disappear. On the other hand, new systems, information and training opportunities and the better synoptic view that will be acquired via such systems will facilitate a general upgrading of all jobs. A third scenario, which we refer to as polarisation, is a relatively prominent theme on the labour market at an aggregated or macro level, especially with regard to income and qualifications structures. We tend to relate this to the operational level to some extent, and we at least believe that we are able to find some evidence of it in various activity areas in different employment segments. Maintenance activities are a classic example. These are demanding tasks in many regards, but are taken apart in the wake of new planning and formalisation methods. Polarisation then means that certain tasks are upgraded and become more challenging, some tasks are automated, and others are downgraded from the medium level; this opens up a chasm. The question is whether this will be a long-term tendency. This has been referred to by colleagues in England as “lousy and lovely jobs”, i.e. what is left over at the end. This would be the third scenario. The fourth scenario cuts across the three already named and perhaps affects more or less

everyone. In overall terms, this can be designated as flexibilisation and delimitation, in other words “working in the cloud”. Delimitation or flexibilisation thus means an erosion of organisational structures, of time regulation and of localities where work is carried out. With regard to internal operations, there is empirical evidence that this leads to project groups, temporary jobs, a kind of dissolution of organisational structures and to the debate with which you are familiar—inter-company development tendencies, platforms and work chains controlled across firms. The end result can be very precarious jobs in the form of “crowd workers” or solo self-employed persons and a different outcome with regard to demanding tasks. I think that we are living in a societal formation or system which is no longer conceivable in any way without technological development. And so I arrive at the design perspective. This is an argument within the Industry 4.0 debate. New intelligent systems are in a position to minimise and make more effective use of resources and so forth. Surely there is a lot to this but I would say it is not yet being used enough. This would be a question of regulation. Politics are in demand here. There is talk about machine responsibility, which would need to be defined, but the assumption is that these autonomous systems possess something that resembles their own responsibility. I am not very firm in philosophical action theory, but I am convinced that the notion of responsibility also needs to be linked with norms to some extent, with the allocation of action and responsibility which cannot be ascribed to these new technological systems in such a way. The problem arises, of course, when decisions are taken in a way that is isolated from the systems. The consequences are then not foreseeable, and the processes via which a system arrives at a certain decision are completely non-transparent. There is also a lack of transparency with regard to what is learned from the process by the systems and how a different decision might be taken next time. How can mobility be handled in the future? Society is becoming increasingly mobile, and this is an objective which it continues to pursue. But the consequences are all side effects which are difficult to calculate and may get on society’s proverbial bad side at some point. They could be seen as bringing a massive need for regulation in their wake. Yes, this is a central issue. New technologies may somehow once again bring about a shift in the current international division of labour, possibly a reintegration and perhaps reversal of past globalisation processes. Branch structures will also shift. Functions and occupational profiles may change or be expanded. This is a point which we also encountered yesterday. How will occupational profiles change? There are currently two conflicting positions. The first, to which I am also inclined, is a conservative and moderate position which I believe has its origins at BIBB. This argument involves pursuing the upgrading of certain tasks and occupations and the updating of occupational profiles etc. as what is presently happening. Others say that focusing on occupations is no longer of any use. We need to think in terms of competences. If people understand what they mean by this, we no longer need task-specific stocks of knowledge. It is merely necessary to have skills and the ability to deal with various action requirements. This is a completely different perspective. And it brings all kinds of social and labour market policy consequences in its wake. Tendencies towards shifts

and erosion are doubtlessly included in these considerations and are bound to play a part in this regard. #00:20:51-9#

How are drivers and consequences of technological change connected?

As far as diffusion is concerned, i.e. the dissemination of certain technologies amongst a wide variety of user groups and application areas, I believe that there is an important functional argument, somewhat historically abridged and allowing for criticism. How should I put it? Complementarities or elective affinities between the preferences, needs and bottlenecks that are certainly in place must exist between users on one side and the opportunities afforded by the new technology on the other. I think this argument is absolutely central. There are many arguments that play a role in various areas—price, functionality and knowledge with regard to what needs to be present collectively. This is one thing. Mechanisms at the direct user, micro or action level are a second crucial factor. These decision making processes have been an object of discussion for some considerable time and are of current interest with regard to new technologies. We refer to them as introductory processes. Introductory processes thus have a role to play. Firstly, there are the decision making processes undertaken by the key stakeholders in an organisation or company. Secondly, political negotiation processes also occur at this organisational level. These involve different actors from within management or from different management factions who are convinced to varying degrees of the respective merits of certain technologies. Thirdly, of course, we have the labour policy constellations that are specifically relevant in Germany. What role is played by the works council? What role is played by the trade unions? Does management seek conflict? Or does it attempt to avoid confrontation by taking a step backwards? What resources do the decision makers have at their disposal? Are they in it for the long or short haul? Do they have a supervisor breathing down their necks and asking for a progress report every two months? What knowledge do they have? And what degree of scope are the decision makers accorded by the company within the constraints of everyday business? The counter argument at some point will be that if they form part of a larger value-added chain, sooner or later they will come under pressure and will need to introduce new systems and be able to perform tasks such as data transfer. This may possibly put them in a difficult situation. My supposition would be that these processes involving elements and mechanisms that are effective here and which tend to have to be formulated in micro policy analytical terms have essentially remained the same. These new networking technologies however, form an additional argument and supplementary thesis—i.e. if digitalisation and Industry 4.0 are conceived in terms of the characteristics of “big data”, networking and intelligent systems. The crucial stakeholders are thus now confronted with new challenges. They require new knowledge and new action capacities. They need to arrive at a point where they are able to assess the net effect of such far reaching decisions on the deployment of new technologies, especially with regard to networking and the use of data. This alters the question as to whether this can still be managed in everyday processes. In this case, therefore, there is also an academisation of key stakeholders and decision makers. Various examples in specific

historic situations have shown that there is always a development boost, although we also need to accept that incremental innovations are the norm in engineering development, both economically and technologically. Further development thus takes place on an incremental step-by-step basis. The first thesis was already formulated above. It assumes different social consequences of new technologies in the most general meaning of the term and of various development pathways rather than postulating technology terminism. We do not have any "one best way" for the use of technology, i.e. if someone were to come along today and say that the new autonomous systems require in particular a form of work organisation which constitutes an upgrading. This brings me to the second thesis, which is that the use or rather the introduction, the specific design, the form of use and the organisational usage of the new technologies is a structural object, a decision making object. We had this before—a micro political decision making process which has the introduction of new technologies as its object. The same can, however, of course be related to the laboratory studies mentioned right at the outset. These tend to act via invention and innovation processes, and social negotiation processes and decisions ultimately play a huge role. This would, in some measure, be the second point. And it is a relatively important one. The third thesis or hypothesis which I will formulate is something which I feel is accorded far too little attention in the current debate. There are, of course, barriers, limits and inhibitions to the effectiveness, viability and usefulness of new technologies. These need to be looked at carefully in order to on the other hand be able to weigh up the social policy consequences properly. #00:26:41-7#

What measures can be taken to steer technological change?

Following the discussion in various academic and public groups and circles and reading many publications one might be left with the impression of an autonomous technological development, a sort of technology push which is driving forward societal development. To couch things in overcritical and pointed terms, indeed to speak polemically, it may be said that for many of those involved, technology is something which simply appears from nowhere. Particularly if we pursue the debate in connection with the newer and current discussion centring on the fresh areas of potential offered by artificial intelligence, the impression conveyed is that the boost now expected with regard to the possible applications of artificial intelligence systems in the widest sense has its roots in new growing areas of technological potential, the increasing effectiveness of computer systems, the fact that such systems have become massively cheaper, networking and other similar processes, "big data", the possible areas of use of "big data" methods and so forth. However, virtually no questions are posed with regard to where the interests, stakeholders and certain factors which brought about this indisputable technology boost and set it in motion actually lie. I believe that the development of artificial intelligence can serve as an empirical and historical example for the conducting of a number of systematic and highly interesting analyses. The topic of artificial intelligence actually goes back to the 1940's. Acting from within this domain in particular, it has consistently formulated major promises and then gone on to topple the ensuing hype, if indeed hype occurred. In the field of innovation research, there is a concept with which we have already worked in some cases within the context of the aforementioned micro system

technology analysis. This is called “promising technology”, defined by certain key stakeholders as an “expectation statement”. This enters the discussion or specialist debate at some point and then acts as a mechanism or catalyst towards which a wide range of participants move and by which their actions, objectives and “expectations” are then guided. Market processes and future visions are also very strongly influenced by expectations, and this plays a massive role in technology and technological development at the level on which I am now focusing. “Industry 4.0” is a classic example. On the one hand, this is a vision which is difficult to grasp. On the other, it brings an inherent promise of modernisation which, again to speak crudely, is not easy for any reasonable company manager to shake off. So, from my point of view at this structural level, I would collate two developments that arrive from different directions. One of these is the economic structural level previously mentioned and only vaguely outlined. This exists in the fields of business and industry and consists, for example, of the relationship between opportunities for rationalisation and the flexibility requirements of the market. At the time, therefore, the market and the production economy were the categories on the one side. On the other side, the economic conditions included the possibility of accessing or using certain areas of technological potential and then drive forward and implement technological development. If we are speaking of technological development, we must sometimes follow the old political economist Joseph Schumpeter, a name which is frequently forgotten, by differentiating between its various phases. For one thing, there are invention and innovation. Inventors and innovators are always to be found somewhere. They may comprise a single person sitting in a small room or involve the systematic development of a robot system. This is however not yet linked with any kind of statement regarding how and if this system can be diffused and secondly regarding how such a system is to be implemented and used in specific application contexts. Schumpeter established a banal yet fundamental principle. The fact that we have developed innovation oriented to the market does not provide any indication as to how this process will be realised. Diffusion is the central category in this context. Considerations regarding diffusion mechanisms which are more theoretically oriented can be conflated with considerations technology and innovation research, where the factors I have outlined above progress to certain path-dependent processes and to the use and further development of technology. This then exerts a reciprocal effect on structural conditions. The supporting factors at the level of invention or laboratories are bound to be different in general terms to those found at the application level. The development or innovation level is naturally dependent on structural conditions within the scientific system. It relies on available knowledge, on the funding opportunities that are in place in the given scientific research system. Structural conditions are once again at play. Major international comparative studies on innovation processes have been carried out. These have produced clear and convincing outcomes. Innovation systems, or what we would today call the ecosystem or innovation ecosystem are opened up and supported or inhibited by various structural constellations and different innovation perspectives. But the argument in response to your question was that, in respect of the factors which foster innovation processes, we need to start by taking a precise look at the structural environment, i.e. the structure of the respective innovation system. There is a reason why innovation research has been speaking about different national innovation systems for some considerable time, particularly in international comparative terms. I would say that the nature of the laboratories is determined by the conditions and

structures of such an innovation system and the constellations of stakeholders and funding opportunities. The question is what traditions etc. are in place. These and innovation culture, to introduce a concept that is difficult to define, force development in certain directions. So I would speak of path dependencies rather than of inhibitions and barriers. This is an important point which we are currently facing. Is this disruption or not? Is technology driving change so quickly that massive structural shifts are taking place? But such structural changes are very difficult to find in technology development historically. Schumpeter would say that there are creative entrepreneurs who jump off the trodden path and somehow bring about destructive change, but that they are rare. On the one hand, we have areas of potential, artificial intelligence and autonomous decision making systems. On the other hand, we need to speak of barriers. However, it may even be possible to classify these barriers to a certain extent. One simple example could be termed functional barriers. This is the famous “Polanyi’s Paradox”, which is constantly stressed in literature and for which empirical evidence is constantly found. The crux of the paradox is that we know more than we can tell. The classic example would be: “Can you explain how you learned to ride a bicycle?” Neither you nor I can do so. To put it in a different way, until today reaching for something in a cluttered box is obviously very difficult for a robot – no matter how intelligent. But such an act does not constitute any problem at all for you and for us. So there are functional limits to intelligent systems. They cannot be deployed everywhere. A robotics expert with whom I am well acquainted once formulated this as follows: “We have systems that can run on a smooth surface. As soon as there are cobblestones, they fall over”. The thesis is that these functional limits are naturally extended by technological development and innovation but that new barriers may emerge as the result of complexity. This is the first set of barriers. The second set, as we mentioned before, can simply be termed as the economic decision making process oriented barriers to implementation. Every head of production will ask the following straightforward questions: “Of what benefit is it to me? What will it cost? What sort of consequences will I have to deal with?” This does not mean that such systems are implemented via a rectilinear procedure. Thirdly, general political perspectives also naturally play a role. How are such systems legitimised or evaluated normatively in the societal debate in the first place?