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HOW TO GOVERN TECHNOLOGICAL ADVANCES BY EDUCATION?

Abstract: Whereas the technological future of the society is traditionally discussed in the polarity of society and technology we enlarge the perspective to the triangle of society, technology and population. By this we get grip of the role of population in shaping future technologies. Referring to some classical investigations, which expect a coming „megamachine" we argue that human-centred education will minimise „technological cages" and it will change the society profoundly. Taking the European Union as an example we will show that current and mid-term technology policies go toward softened technologies, but their successes are mainly hampered by the backward-oriented educational policies for „employability". After that we discuss the implications of a shift from a rationalistic to a dialectic understanding of sciences were living systems come in and the civil society gains of importance. But the implied division of society into a high labour intense and a high capital intense sector can endanger an overall transition to human-centred technologies. However, societal development has already become an open process with a remarkable influence of the general population. Human-centred education will unfold its immense creativity in favour of human-centred technologies, especially when it is supported by a new economic theory and an accordingly designed paradigm of societal development.

Key words: *Technological Advances, European Technological Policy, Human-centred Education*

SOCIETAL-TECHNOLOGICAL INTERRELATIONS AND HUMAN-CENTRED EDUCATION

Fortunately, previous beliefs that technology is mainly an independent force of societal development and has weak relations to social organisation and its cultural and ethical values, have disappeared. Nobody favours any more a pure technological determinism and actually we perceive the intimate interrelations between society and technological advances, which develop under ecological, social and eco-

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nomic restraints. Under these conditions we should not ask, if technology is the servant or the master of the society, but we have to look at the already existing amalgam of society and technology and this perspective is especially important for the search how to govern technological advances. Methodologically, we cannot any more divide between the society and its technology, because we have for neither of these areas a well-accepted theory. But even if we had such theories without a self-regulating mechanism toward a human society, for governing the amalgam we have to introduce a third actor and the only one possible is the population itself. Therefore governing technological advances can only take place within the triangle of the existing society, the relatively separated technological advances and the population engaged in societal and technological affairs. As the engagement of the population for a human technology depends on the degree and orientation of the education, the latter is of decisive importance for governing technological advances. Moreover, if the population wants alternatives to existing technologies the consequences will induce considerable changes of the society. Creating human technologies will be supported by a new paradigm of societal development (Jacobs 2012) in which human-centred education will play the key role.

Let us shortly refer to some prominent voices of long-run technological development and its relation to society. Jaques Ellul (1964) defines his „technique" mainly as rationalistic, traces the historical developments in the economy and the state and discusses the possibilities of human technologies in a supposed „monolithic technical world". He rejects solutions by technologies of the „second degree" and votes for the definition of new ends for a human society in the technological age. According to this rationalistic analysis he comes to a decisionistic policy approach without clearly defining the ends and goals of a human society. Lewis Mumford (1974), who goes into more details of the interaction of society and technology concentrates on the coming „megamachine" with its power structures, which restraint the potential societal richnesses beyond quantitative economic wealth. Based on his dialectic methodology — inspired by Darwin — he regards the society as a living system with complex organic structures, not far away from the present discussion of eco-systems and entropy and with some relations of Georgescu-Roegen's approach. Although, Mumford and Ellul derive on the micro level quite different consequences they agree that on the macro-level the society is endangered by a monolithic technical world, resp. a megamachine with their power structures. In many respects early sociologists, like Max Weber (1922), Karl Mannheim and others, as well as philosophers, like Martin Heidegger came to the same and rather pessimistic conclusions. However, these investigations do — with some exceptions of Mumford — not refer to the potential contribution of the population and its education to a transition into a technologically underpinned human society.

Classical treatments of the technological society have included manifold historical, cultural and ethical dimensions, but since a few decades we are confronted with a strong turn to a narrow economic focus, which only recently goes reluctantly toward a broader perspective. This is due to the far-reaching economic and societal crisis and demonstrates the limits of primarily economic innovation and dissemination of technologies. To our regret, technological innovation is strong-

ly war-driven and — as an example — European research policy was highly influenced by the economic competition with the USA (Servan-Schreiber 1970) and has a straight line to the European Framework Programmes, the Horizon 2020 (Commission 2011 a) and the foresights in Global Europe 2050 (Commission 2011 b). European educational politics are far behind, which means that priority is not given to the empowerment of people by education, but to production of „things" for them by an economically competitive economy. In academic research of technological innovation we find since the 1970 ies, starting with Schumpeter's „creative destruction" and Kontratieff's „long waves" many optimistic concepts to prevent a decline of economic growth. But even in the framework of the narrowly defined GDP this strategy to master societal development by accelerated technological innovation was not successful. Earlier warnings by the Limits of Growth (Meadows) and the Social Limits to Growth (Hirsch) represented some counterweight to the technological optimism. But the now emerging technologies are to a large extent considered as chances to regain high economic growth, not for more social equality and even less for the empowerment of people by human-centred education.

We have described the amalgam by the interaction of society and technology and in simplified view technological advances are produced by the „man-made brain power industries" (Thurow 1999, pp. 314), which depend highly on the general educational system. Comprehensive education is a precondition for the establishment of an effective research system (Hoedl 2007). Certainly, the brain power research system changes over time the content of the educational system as well as the organisational structures of both systems. Until now we find a dominance of the rationalistic understanding of sciences and a corresponding production of new technologies with restricted organisational innovation. If we want to go toward a dialectical development of technologies, research and education has to adapt much more to societal needs, which can only be generally and vaguely specified. But even, if we could define them clearly, this would lead to a decisionistic approach for which neither the economy nor the state can have valid information. It is only the population, which can develop a vision about the technologies wanted and only human-centred education can be the governing force for human-centred technological advances.

SOFTENED TECHNOLOGY POLICIES AND RESTRICTED TURN TO EDUCATION

Science and technology policies are growingly synchronised world-wide and we take as examples the European policies, specified in Horizon 2020 and in Global Europe 2050. Especially, in the longer term study we find a softened technological determinism: On the one side frontier research should ensure global scientific competitiveness and on the other practical innovations should furnish solutions to cope with the Great Societal Challenges. It is not any more a pure rationalistic spectrum of technologies, which is proposed for application and it should be developed and applied in some cooperation with the society. An early and specific instrument of firms is the Consumer Related Management (CRM), which anticipates consumer preferences. On the regional level a variety of clusters cooperate in the

framework of open innovation, which is related to open research and includes people's participation already before the spreading on the markets. No question, these examples are mainly motivated by economic criteria, but in the majority of cases they have also positive societal effects and give activating impulses for peoples participation and their learning processes. The need for an involvement of educated people is even greater in the up-coming trend to social innovation, which enhances organisational changes and is an important step toward embedded technologies, which need a participatory approach. Softening technological advances is bound both to interdisciplinary education and research as well as to highly complex technology policies, which induces also some changes of the societal development.

Let us illustrate the enormous complexity of the European technology and innovation policy, which can never be managed by firms and the state without an active participation of the population. Instead of the ideological assumption of self-regulation and innovative economic competition the Europe 2020 Strategy (Commission 2010) aims at enhancing simultaneously economic, social and ecological sustainability. They should be realised by the interdependent priorities of a smart, sustainable and inclusive growth, which aim — until now without any modification of the GDP indicator — to a higher and more stable economic growth than before the crisis. Smart growth will be based on knowledge and innovation, sustainable growth on a more resource-efficient, green and competitive economy and inclusive growth should create more employment and social and territorial cohesion. All three priorities are bundled into seven flagship initiatives, the technological content of which is more specified in Horizon 2020 by again three mutually reinforcing priorities of Excellent Science, Industrial Leadership and Societal Challenges, complemented by the European Institute for Innovation and Technology (EIT) and the Joint Research Centres (JRC). This highly complex organisation of the European technology policy interacts with the innovation impulses of the private economic competition system and represents the guidance for the longer-term technological development, which is mainly oriented toward global economic competitiveness. If we enlarge our perspective to the societal development and include cultural and ethical dimensions we cannot any more say who is driving and who is driven within the amalgam of societal and technological interactions. On the micro- and meso-level different kinds of technology assessments will contribute to more human-centred technologies. But without an underpinning by well-defined values, derived from an adapted societal paradigm, they will fail. And responsible and ethical research (Karatzas 2012), which itself became highly complex and difficult to manage will not be an adequate counterweight.

In an economy-driven technological development the correctives of public technology policies and people's participation have a limited influence and they are even smaller in cases of a low educated population. But in the longer-run we are confronted with the additional problem of large infrastructures, which need high capital investments and represents sectorial adapted superstructures, which may lead to corresponding technocratic cages (Mumford 1974, p. 833). In Global Europe 2050 a variety of more systemic and holistic technologies, for example for mobility and the energy, are proposed to cope with the future societal challenges. Such systems may render services more cost-effective and respond partly to societal needs,

but one should not hesitate to question some dimensions of the global information systems including the Internet, because we do not know in how far and for whom they are in sum beneficial. Large infrastructure could organisationally be made more socially viable, but if they are owned by large corporations and the state they create (global) monopolies and tend to induce a techno-economical determinism to which the society and the consumer have to adapt. Global Europe 2050 gives certainly more importance to the changing socio-political environment than Horizon 2020, but it neither questions the endogenous dynamics of technologies nor the primarily rationalistic understanding of science. It votes for massive investments in „human capital" and its application in the private and public sector, but leaves the fundamental structure of our economic society beyond its considerations. In such an analytical framework the relation between technology and society cannot be discussed and we can say that European technology and innovation policy follows a technologically underpinned economic determinism, which is complemented by an economically oriented education instead of a human-centred education.

In our short references to the historical discussions of the technology-society relations we referred to the importance of the concept of sciences and the educational implications. What we see now globally is still a dominance of economically coined educational systems. In face of the increasing unemployment, which itself derives from the increasing substitution of labour by capital, „employability" has become the key word for education. The narrow and discipline oriented specialisation of an ever increasing variety of study courses and the financial dependence of the educational system on private funding turns it to a short term orientation toward the economy. Although Universities have become more flexible, they are still the transmitter of inherited knowledge without larger changes toward a new understanding of science and scientific education, which would prepare for societal engagement and action instead for immediate needs for employment. At the same time the above described softening of technological advances need broader and holistic perspectives. Actually, there exists a discrepancy between the qualification needs in progressive economic and societal fields and what the majority of educational institutions furnishes. The employment needs more and more fully developed personalities to cope with increasing intra- and entrepreneurship (Picot 2001, pp. 451), which are signs that the „human factor" gains of importance both in the economy and society. No private or public institution can be run without a department for „human resources". In a longer perspective, the prevailing University system will probably transform profoundly toward learning instead of teaching and to more practical and action-oriented interdisciplinary knowledge. We may argue, that the future of education has to concentrate on human-centred contents, which will be in favour of human-centred technologies and a human society.

MORE RADICAL TECHNOLOGICAL SHIFTS AND LIMITING POWER STRUCTURES

What we learn from the prevailing tendencies in global technology and innovation policies are the tensions between the inherited rationalistic perspective and

a dialectic development, where organic and living systems are in the centre. Paul Crutzen (2000) has reminded us that we are in an Anthropocenic Epoch during which humans are not only the cause, but also the potential to surmount existing difficulties. If we succeed to reorganise our society humans can unfold their potential in favour of human-centred technologies, more equal global development and minimise societal crises as well as military conflicts. Instead of an antagonistic competition we can turn to cooperation and finally to a cooperative creativity (Huether 2016). We could develop and implement solutions, where empathy will play an increasing role and lead to a consciousness of our biosphere in which we live (Rifkin 2011, pp. 253). In an eco-centric perspective we are able to anchor our analysis in entropy and coordinate human activities by lateral, less hierarchical regional and global networks. By this, we generate more ecologically viable and human-centred scientific and technological advances, because it enhances the human creativity instead of promoting ever growing only economically efficient large production and governmental structures, which cannot be run without suppression of the involved population. More radical technological shifts are bound to decentralisation and technological advances will be primarily bottom-up induced.

Nearly half a century ago Fritz Schumacher (1973) has proclaimed that „Small is Beautiful" and in many areas relevant opportunities are emerging. But at the same time automation and robots begin to ripe and alleviate from rationally-repetitive work and in the future robots may become intelligent and self-learning. Far-reaching automation needs enormous research and development and we do not know in how far the reduction of work will be compensated by the increasingly outsourced infrastructures and brain work. The most probable future of economic structures will be characterised by a division between a highly automated and capital intense sector producing for large markets and a partly informal sector with high labour intensity directed toward regional and local demand. Tentative prognoses say that in 2050 the civil society will account for half of total employment (Rifkin 2011, p. 281). In terms of employment we can expect a crowding out of the automated sector by the informal sector, which will be composed by a high diversity of small and medium firms with self-employment, non-profit orientation etc., responding primarily to increasing demand in social, health and education services, including activities for repairing and recycling with flexible working times (Peach 2015, pp. 113). The economy will allow a further shortening of working time, but not for isolated leisure time, but by new work-life balances, which give room for more practically oriented interdisciplinary education, partly for individually tailored knowledge needs.

The informal sector and its educational demands are by no way clearly separated from the automated sector. If we assume that large industries are bound to large infrastructures they depend highly on the informal sector, which furnishes services for consulting, advertising and other outsourcings. Seen from the traditional economic theory we can say, that the market failures of the automated sector can only partly be repaired by the state and the growth of the informal sector with its broader societal orientation will be an indispensable complement. However, we have to ask in how far the automated sector itself will develop toward living systems. No question, many large technological systems, for example in ener-

gy production, can be substituted by networks of smaller units. In other areas, like the automotive industry large production units will remain. The running of such large technological systems will need less workers and more white-collar employees and related brain power workers. But the production of such system will for the sake of economic efficiency follow the rationalistic perspective to which the digital revolution contributes. Including the emerging digitalisation of private households we are possibly on the track to form our brains accordingly (OECD/CERI 2007) instead of looking first at the humans. Some decades ago, the human-oriented analysis of the Fordism (Bravermann 1977) has led to political programs for a „humanisation of work" (Matthöfer 1980) and a reorientation of education (Bosch 1992), but they had limited effects. Some hopes that the introduction of the then emerging information and communication technologies would humanise work by itself were not confirmed. Beyond the certainly human-oriented effects of decentralisation of production there may emerge isles of new technological cages, which have by feedback negative consequences on the actually developing and rather human-centred informal sector and the civil society.

In our simplified distinction between a high capital intense and a more labour intense economic sector we identified the latter as the progressive field, in which more human-centred technologies appear. Additionally, we detected in the globally synchronised technology and innovation policies a variety of reluctant approaches toward human-centred technologies. But for seriously judging further advances we have to look at some main obstacles, which concern over-optimistic judgements of the future role of the informal sector. With few exceptions, we find worldwide an analytical neglect of the totality of societal dynamics, which may overrule the progressive elements of the civil society (Prisching 2005). We confine our considerations to some economic dynamics, which dominate actually to a large degree many political, cultural and ethical dimensions. In the framework of a Socio-Ecological Market Economy we can ascribe ecological sustainability to less natural capital inputs, economic sustainability to less man-made and financial capital inputs and social sustainability by higher employment. Actually, we have no tendencies to reduce capital inputs in favour of higher employment and within capital inputs a steadily increase of financial capital. Can we under these multi-dimensional power structures (Russell 1968) expect a turn to a human-centred technology, were the majority of the population shape it? Certainly to a limited extent, but only under restraints of the prevailing basic rules and values of the society. So we should be aware of the some experiences during the last fifty years, where partly successful reform policies in the 1970 ies were cancelled-out by the neoliberalism without bringing better results. Some foresights for the next decades suggest — although they are based on past developments — that global inequality will considerably increase (Piketty 2014). However, in face of the immense social power of the population largely underutilised (Harish 2015), p. 37) we should optimistically count on a dictum that „power of vested interests are largely exaggerated compared with the gradual encroachment of ideas" (Keynes 1967, p. 383). Therefore, it is wise to engage intellectually for the development of a new paradigm for societal development and human centred education.

BEYOND „IRON LAWS" OF DEVELOPMENT AND CHANGES OF SOCIETAL PARADIGMS

Societal development is not governed by formerly supposed „iron laws", especially supported by rationalistic economic growth theories, but is a dialectic and open process in which the total population becomes increasingly more important. Purely economic estimation of „human capital" in highly industrialised countries show that it accounts for more than three quarters of total economic resources (Slaus 2015, p. 107). No doubt, the most influential impulses for the development of the amalgam of society and technology are the „man-made brain power industries" and the educational systems along the live-long learning chains. But if these drivers have no vision about the research priorities and the content of the educational curricula, they may not enhance societal security, welfare and wellbeing. Increasing deviations from this generally accepted goals can partly be reduced by an adequate technology and innovation policy, which has to include the aspirations of the population. If the rather diffuse aspirations can be canalised toward a spirit of anticipation about the future of the society wanted, anticipation (Poli 2014, pp. 23) could more strongly anchor the vision and the goals of the population. Certainly, the transition to a new society is hampered by vested interests, but decentralisation and lateral governance, which are increasingly enforced by the coming technological advances give more weight to the large population, the education of which has to go far beyond the iron laws and employability.

The basic ideas of what we call here human-centred education have a long tradition going back to the early Enlightenment were societal questions should be managed by the population itself, educated individually and as a society (Hoedl 1997, pp. 27). To cite a few names: For Jean-Jaques Rousseau education should develop the individual according to the human nature, for Immanuel Kant it should enable the individual to use its own reason and for Pestalozzi it has to develop the personality for a pure human wisdom. All of them give priority to personal development vis-a-vis professional qualification. According to such principles Wilhelm von Humboldt designed a University, where learning has priority over teaching, but just a few decades later professional qualification took over and actually economisation has lost sight of the fundamental human orientation of education. It is not by chance, that modified reconsiderations of the classical ideas of education are developed in the current period, which need a redefinition of the role of the individual and the society with a comparable depth. In a broader sense some discussions speak about the need of a „New Enlightenment" (Forum Alpbach 2016). On this occasion I will not discuss any detail of the recently profound reflections on human-centred education (Jacobs 2012, Zucconi 2012). Although there are some differences to the capability approach of Amarta Sen (2003, pp. 347), the basic ideas to give priority to the human potential of the individual and society are in a clear neighbourhood. So we can be somewhat optimistic, that an enlightened population will contribute to the creation of a human amalgam of society and technology.

Human-centred education and its interdisciplinary orientation is a powerful instrument to unfold the potential of human capabilities. To make them effective

for governing technological advances we have to go back to the triangle of society, technology and the population and human-centred technological advances will change each of the three actors. Therefore, there exists a vital need for a new paradigm of societal development and if we consider the prevailing economisation, the same urgency exists for a new economic theory. Since a decade a new understanding of the economy is tackled from different angles and recently contours of a New Economic Theory have been proposed (Jacobs 2015, pp. 139). Evidently, there is still a long way to go to a coherent new economic paradigm, but it should not follow the rationalistic understanding, by which natural sciences largely influenced economics and resulted in closed systems. It has to be an interdisciplinary and open paradigm, including theoretical and practical questions. Probably it will not fit into the commonly accepted term of a „scientific revolution" (Kuhn) and will not be a ready-made recipe for politicians, who are inclined to implement it „both when it is right or wrong" (Keynes 1967, p. 383). A complementary line to develop a new understanding of the economy centres around the critique of the narrow discipline-oriented economic categories and the need to include in principle all relevant social and natural dimensions. The development of a new macroeconomic theory (Jackson 2011, pp. 148) will not cover the problems with which the society is confronted. More promising is the concept of a Socio-Ecological Market Economy (Hoedl 2014), which is fully open for interdisciplinary approaches without losing contact to prevailing economic power structures. The changes of them depends in such an institutionally oriented framework also on a rigorous empowerment of people by human-centred education.

Let us now summarise our conclusions for the question how to govern technological advances. Those who await a clear-cut scheme for implementation will be deceived, because they are still a victim of a rationalistic and decisionistic understanding of science. What we found out is: *Firstly,* an irreversible tendency to a softening of technological advances toward ecological and social dimensions, partly supported by public technology policies and also by private firms. The main existing deficiency in all this areas is the low importance given to education and the still dominant target of employability. *Secondly,* there are increasingly more rigorous approaches to technological advances, guided by a dialectical understanding of society and technology, but their implementations are limited to specific areas and the civil society. And accelerating and spreading their implementation more widely touches on the basic values and rules of the society and its power structures, like the global financial system. From these two findings, we can *thirdly* conclude, that a turn from employability-oriented education to human-centred education will question existing power structures and new paradigms for the societal and economic development will enhance a transition to human technologies. And *finally*, the transformation of the above described amalgam of society and technology needs still highly complex scientific research and will be a longer term open process. But for humanising technological and societal developments we have no other institution than the humans themselves and their empowerment by human-centred education.

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