

Technology Governance

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Abstract — Technological innovation is evolving in faster and faster cycles. One of the most recent waves of disruption manifests in the progress in the field of Robotics, Automation and Artificial Intelligence. These innovations combined with the current Megatrends will impose global challenges on our societies and on humankind. We are proposing a holistic, dynamical model to address the ethical, moral, social, political and economic aspects of these transformational processes in advance: Technology Governance will provide a methodology to define frameworks and guidelines involving all stakeholders in a structured, interdisciplinary discourse.

Keywords — *technology governance, robotic governance, ethics, roboethics, disruptive innovations, technology regulation, megatrends*

I. INTRODUCTION

The notion “Megatrend“ was established in 1982 by American futurist John Naisbitt [1]. According to his definition, „Megatrends [are] large social, economic, political, and technological changes” and they are expected to imply profound alterations of daily and work life of people. A well-known and commonly agreed example is Globalization. But with technological progress new Megatrends will constantly keep emerging, some of which might impose challenges on society.

These challenges will have global impact – because of the global nature of the megatrends – and thus will have to be addressed internationally and interdisciplinary. Naisbitt identified similar patterns in the waves of change when analyzing the transition from the Industrial age to our current age characterized by the extensive focus on information and digitalization. He already identified the increasing acceleration in technology-adoption that might – and as we know now really has – lead to an overextension and thus mental overload of people constantly confronted with the increasing flood of (digital) information.

Today we know that these problems and issues Naisbitt predicted have become very real. For future technological disruptions, this offers a big chance: we can learn from the past and start discussing the ethical, moral, socio-political, socio-cultural and economic dimensions and the impact of such technologies as early as possible. Similar conflicts can (and have been) foreseen for the field of automatization. As early as in the 1980ies, Naisbitt conjectured people would react frightful and refusing as automatization, quite obviously, might

have the potential to permeate all areas of the human living realm and society – from production over entertainment to our homes. The question about the future of human labor and thus of the preservation of jobs is imminent. Hence, it is hardly surprising, that internationally renowned scientists and experts are publicly discussing topics like Roboethics and Robotic Governance [2], [3] at events like the 1st IEEE IROS Futurist Forum at IROS 2015 in Hamburg [4] or as part of the WeRobot 2015 Panel in April 2015. The discourse has even arrived in mainstream media like daily press, as some recent articles prove [5], [6]. Nevertheless, this is only one of several huge Megatrends that are about to change our lives.

In this article, we construct the hypothesis that it will not be enough just to address some single issues or problems that might arise from technological advancement. Rather, we propose a different approach that requires the establishment of a continuous, dynamic and holistic process. This process has to reflect the interests of all stakeholders involved and offers a structured methodology to define frameworks and guidelines to react adequately on such disruptive transformations. Only with the help of a so-called Technology Governance can humanity achieve timely reactions, reflections and adjustments on fast-paced changes of social structures driven by technological triggers and accordingly arising megatrends. We will need the institution of Technology Governance in order to be able to react on megatrends without leaving anyone behind and still shaping a sustainable future for coming generations.

II. TECHNOLOGY ETHICS

For a discussion of ethics associated with technology, it seems reasonable to look closely at already existing paradigms and models from corporate ethics. The ideas of business ethics after Ulrich [7] offer a discourse ethics approach. It describes a so-called philosophical interpretation of rational ethics that is applied on economics: a purely efficiency-based, economical way of acting should be contrasted by a comprehensive concept of reason, which offers a way for critical reflection and thus offering the foundation for an unbiased debate.

Accordingly, the “location of moral” has to be the open, transparent and public discourse. Goal of the (eth.) republican, discourse ethical approach (see Steinmann and Löhr [8]) is a peaceful solution of conflicts between stakeholders, that are not statutorily regulated. This implies the necessity that every stakeholder has to take part in the discourse and is allowed to share his position in the public debate. Furthermore, the

principle of consensus has to be applied, which means that the discussion has to be limited to the minimum set of topics necessary in order to reach the broadest possible consensus.

Homann's theory of institutional ethics [9] states that moral aspects can only be placed over the economical pursuit of profit in a corporate setting if appropriate frameworks have been established. The generation of moral standards in economical and commercial contexts, though, leads to an internalization of transactional costs, which subsequently makes unmoral behavior and acting unprofitable and thus unfeasible. For the successful implementation of Technology Governance this implies that the development of an according framework and set of guidelines is crucial!

The governance-ethical theory of Wieland [10] suggests going even further by interpreting enterprises and corporations as subsystems of society. He suggests, that every corporation represents an own set of values and moral rules that are represented by its governance and organizational structures. First, these rules have to be codified before they can be influenced. Moral goods like fairness and trust lower transactional costs and consequently increase the corporate profit and thus the chance of cooperation with and between the different groups of stakeholders. Hence, investment in moral goods is absolutely in the interest of corporations and will have positive effects on their revenue stream.

For some of the current megatrends, efforts already exist to find and define suitable ethical frameworks to help dealing with the changes. One example is the notion of "Roboethics" which has been coined in 2006 as essential part of the Roboethics Roadmap des European Robotics Research Network [11]. The initiative makes obvious, that there cannot be one universal, generally valid solution or methodology regarding the field of Roboethics, but different diversified stages of development that closely address the respective state of technical progress at each given point in time. There is a fundamental difference in seeing robots as pure machines, attributing them with an ethical and moral dimension or even define them as some kind of new species with embodied consciousness, perception and their own form of intelligence – and all these interpretations were and are vividly discussed, leading to no clear answer about the classification of robots. Many publications and research efforts circle around single aspects and questions in the field of Roboethics that arise from above mentioned distinction, including the question whether robots should be allowed in a military context [12] or who has to be held accountable for the actions of robotic systems [13]. All these aspects have to be combined and subsumed in one single concept.

III. NEED FOR TECHNOLOGY GOVERNANCE

The notion of a Governance can usually be summed up as the totality of institutional arrangements for coordinating collective acting. This includes actions and interactions of all kinds of protagonists from the public and private domain whose conduct and Governance are defined by institutional regulatory bodies. A target-oriented, goal-driven political coordination is no longer possible under these circumstances [14]. A Technology Governance will not be a strict juridical or

regulatory set of laws and commandments that tries to control and restrict the development of new technologies. It will more likely consist of a dynamical framework of guidelines that wants to help finding a general direction and that breathes and grows according to the changes in technology and society. From an economic point of view, one could assume that the forces of the market and of hierarchical organization might be sufficient to regulate a corporation. It could be expected that enterprises, whose management does not comply with basic codes of conduct would automatically perish. Unfortunately, perfect markets do not exist in reality. Hence, the sphere of influence of managers has to be limited by laws, regulations, guidelines and policies [15].

Especially in respect to technological disruption there is a huge need for regulation. This becomes obvious regarding the acceleration of societal change based on technological progress mentioned in the introduction. As Naisbitt [1] states, the change from an agricultural to an industrialized society took about 100 years, whereas the change towards and information society only took another 20 years. Based on the assumption that this trend can be extrapolated into the future, it is to be expected that the timeframes for humanity to adapt to these changing circumstances will get shorter and shorter. This conjecture seems feasible regarding the current development of Robotics, Automation Technologies, Smart Machines and Artificial Intelligence.

A further example for the disruptive impact of technological innovations is the recent debate about autonomous driving vehicles. On one hand, the development of these technologies has great potential for positive impact on society: accidents could be avoided, time can be used more efficiently or new concepts for car sharing and urban mobility can be realized, just to name a few aspects. For the driver an autonomous car would mean less stress and will result in higher mobility even at older ages. Nevertheless, it will and already has surfaced new questions and issues, e.g. from a legal point of view the question of liability in case of an accident has to be answered. Furthermore, some very substantial ethical and moral problems must be addressed as well: What if a system were to decide about life, injuries and death of one or several parties in some of the well-documented discourse ethical cases? Would it be justifiable to sell cars that knowingly could endanger the life of their driver – or of other people – in order to protect a larger group of pedestrians? These questions have to be discussed beforehand by interdisciplinary experts, including ethicists!

IV. CONCEPT OF A TECHNOLOGY GOVERNANCE

Derived from chapter II it is obvious that for the development of a Technology Governance two elements are important: on one hand the establishment of a stakeholder dialogue and on the other hand the definition of a corresponding framework of guidelines.

It has to be noted, that jurisdiction has not only a direct influence on technological innovations, but also additionally an indirect one: The influence of Market Pull and Technology Push is well known and widely documented in the field of innovation management. Figure 1 suggests a model for the

correlation of these driving forces based on Wagner et al. [13]. Similarly, legislation can directly influence the emergence of innovation, as Porter's hypothesis on the creation of lead-markets for environmental innovation clearly highlights [17]. On the other hand, innovations vice versa influence legislation and regulation. Above all legislation also indirectly affects innovation, like in the case of regulation of CO₂ emission, which indirectly affects the demand for products with different CO₂ characteristics.

Interestingly, regulation is not only affecting innovation through strictly formulated rules and laws, but also softer guidelines have been proven to unfold similar impact. In any case, the influence of regulation and legislation on innovation is exuberant which clearly underlines the importance of this instrument. Apart from governmental (singular) control, polycentric constellations, like in the form of network coordination, gain more and more influence regarding political economical Governance [18]. As the management usually tends to take decisions in favor of the capital/shareholders, its discretionary leeway should be limited by ethical guidelines, in order to solve occurring issues in discourse on a case-by-case basis [19].

Another reason not to purely rely on legislative regulation is the reactive nature of legislation, only addressing problems that already exist. Especially in the context of innovations that evolve from disruptive technological inventions a proactive and preemptive strategy should be adopted. A good example might be the development of the Internet and the inhering issues in the field of data protection and data ownership. Even after years of discussion and ongoing conflict, there is still no consensus on how to deal with this delicate topic and it seems that also in the near future this issue will not be globally addressed. Ideally, this discussion should have taken place as integral part of the conception phase, because then decisions could have affected the design and architecture [20].

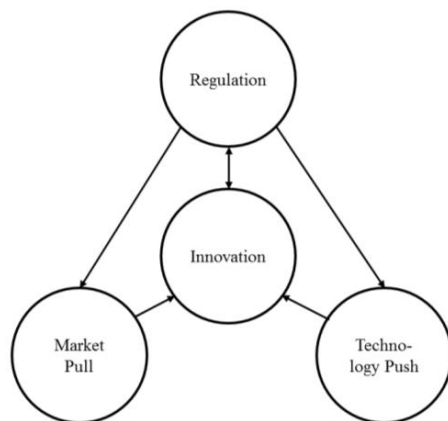


Figure 1. Correlation of Market-Regulation- Technology-Innovation based on Wagner et.al. [16]

Unfortunately, it usually takes a long time and a lot of bureaucratic effort before changes in technology are properly reflected in legislation. In most cases, a single issue first has to be brought to court, where judges have to try to apply current law to new circumstances. Standards are usually easier to handle and evolve quicker, but they have the disadvantage that compliance is completely voluntary and there is usually no means of sanctioning if a party does not comply with a standard [15].

Although, this problem seems generally resolvable as some standards, e.g. the German Corporate Governance Codex, have successfully evolved and are broadly adopted. Additional soft criteria to follow ethical and moral guidelines might also be the fear of a corporation to suffer from image damage and bad publicity. Prerequisite for this to work is that there is at least the general possibility that the public will learn and then adequately react to the lacking compliance. This would require an institution that monitors the compliance to social, moral and ethical guidelines which are not legally binding. This institution would in case of a violation inform the public and thus catalyze a reaction.

The second important aspect in order to establish a Corporate Governance concept like Technology Governance is the initiation of a structured dialogue of stakeholders. It can even be regarded as the initial and most important element for Technology Governance. To spark this discourse, it is crucial to first raise awareness for the issue of the topic inside all stakeholder groups [3]. Unfortunately, just because experts and researchers might be aware of technological triggers and their resulting changes, e.g. with the fourth robotic revolution [20], that does not automatically imply that the whole society is already sensible for the issues.

Based on the continuous developments and innovations in the field of technology, Technology Governance cannot follow a static approach. The occurring problems and framework conditions will always keep changing and thus keep influencing and altering the interests of the different stakeholder groups. In order to provide an incentive for the diverse stakeholders to invest into partner-specific relationships and hence to instantiate and generate quasi-pensions, the awareness for the difference of the stakeholder interests has to be considered when defining the initial framework for the Technology Governance [15]. It is very obvious that this will also lead to a huge potential for conflicts of interest: The motivations of researchers diametrically differ from those of environmental organizations, employees usually want to protect their job and improve their salary whereas employers commonly try to maximize their profit.

For this evident reason, the dialogue between all groups of stakeholders is so important, as it might be the only way to reach consensus and agreements that provide a bearable solution for all parties involved. The discussion in interdisciplinary teams should also be the commonly agreed starting point for a holistic approach towards the definition of a Technology Governance. This will be the only feasible way to ensure the support from all different shareholder groups [2].

Technology Governance should generally be interpreted as a tool for sustainable management. In accordance to the

Brundtland-Report, published 1987 by the United Nations [21], a development should be considered sustainable if it “addresses the demands of today’s generations, without threatening the capabilities of future generation to meet their needs”. The principle of generational justice should also be applied for technological innovations. The concept of sustainability was initially limited to the field of ecological sustainability. Since then, it has evolved into a three-pillar mode, which added an economic and social dimension to the ecological one. The addition of a political-institutional dimension is currently discussed in literature [22].

This structure could provide a basic structure for the different layers of Technology Governance. The ecological dimension includes aspects like the impact of technological progress on pollutant balance. The social dimension, on the other hand, involves topics like “future of work” and socio-economic implications of technology on society.

In addition, the differentiation by technological categories might also be feasible, although the differentiation of different technologies seems to be quite fuzzy. The advantage of such an approach would be to “chop down the elephant” into smaller pieces, e.g. a Robotic Governance [2], Artificial Intelligence Governance, Smart Machine Governance etc. These examples show that the definition might sometimes be overlapping – but this has not to be a negative aspect. An AI-Governance might be part of an IT-Governance, but could also be part of a Robotic Governance. This exemplifies the interdisciplinary character of the different topics: outcomes of one topic group can help the discussion in another group. Ongoing exchange should be fostered. This proves that Technology Governance is no rigid construct but a living, constantly evolving flexible methodology that adjusts to the changing needs and requirements of each stakeholder group – structure, layers and content are always adaptable.

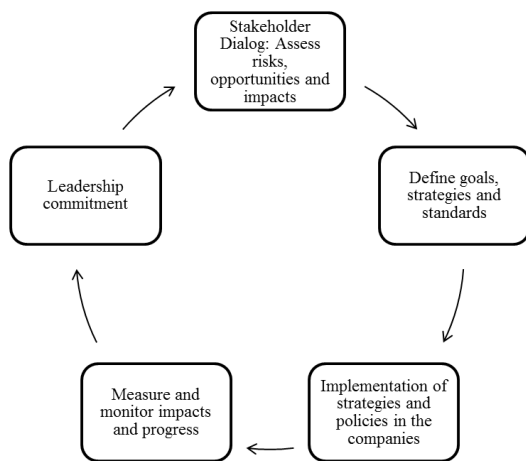


Figure 2. Adaption of Process Model after C. Hall [23]

V. IMPLEMENTATION OF TECHNOLOGY GOVERNANCE

Basically, the implementation of a Technology Governance can follow the phase model depicted in Figure 2, based on the theory of C. Hall [23].

As the development of juridical “laws” is hard to influence and usually takes very long, the most important goal of a Technology Governance has to be the implementation of so-called “Soft Laws” like standards and guidelines. This can foster an ecosystem driven by voluntary self-regulation, which is driven by intrinsic as well as extrinsic motivation. On one hand, the creation of structural and value-frameworks helps to establish an environment of social pressure, in which corporations can only be economically successful if they comply with these standards and guidelines. On the other hand, the enterprises do not want to neglect the rules and guidelines, as they (hopefully) provide the best solution for all parties involved. Standards can also be seen as providing benchmarks that help companies to check their performance – like key performance indicators in a balanced scorecard system would, but only for social, ethical and moral means. This increases overall transparency in the market and applies to all players in the ecosystems thus guaranteeing fairness. If a standard proves to be suitable for regulating one aspect of the ecosystem, it can also be considered a first draft or basic input for more mandatory regulations like laws [15].

The implementation will happen on several layers: many companies already have established frameworks, structures and values to address governance issues – like a CSR-department or a Corporate Governance Officer. These departments and bodies have to be addressed and involved in the discussion. At a later point in time, Technology Governance certifications might also be a good tool to establish awareness – like other existing certifications, e.g. the UN Global Compact or the German Corporate Governance Codex. But before this can be fruitful, the corporation has to understand the benefit from addressing these issues and looking into Technology Governance, which can be fostered by generated pressure from other stakeholder groups. The initial element, in any case, is basic and uniform awareness of the issues.

The first step in establishing Technology Governance – or any other Governance framework – is the common understanding for the existence of a problem or threat. In Automation and Robotics, for example, this awareness mostly exists in the scientific community and with other experts from industry. The general public and the end user have not really been in touch with robotics technologies, yet. This will change, at latest when robotics is going to permeate all areas of the living realm and our grandchildren will grow up as first Generation ‘R’ of Robotic Natives [20]. It is also in the interest of the companies, that customers also deal with innovations and their impact on daily life because this ensures that the impact of these innovations is not only perceived on a short timeframe but also on a long-term view. Without public perception and discussion, innovations do not find the required markets and will not evolve – this will also be crucial for, e.g., self-driving cars and consumer robotics [1].

Surely, it is unrealistic to believe that we could get in contact with every single stakeholder and respect every small,

particular personal interest. Hence it will be even more important to summon teams that are constituted from different interdisciplinary experts that try to address all issues on different levels. A good starting point would be a group of ethicists, researchers from different fields of technology, lawyers, industrial and political leaders and NGOs, to ensure the maximum level of diversity and thus addressing as many needs and requirements from stakeholders as possible.

VI. CONCLUSION

This paper provides the basic concept for the establishment of a Technology Governance that deals with the ethical, moral, socio-political, -cultural and -economical questions that will arise from technological progress driven by the Megatrends. We put up the hypothesis that humanity will need a dynamically adjustable framework of guidelines as tool of sustainable management in order to deal with the accelerated technological development and its impact on society. We will need this framework and methodology to address the needs of all stakeholders involved.

Critics of Soft-Laws usually hint that they might not really cause change as they “only” foster self-selection [15]. This is generally true, but the pressure to transform this intrinsic motivation into an extrinsic pressure driven through public awareness of society is imminent. An important factor is the awareness of society how much the issues are perceived as threat. If there is enough benefit or incentive for the corporations to comply with the rules, they will stick to them.

It will by far not be easy to convince stakeholders to support such a highly dynamic, self-regulated and – in the beginning – abstract idea like Technology Governance and make this concept come true. Regarding the fast technological progress and the constant societal change – comparing the impact of the internet and our struggle with it – we will have no other chance than addressing the issues that are arising from technology and innovation as early as possible. We are facing a global challenge, which will shape the future for the next generations and thus has to be addressed by society, government, industry, research and all other stakeholders! It will be the only way to provide the coming generations with the hope for a sustainable, self-determined future. It surely is better to be prepared for change than rely on chance!

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