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From „Industry 4.0“ to „Society 5.0“ and „Industry 5.0“: Value- and Mission-Oriented Policies.

Technological and Social Innovations – Aspects of Systemic Transformation

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#Innovation-Policy #Innovation-Sovereignty #Technological-Sovereignty #Digitalization #Sustainability #SDG #Industry50 #Industry40 #Society50

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List of Abbreviations:

AI	Artificial Intelligence
CTA	Constructive Technology Assessment
EC	European Commission
EIS	European Innovation Scoreboard
EP	European Parliament
EU	European Union
PTA	Parlamentary Technology Assesment
RRI	Responsible Research and Innovation
R&I	Research and Innovation
SME	Small and medium Enterprizes
STS	Science and Technology Studies
TA	Technology Assessment

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Abstract

The debate about the term "Industry 5.0" is already underway. The comments range from conceptual nonsense (Liggesmeyer 2021) to "necessary course correction", which, significantly, was not initiated by industry itself but by the EU Commission (Buchinger 2021) or Society 5.0 and Industry 5.0 are imagined as the futures of Europe (Carayannis & Morawska-Jancelewicz 2022). Xu et al. (2021) ask if this is the co-existence of two Industrial Revolutions – the fourth and the fifth – or if this is a continuation and an evolution from one step to another within industrial concepts. One has to agree when Carayannis and Morawska-Jancelewicz (2022) resume that concepts of Society 5.0 and Industry 5.0 are „not a simple chronological continuation or an alternative to Industry 4.0 paradigm“. The main question that follows is if "Green Deal" as "Industry 5.0" or „Society 5.0“ are connectable to "Industry 4.0" (Banholzer 2021c)?

As I will argue, the European concepts of „Green Deal“ or „Industry 5.0“ can be seen as an answer to the question of what normative basis could be found for the governance of network-society which is as well functional as fragmental differentiated. Modern societies following the innovation paradigm have a need for orientation. Concepts like „Industry 5.0“ underline that a forward-looking modulation of technological developments to be possible (Rip 2006) and generate a framework for orientation. Similar to the „Industrie 4.0“-process and the announcement of the Fourth Industrial Revolution of the German government in 2021, the European Commission formally called for the Fifth Industrial Revolution or „Industry 5.0“, after discussions among participants from research and technology organizations as well as funding agencies across Europe, devising a top-down initiative in response to the changing societal and geopolitical landscape (Xu et al. 2021: 532). Industry 5.0 centers around three interconnected core values of human-centricity, sustainability, and resilience and therefore is not a technology-driven revolution but a value-driven initiative that drives technological transformation with a particular purpose (ibd.: 533). Industry 5.0 addresses the challenges of a functional and fragmental differentiated society. Flexibility, agility, project-orientation, entrepreneurship are part of the concept. Industry 5.0 focuses on social heterogeneity in terms of values and acceptance, measurement of environmental and social value generation, participation and transparency of customers or interest groups and NGOs, interdisciplinarity of research disciplines and system complexity, and ecosystem-oriented innovation policy with outcome-orientation. But: Industry 5.0 requires also new policies and policy instruments, a Governance 5.0, new partnerships, and new objectives for policies affecting industry, knowledge-society and economy. Additionally, a portfolio approach to research and innovation projects is needed, combined with the willingness and a mandate to take informed risks – in development paths and financing.

In its coalition agreement, the new German "traffic light" coalition has committed itself to a mission orientation in R&I policy and therefore is close to the ideas of Industry 5.0. But: The term Industrie 5.0 is not mentioned within the coalition agreement or in other discussions. The new coalition has described itself as a "progress coalition" and, in the run-up to and in the coalition agreement placed an emphasis on innovation, science, science transfer and research as the basis of the national economy and the welfare of society. Goals like clima protection and *Energiewende* or fostering science transfer via (new) innovation agencies are in line with the ideas of the EC (cf. Banholzer 2022a).

Response from other governments and industries to Industry 5.0 is still limited for the time being. Academia, though, has quickly embraced the discussions on Industry 5.0 and highlighted the relevance of Industry 5.0 (Xu et al. 2021). The landscape of R&I-policies in EU membership states is heterogeneous, and often still focussing a linear understanding of innovation. This outlines the challenges and obstacles that have to be passed if Europe wants to climb on top of innovation rankings and parallel helps to solve problems like climate crises or global challenges in health care.

The characteristic of Industry 5.0 as a top-down-concept is the core point that leads to a very critical aspect. Industry 5.0 as a value-based conception of society and mission-oriented policy design implicitly presupposes the discourse on values and on the willingness to bear the costs that arise. But this is done without outlining a conception of the public sphere, political discourse, or deliberative, agonal, or pragmatist debate in pluralistic democracies (cf. Banholzer 2022c). This circumstance is certainly due to the construction of the European Union and the fact that the concept was elaborated and introduced by the European Commission - i.e. it represents a concept of the executive. This again shows the democratic deficit of the European Union, which shows parliamentary representation as not yet fully developed. However, if transparency and participation are demanded in transformation processes and, in addition, the state and politics act as equal network actors on the one hand, while decisively defining the legal framework on the other, this creates a disproportion that has a counterproductive effect on the acceptance of mission orientation.

1 New paradigms and new answers

For around five years now, a growing debate has been taking place around a continuation of the Industrie 4.0 concept and attempts to integrate further aspects beyond technologies with the cipher "5.0". These include a re-integration of people into manufacturing, a focus on resource efficiency and thus sustainability aspects, or efforts to integrate the goals of the circular economy. This debate is currently reaching a preliminary climax with the European Commission's explicit call to provide innovation, research and industrial policy with a normative framework as a "Green Deal", "Industry 5.0" or "Green Industry" (European Commission 2021 and 2022). As stated by Banholzer (2021b and 2022a), society and thus also politics are undergoing a paradigm shift, which, considering the crisis phenomena caused by pandemics, climate change and also foreign policy conflicts between economic and technological blocs USA, China and Europe, also highlights the limits of technological policy (August 2021a and 2021b) and makes clear the need for normative debate.

1.1 Technological Policy Paradigms and the Normative Gap

The aforementioned crises have once again brought to light deficits in digitization, in the equipment of the health and education systems, or in the lack of forecasting and strategic capabilities of society and, above all, of politics, which have long been addressed but have not been dealt with (Banholzer 2022a: 17). Reckwitz (2021b: 119) interprets this as the phase - normal and inherent to every modernity - in which immanent contradictions and deficiencies become visible and a new form of modernity, a "postmodernity", is constituted. For this late modernity, Reckwitz (ibid.) describes three specific moments of crisis, the social crisis of recognition, the cultural crisis of self-realization, and the crisis of the political. According to Reckwitz (2021b: 120), these are joined by another crisis, namely the crisis of "the progress-oriented regime of the new".

What is required is a holistic approach to politics that is not exclusively oriented to the primarily technically interpreted incremental innovation imperative, but places mission orientation and procedures oriented to overcoming the "grand challenges" at the center of political action and social discourse (cf. Christensen & Fagerberg 2021; Mazzucato & Dibb 2020; Burget, Bardone & Pedaste 2017). However, as argued in Banholzer (2022a), this requires closing the normative gap that previous governance paradigms inevitably leave open. In light of this, Vincent August (2021) suggests that Reckwitz's interpretation should be continued or corrected to the effect that the current situation should be described as a clash between neoliberalism and the network idea, both of which should be seen as facets of technological governmental thinking distinct from sovereignty theory (ibid.: 401). Sovereignty theory assigns a prominent and responsible position to both the state and politics. In neoliberalism, on the other hand, the state as a framework provider is supposed to enable market-like transactions and coordination; the network idea, also in contrast to sovereignty theory, sees the state and politics "only" as co-actors in a system of volatile networks. Both directions are manifestations of technological governmental thinking, which invokes subjectivity, transparency and freedom and rejects hierarchical orders and thus control paradigms.

With August (2021: 405), this can be taken as an indication that the technological approach has deficits in society's self-description. The pandemic and flood disaster situations in particular have shown that factually existing expectations are directed at the state and at politics (August 2021: 407). This includes both organization and normative orientation, and thus also a form of definition of the common good that is actually negated or at least pushed back in technological approaches to government. Because the technological approach offers both rhetorically and conceptually an

open flank in the realm of collective self-understanding and collective action (August 2021), it is necessary to draw at least in part on the tools of modernity.

1.2 Filling the Normative Gap: Industry 5.0

As I will argue, the European concepts of „Green Deal“ or „Industry 5.0“ can be seen as an answer to the question of what normative basis could be found for the governance of network-society. First there is a look at a concept Society 5.0 promoted by the Japanese prime minister Abe from 2016 on. Some critics of the "Industry 4.0" concept missed the role of humans and complained about a human-centric continuation of the concept. Abe suggested bringing Industry 4.0 and Society 5.0 together could be the solution of many problems that industrialized countries are facing.

1.2.1 Japanese Concept „Society 5.0“

At the Cebit trade show in 2017, which took place in Germany, Japanese Prime Minister Shinzo Abe outlined the government's program for Society 5.0 in his opening speech.[1] This means the development of Japan into a "Super Smart Society"[2]. A program that considers digitization in its disruptive significance for society as a whole and sees it as an approach for dealing with the so-called Grand Challenges. The Japanese „Society 5.0“ can be seen as a strong response to the German „Industrie 4.0“ (Waldenberger 2018: 49). At the time, Prime Minister Abe also addressed Chancellor Angela Merkel with the suggestion of combining the competencies of Industry 4.0 and Society 5.0 in the future. Unfortunately, however, these thoughts on the social impact of digitization and Industry 4.0 were not to be found at the Hannover Messe four weeks later at the same place as Cebit. The discourse on Work 4.0 is being conducted, but the collective discourse on designing Industry 4.0, the task of contouring design publics, is not being perceived.

The Japanese government program focuses on the challenges facing every modern industrial societies. According to its own description, Society 5.0 is not aimed at productivity, but is intended to help deal with social issues (Keidaren 2016). The program makes it clear that far-reaching changes are needed: „To create such a society, we must eliminate barriers in five areas: ministries and agencies, legal systems, technology, human resources, and public acceptance.“ Like Waldennberger (2018: 51) points out „Society 5.0“ plays a pivotal role in the 2017 updated growth strategy under “Abenomics” which was approved by the Cabinet in June 2017 under the title “Future Investment Strategy – Towards the Realisation of Society 5.0”, the Growth Strategy 2017 sees the efforts undertaken towards Society 5.0 as “the key to break secular stagnation and achieve mid-and-long-term growth”. Deguchi et al. (2020) underline that the „vision of Society 5.0 requires us to reframe two kinds of relationships: the relationship between technology and society and (aswell) the technology-mediated relationship between individuals and society“. Despite Chancellor Merkel's reply that the Japanese idea of a Society 5.0 in particular was a very interesting vision that would also be inspiring for Germany, the intensive discourse on the normative and ethical prerequisites failed to materialize. Meanwhile, leading Tech Companies like Siemens are integrating the topic of Society

[1] See a comment on discourses on Industry 4.0 at the Hannover Fair 2017. http://tj-industrie40.de/suche-nach-der-society-5-0/

[2] Adrian Lobe (2017) criticizes after Prime Minister Abe's speech that the concept of the "ultrasmart" society has not been thought through to the end. The computerization of economic and political processes leads to the delegation of more and more cognitive competencies to artificial intelligences and to the disenfranchisement of citizens.

5.0 into their marketing concepts.[3] But: As Adrian Lobe (2017) remarks the Society 5.0 is an integrating concept of a network society, but it is still missing a reflection on ethics and norms. Younger scientific publications try to connect Industry 4.0 with Society 5.0. Pereira, Lima and Charrua-Santos (2020: 3305) claim that Society 5.0 focuses on the use of tools and technologies developed by Industry 4.0 „to benefit the humankind". Intelligent systems, developed by Industry 4.0, could be seen by society as a beneficial rather than as adversaries (ibid.). And: The new Society 5.0 paradigm „will play a predominant role in creating a happier, satisfied, fulfilled and consequently more productive society" (ibid.). According to Fukuda (2020) „Society 5.0" is able to transform even innovation ecosystems. Society 5.0 is the vision of a new human-centered society in the fifth stage, which means to shift from a push-based STI ecosystem to a pull-based STI ecosystem and enabling to increase the system's resilience through value creation for society (ibid.). Others claim that Industry 4.0 is forcing a transition – to a Society 5.0 - and within this transition, open innovation and value co-creation can play an important role (Aquilani et al. 2020). Other researchers discuss Society 5.0 as a framework for analyzing and understanding the practice of corporate social responsibility (CSR) in modern organizations (Potočan, Mulej & Nedelko 2020), or as a possibility for finding better actions to realize Sustainable Development Goals (Zengin et al. 2021) for example through evidence-based policymaking using artificial intelligence (Shiroishi, Uchiyama & Suzuki 2019). Meanwhile, Europe – the European Commission – is not using the term Society 5.0 but looking at the „Green Deal" or the concept of „Industry 5.0" promoted by the European Commission in the past few years one could think that this is another pathway in the same direction as Society 5.0 and this could also be the missing link to bring technological governance together with ideas of the modernity about responsibility and capabilities of the state.

1.2.2 Impulses from the European Commission: Industry 5.0 and Green Deal

The "Green Deal" and the concepts "Industry 5.0" or "Green Industry" (European Commission 2021 and 2022) can be seen as a normative framework. This approach of the European Commission thus picks up the normative gap left open by a technological governance approach focusing on agility, entrepreneurship, flexibility, and creativity and fills it by borrowing from common good concepts from the modern era. As a value paradigm, the definition of the SDGs or the orientation towards a common good approach are a recourse to the concepts of postmodernity and fill the normative gap that neither neoliberalism nor network idea as a technological counterpart to sovereignty theory can close (Banholzer 2022a). The reindustrialization[4] of Europe is communicated in the "Green Deal" as "Green Industry" and "Industry 5.0". "Industry 5.0" shifts the focus "from shareholder to stakeholder value" and thus promotes the emergence of a "sustainable, human-centric and resilient European industry" (EU Commission 2021). This broadening of the concept thus takes up a topic that has accompanied the discourse of digitalization in the factory from the very beginning: the deserted factory. Already at an early stage, protagonists of digitization of factories in Germany had already attempted to replace the human being in their concept as the "conductor of the value chain" (VDMA 2015; Soder 2015) to counteract dystopian narratives.

[3] Like the Siemens consulting division Siemens Advanta: https://www.siemens-advanta.com/blog/society-50

[4] Aspects of reshoring industrial jobs or firms shall not be discussed here. But there is intresting research on this topic according to the Nordics. In their research on backshoring acitivities Johansson and Ohlhager (2018) for Sweden and Heikkilä, Martinsuo and Nenonen (2018) for Finland agree that backshoring activities are based on a variety of factors: quality, lead time, access to skills a knowledge access to technology, proximity to R&D. Heikkilä, Martinsuo & Nenonen (2018) indicate that the patterns of backshoring in small and open Nordic economies might differ from those of other industrialized countries.

1.3 Summary and Research Questions

To analyze Industry 5.0, the ideal types of innovation policy according to Laasonen, Kolehmainen and Sotarauta (2020) will be consulted and used as a framework for classifying holistic or detail-oriented policies (cf. Banholzer 2022a). The authors have identified the main approaches to innovation policy, the way in which they implement of R&I policies are summarized based on two dimensions (Laasonen, Kolehmainen & Sotarauta 2020: 5). The horizontal axis represents the adaptation of innovation policies. The general expression of an innovation policy focuses on the generic conditions, frameworks and structures for innovation. The ideal type of R&I policy is to play too active a role in guiding innovation activities and selecting individual innovation actors, industries or technologies because resource inefficiencies, negative path dependencies or decoupling of domestic and foreign markets are feared.

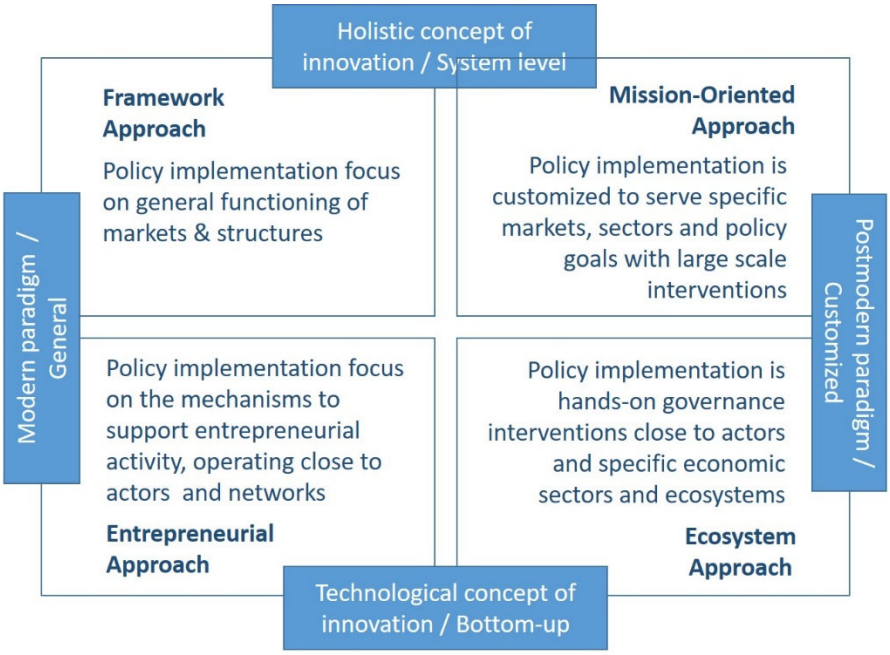

Figure 1: Ideal types of innovation policy used as a framework for classifying holistic or detail-oriented policies. Source: Laasonen, Kolehmainen & Sotarauta (2020: 5).

This approach contrasts with the orientation toward focusing and specializing innovation policies. Innovation policies. A "tailor-made innovation policy" is designed to meet the needs of and regions and the solution of specific development-related problems. Specific development-related problems. The role of innovation policy in this is to guide development and facilitates innovation in these specific sectors of the economy (Laasonen, Kolehmainen & Sotarauta 2020: 6). The vertical axis maps the scope of innovation policy interventions and differentiates whether innovation policy starts at the system level (Large Scale System Level) or the micro level (Grass-Root Level). In the system-level polarization, innovation policy monitors the functioning of markets (e.g., via taxes, support systems, or regulations), the general structures and composition of the economy and the innovation system. The countervailing form is oriented toward the individual actors and networks on the ground. The national innovation strategy is implemented in a decentralized manner through collaboration between national, regional and local political actors, as well as companies, universities and other research centers in the region (ibid.). These dimensions result in four ideal-typical characteristics of innovation policy, which are to be understood here as general policy approaches.

The question that now follows is whether the "Green Deal" as "Industry 5.0" is connectable to "Industry 4.0" (Banholzer 2021c). The debate about the term "Industry 5.0" is already underway. The comments range from conceptual nonsense (Liggesmeyer 2021) to "necessary course correction", which, significantly, was not initiated by industry itself but by the EU Commission (Buchinger 2021). The question is if this ist the co-existence of two Industrial Revolutions as Xu et al. (2021) say or if this is a continuation and an evolution from one step to another within industrial concepts. But: One has to agree when Carayannis and Morawska-Jancelewicz (2022) resume that concepts of Society 5.0 and Industry 5.0 are „not a simple chronological continuation or an alternative to Industry 4.0 paradigm“.

2 Technology vs. Values or Technology and Values

As a project group of acatech (2020) recently emphasized once again, the fourth industrial revolution cannot be implemented through the implementation of individual, isolated prototypes; the focus is primarily on the design of systematic transformation programs, and this process is not nearly complete yet. Nevertheless, the European Commission is initiating a debate about industrial transformation, which it is introducing with the term Industry 5.0. In the following, the background and origins of Industry 4.0 will be briefly discussed, before going into the details of Industry 5.0 in chapter 3. The term "Industrie 4.0", its meaning and its impact have meanwhile been discussed in detail (cf. Banholzer 2018b, 2019 and 2021a; Meyer 2020). The discussion of whether Industrie 4.0 should be described as a utopia, a sociotechnical vision, or an empty signifier will not be revisited here. It should be noted that the term was and is not based on a concrete definition, that there is no "Industrie 4.0" product that can be purchased and used. Nevertheless, the term has managed to get digitization in production onto the political and media agenda. And via the discussions in the industry, moreover, the technology field has been contoured and defined over time. The cultural dimensions and influencing variables on the adaptation of such a concept have also been pointed out (Banholzer 2021a). And so, through the discourse on "Industry 4.0," a debate has also developed about the effects on employment relationships, job profiles or effects on business locations. This, in turn, has posed and continues to pose the question of values and norms that can limit and regulate or guide such a development.

2.1 Rethinking Industry 4.0

In times before the Covid19-Pandemic climbed the agenda, the term Industry 5.0 was used as a reaction to the vision of Industry 4.0. While various countries across the globe had similar initiatives, Industry 4.0 became known worldwide but still predominantly has a European connotation. Considering the potential for value creation, since 2011 initiatives have already been launched in numerous EU countries.

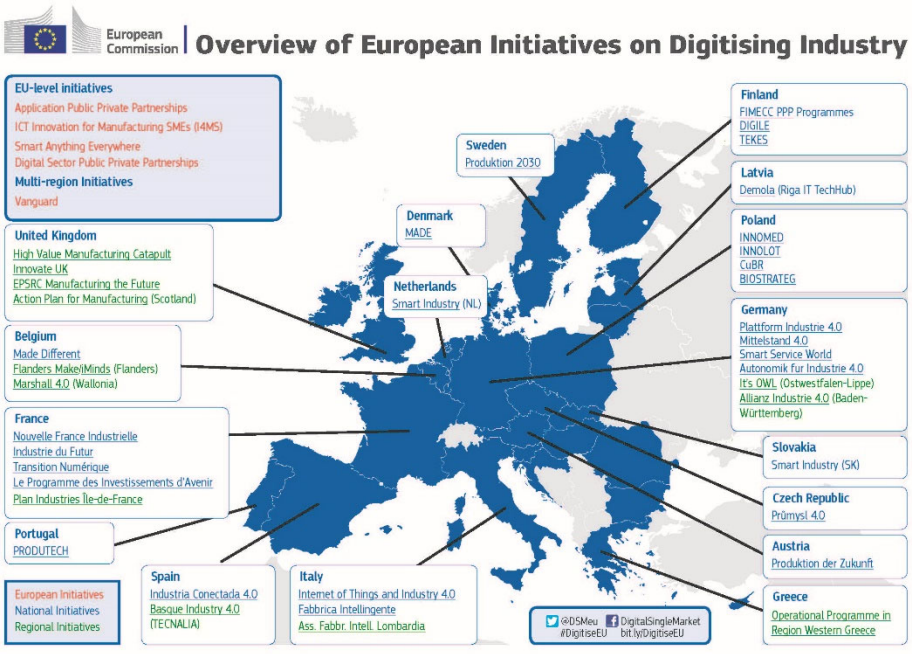

Figure 2: Overview of Initiatives on Digitising Industry in Europe. Source: http://ec.europa.eu/information_society/newsroom/image/document/2016-16/overview_of_digitising_industry_with_links_15202.pdf

Building on existing projects, the EU Commission had launched plans to support national initiatives through financial measures in all industrial sectors, such as „Industrie 4.0“ in Germany, „Fabbrica Intelligente“ in Italy (focusing on "sustainable, adaptive, intelligent and high-performance manufacturing") or „Industrie du futur in France“ (industrial plan extending to all areas of life and based on the application of the latest technologies) or Production 2030 in Sweden.

The most recent concept of Industry 4.0 revolves around integrating information technology and operational technology with near-real-time connectivity in the producing industry to provide actionable intelligence to decision-makers. Therefore, Industry 4.0 refers to the transformation of industry through the adoption of techniques and processes based on information and communication technologies (ICT) to manage and optimize all aspects of the manufacturing processes and supply chain (Alexa, Pîslaru & Avasilcai 2022). Industry 4.0 relies heavily on automation and has been intimidating workers on factory shop floors.[5] Among the new disruptive elements introduced by Industry 4.0 are big data and analytics, simulation, horizontal and vertical system integration, cybersecurity and cyber physical systems (CPS), cloud technologies, additive manufacturing, autonomous and collaborative robotics, and augmented reality.

This European thinking is also present in the idea of Industry 5.0 or, at least, in the way Industry 5.0 ‘evolves.’ As a term and vision, Industry 5.0 isn’t a European nor new ‘invention’. In the US, where the term Industrial IoT, originally in the sense of Industrial Internet - hence the ‘Industrial Internet Consortium or IIC - is often used instead of Industry 4.0. Consequently, at the core of Industry 5.0 concept are new business scenarios aided by advanced technology themes, focused on delivering individually tailored customer experiences. The individual definition of products, services and solutions will fuse into one and create Industry 5.0. Following industry analysts from Frost and Sullivan (2019) in Industry 5.0, customer aspirations will drive the market interests toward hyper customization.

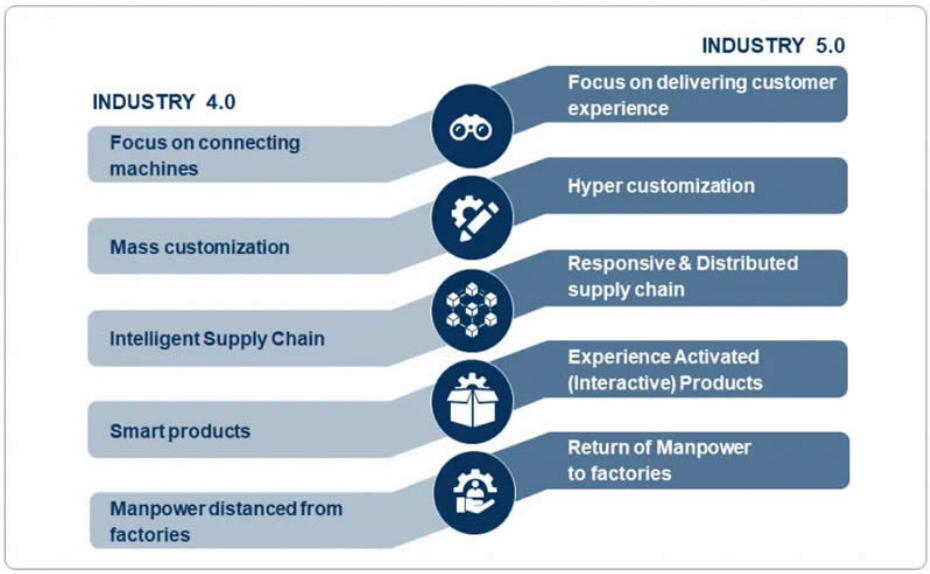

Figure 3: Forst and Sullivan argue that Industry 5.0 is an evolutionary step foreward from Industry 4.0. Industry 5.0 is therefor again technology and economically driven. Source: Frost & Sullivan 2019.

[5] Explanation from Frost and Sullivan: https://www.frost.com/frost-perspectives/industry-5-0-bringing-empowered-humans-back-to-the-shop-floor/

Driven by the impact of the pandemic, the focus on topics such as sustainability and resilience, and the call to put people more central again, it has become a subject policymakers and organizations increasingly pay attention to. There is a wide consensus in the literature that there is another aspect - the next natural step in this evolution from Industry 4.0 to Industry 5.0, should be focused on sustainability and waste prevention. Additionally, the bioeconomy vision of the European Commission is also centered around sustainability and bioeconomy is predicted to have a deep impact on businesses and industries (Alexa, Pîslaru & Avasilcai 2022: 224). As the Directorate-General for Research and Innovation underlines, Europe today faces a triple imperative to protect, prepare and transform in its quest for building forward better after the deadliest pandemic of the past century and for building forward better to address the greatest challenge humanity has ever faced – climate change and biodiversity collapse (European Commission 2022: 3). That means that Industry 4.0 with its focus on technology and efficiency is not the right concept to meet that challenges.

2.2 Technology without Values?

Industry 4.0 as a concept for computerized and smart manufacturing at a new stage was established in 2011, when a whitepaper was handed over to the German chancellor Angela Merkel at the Hannover Fair. Industry 4.0 was a project within the high-tech strategy of the German government. The authors of the whitepaper from 2011 were Henning Kagerman, head of the German Academy of Technology (actech) and a former manager of SAP, and Wolfgang Wahlster, Professor of computer science at the University of Bremen and director of the German Institute for Artificial Intelligence (DFKI), and Wolf-Dieter Lukas from the German Federal Ministry of Education and Research (BMBF). Today, Industry 4.0 is recognized as an initiative from Germany, which has become a globally adopted term in the past decade. Many industrial countries have introduced similar strategic initiatives, and a considerable research effort has been spent on developing and implementing some Industry 4.0 technologies (Xu et al. 2021). While the vision or the concept of Industry 4.0 (Banholzer 2021a) has reached the ten-year mark since its introduction, there is a growing debate on Industry 5.0. Industry 4.0 is considered to be technology-driven, whereas Industry 5.0 seems to be value-driven (Xu et al. 2021). For discussions in German news media, obviously, there is still a focus on the dualism of robots vs humans. In 2018, the German National Academy of Science Leopoldina discussed the paradigm of new work: How will we work in 2030? As Bernhard Schulz[6] claims, experts prefer to talk about "Industry 5.0" when they mean future-oriented human-like functioning production, while "Industry 4.0," just proclaimed the magic term for computer-controlled industry, merely means "a little better" than times of production in the 2010s. Like Karl-Heinz Land[7] in a way of post pandemic optimism points out, that Covid has brought the digitazation and fullfilled the Industry 4.0 paradigm. Now, he argues, societies have to rethink technology and have to bring machine and man back together. But bringing man back into the shopfloor – as a blue-collar or a white-collar worker – is not enough to meet the grand challenges and to support societal transformation. Especially the discussion about the loss of jobs through digitalization, automation and robotics ties in with the debates of the 1980s and 1990s about the nineties of the last century about automation losers in the working class. This makes it clear that an approach that seeks acceptance only by imparting more knowledge cannot be successful. Existing cultural frames must be analyzed, and com-

[6] Schulz, Bernhard: Industrie 5.0 – Schuften bis der Roboter kommt. Tagesspiegel 16.04.2018. https://www.tagesspiegel.de/kultur/industrie-5-0-schuften-bis-der-roboter-kommt/21178564.html (aufgerufen 29.10.2021).

[7] Land, Karl-Heinz: Industrie 5.0 - Stilltsand als Beschleuniger. FR 26.6.2020 https://www.fr.de/panorama/stillstand-beschleuniger-13812730.html (aufgerufen 2.11.2021)

munication strategies must be developed. The fact that there is still a need to catch up is also evident from the attitude in many companies that Industry 4.0 as a management issue, but not as an issue for the shopfloor (cf. Banholzer 2016b).

2.3 Frames of Welfare State and Blurring Bounderies in Science and Innovation

In 1995, the European Commission firstly used the term 'European Paradox' (European Commission 1995) to define the phenomenon of having good higher education systems, well established research infrastructure but failing to translate this into markable innovations.[8] Looking at the German Innovation indicator by Acatech, BDI, Fraunhofer ISI and ZEW (Belitz et al. 2009; acatech et al. 2017) or the European Innovation Scoreboard (cf. EIS 2021) in the late 1990s and early 2000s constantly had seen the small countries of the Nordics on top of the rankings leaving the big economies like Germany behind. Additionally, the EU in comparison to the USA was unable to compete although education, research and science were very well established in the EU. There has been done a plenty of research to figure out conditions to make Europe as a whole better in competing with the USA and today also China. The High-Tech-Strategy of the German Government – including Industrie 4.0 – was one part of these initiatives which were taken to close the gap of innovation and keep the status of welfare, especially in Germany. As shown above and discussed in Banholzer (2021b and 2022) European nations tried to catch up with a linear understanding of innovation.

2.3.1 Success in Digitalization requires Strong Welfarestates

But early in the debate about digitalization of society and industry and even in the period of implementing Industry 4.0-strategies, researchers pointed out that those strategies require an established and strong welfare state (Buhr 2019: 115). For the (grand) challenges coming ahead the social democratic models of welfare states – like the Nordics are said to have – in the view of research are better prepared compared to most of the liberal, Mediterranean, post-socialist and conservative welfare models (Buhr 2019: 116). For example, the Nordics are following the idea to minimize dependence on commercial interests and are therefore focussing on a greater role of the public sector (Buhr 2019). As for Denmark and Norway, scholars describe science policy as a part of the "social engineering state" (Christensen, Gornitzka & Holst 2017: 246). Keen (2017: 25) concludes that "prosperous modern societies are wiser not because their citizens are individually brilliant, but because these societies hold a diversity of know-how and because they can recombine it to create a larger variety of smarter and better products". The research of the Harvard scientists of The Atlas claim that it is indicated that invention of new products requires knowledge of existing, closely related products.[9] As pointed out in Banholzer (2021a) the adaption of concepts like Industrie 4.0 in

[8] If this is a mythos or reality has been discussed in scientific debates. In their research on ICT sector, Tijissen & Wijk (1999) agree with the diagnosis of the EC (1995). Later on, Dosi et al. (2006) remark looking at the data there has not been a European Paradox. Contrary, Rodriguez-Navarro & Narin (2017) argue that there is not only a lag for science-innovation transfer in Europe but also a lag just in the weakening of European science as a whole. Today's discussion on scientific potential and a lag for transforming it into innovations and industry applications are around artificial intelligence. Initiated by a report "For a meaningful artificial intelligence: towards a French and European strategy" written by Cedric Villani, mathematician and winner of Fields Medal and member of French parliament, the French President Emanuel Marcron started an initiative on AI for Europe (Oury 2019; Thompson 2018).

[9] Thus the scientists Jasperneite & Niggemann (2018) from the German Fraunhofer Institute in Lemgo assist in claiming that automatization does not fit with disruptive development and should be thought together with incremental and evolutionary innovation.

Norway (Storting 2017) as Industry 4.0 depends on cultural determinants. Every policy model like Industrie 4.0 has to be analyzed as “a part of a collectively held imaginary of socio-technological progress” that “accompanies a complementary diagnosis of a deficiency in the receiving environment” (Pfotenhauer & Jansanoff 2017: 786). This means that the transfer of concepts and ideas must always consider the cultural framework, both the contexts of the source society as well as those of the target society. Schmidt (2018) refers to such concepts as mental models, as figuration that are implicitly permanently present in concepts such as "Industry 4.0," and which are of course always culturally anchored and accompanied by a corresponding framing.

2.3.2 Fragmental Differentiation and Blurring Scientific Boundaries

Societies have to face blurring boundaries between science disciplines as bionic, mechatronic, or nanotechnologies illustrate. The pace of innovation is accelerating and questions that are raised by scientific approach, technological innovation, and new business models have to be answered by democratic and political discussion and cannot be solved by science and technology themselves. This situation when facts are uncertain even if they are a result of scientific research, when there is a dispute over values, states are high, and therefore political decisions are urgent, this was described by Funtovitcz & Ravez (1993) as a post-normal situation. Another point is the new paradigm of fragmental differentiation of society. Passoth and Rammert (2018: 56) argue that orientating on innovation, progress and the new establishes a paradigm of fragmental differentiation in addition to functional differentiation of societies. Forms of fragmental differentiation will not fully displace the principles of functional differentiation (ibd.). Practice in fragmental and functional differentiated societies “confronts the separate, parallel existence of differentiated spheres with fields and levels that are intertwined and overlap” (ibd.). The guiding principles of the functional differentiated sectors of economic, politics, law, science, and arts that first modernity has institutionalized in enterprises, political parties, law firms, research institutes, and galleries and museums have not disappeared and will not (ibd.: 57). The drive toward continuous innovation disrupts habits, crosses established boundaries, mixes guiding references, and spreads to all spheres of society (ibd.: 58). Therefore, contemporary societies being functional and fragmental have a need for coordination via objectives, missions and norms.[10]

2.4 Political Modulation of Technological Developments

Industry 4.0 can be described as one of the first concepts to address not only technical innovation but also its economic and legal implications, and to discuss its effects in this context. Discourses about Work 4.0 or legal relationships around manufacturing and machine data, payment models with data are only examples of these debates. However, as critics noted early on, these debates remained focused on paradigms such as efficiency, resource deployment and business models, and an integration of social innovations did not take place conceptually. More recently, these social aspects have come more into focus. The importance of a functioning and well-balanced welfare state for an innovation state or innovation society also points to the importance of social innovations. Welfare state and also the question of the contribution of politics, companies or organizations

[10] The consequences of pardigms like experiments, pojects and field testing shall not be discussed closer within this context. For example Böschen et al. (2017) calim the „Experiment as a Dispositive of the Knowledge Society“ or Baecker (2007) and Baur, Besio and Norkus (2018) point out the projectification of science or society as a whole. Another aspect is the program oft he new German government that has underlined to support more entrepreneurship, science transfer and experimental spaces (cf. Banholzer 2022).

and individuals to a common good and the social location of actors raises the question of normative foundations. Moreover, the fragmentally differentiated, increasingly project-oriented and experimental network society requires a normative framework in order to be able to synchronize actors and projects, volatile groupings and pluralistic interests.

Beginning in the late 1990s the European Commission (1996) started to change the innovation policy integrating targets and objectives – or within this context a mission-oriented policy. The papers on topics like Industry 5.0 or the "Green Deal" can be seen as the latest parts of this path on turning policy from linear to network and mission-oriented concepts. The need to steer innovation toward given objectives is rising in today's policy agenda (Joly 2017: 81). As Edquist (2018) claims, determinants or instruments say nothing about the objectives - whether ultimate or direct - that are the basis of a specific innovation policy. Edquist defines objectives of innovation policy as inherently political, which have to be specified separately and exogenous in political and democratic processes (Edquist 2018: 11). In the terms of Huberty (2013) they may be called political preferences. These ultimate objectives are therefore not only affected by political organizations but also by civil society initiatives, lobbyism or scientific research and as pointed out by mass media, trade press and public discourses (Banholzer 2021b; Waldherr 2012), too. Paradoxically, however, the plea for competition between entrepreneurship, inventiveness, creativity, a thirst for research and engineering, and the accompanying openness to technology, often contain far-reaching promises or imaginings (cf. Konrad 2021: 217).

With concepts like Industrie 4.0 the actors consider a forward-looking modulation of technological developments (cf. Rip 2006) to be possible and assert a realistic, relativized, but determined claim to design (cf. Kaufmann 2013: 130). Social research underlines that concepts like the German „Industrie 4.0" or the „Energiewende" are not only technological and economical concepts, but also implement a change in governance. As Passoth and Rammert (2018: 36) point out Germany's energy transition is of course not just about maintaining prosperity or making optimal use of available resources: „It also comes with expectations that the transition of a leading industrial nation such as Germany to renewable energy sources will turn out to involve a political innovation in its modes of governance and a cultural innovation in its patterns of urban mobility, which together will receive recognition in the international arena, be copied in other regions and cities, and be adopted by other collective actors." Alike Industrie 4.0 one can see that the value of these innovations is not assessed because of economic success alone but also on grounds of its potential to reinvigorate Germany's economic role in Europe and promote new co-production and consumption practices (ibd.).

3 Inside „Industry 5.0“

Although manufacturing companies are currently still in transition and explore dimensions of implementation of Industry 4.0, Industry 5.0 „as a new revolutionary wave is emerging as an ‘Age of Augmentation’ when the human and machine reconcile and work in perfect symbiosis with one another“ (Longo, Padovano & Umbrello 2020: 1). In the latest ESIR Policy Brief, experts of the ‚Directorate-General for Research and Innovation‘ argue that a new, much more ambitious and systemic vision is needed for Europe’s industry compared to the one that is currently proposed by the EU updated industrial strategy (European Commission 2022). As Industry 4.0 is an essentially technological paradigm, centered around the emergence of cyber-physical objects, and offering a promise of enhanced efficiency through digital connectivity and artificial intelligence, the authors emphasize that Industry 4.0 is not the right frame to meet the „Grand Challenges“. Industry 4.0 is not fit for purpose in a context of climate crisis and planetary emergency, nor does it address deep social tensions (ibd.). Therefore, a new paradigm is needed: „Industry 5.0“.

3.1 European Commission Innovation Strategy

As discussed in Banholzer (2022a) the European Commission has outlined its orientation toward a new concept of innovation that integrates not only digital and software industries but the hardware-competent industries that are also at the core of the German technology portfolio - e.g., the machine tool and automotive industries as well as the chemical industry. The combination of industry with (non-)university research institutions (Max Planck, Helmholtz, Fraunhofer) and with (financing) institutions such as KfW is also explicitly emphasized. The EU Commission's goal is to form a pan-European innovation ecosystem that is to emerge from the networking of local and regional ecosystems. This also requires consideration of location policy, education policy and entrepreneurship as well as robotics, AI integration or digitization of administration and SMEs. The awareness-raising for new business models, platform economies and data orientation initiated with the Industry 4.0 concept must be continued. What also requires expansion is the strategy for dealing with algorithms and AI solutions.

The current EU Commissioner in charge, Mariya Gabriel (2021), then also calls for a new type of innovation, a new conceptualization of innovation, which should enable both the recovery after the Co-vid19 pandemic and the mastering of the Grand Challenges. The focus here is on moving away from consumption-oriented and, above all, software- and digitization-based innovation toward deep-tech innovators and "transformative technology-intensive start-ups (...) that help us solve our problems" (ibid.). In this context, Gabriel emphasizes the hardware-competent industries that are also at the core of the German technology portfolio - e.g., machine tool and automotive industries as well as the chemical industry. The combination of industry with (non-)university research institutions (Max Planck, Helmholtz, Fraunhofer) and (financing) institutions such as KfW is also explicitly emphasized by the EU Commissioner. The goal is to form a pan-European innovation ecosystem, which is to result from the networking of local and regional ecosystems.

According to the Commissioner, the combination of scientific expertise and established hardware industries should make the EU a pioneer of the new, fourth wave of innovation to meet the pressing challenges of post-pandemic health and construction, green change and technology sovereignty. The proclaimed slogan underscores the hardware component again in view, from "bits" to "bits and atoms." According to the EU, this approach, moving away from pure digital innovation to a combination of the digital and the analog, also encompasses the area of social innovation (Merx & Sievers 2020: 30). This contrasts with the analysis of Botthoff et al. (2020: 3), who emphasize the need for

inter- and transdisciplinary approaches, but also state that the "innovation discourse as well as the objectives and development perspectives of the innovation system will be increasingly information-driven," which they justify with the success of the Industrie 4.0 concept.

3.2 A new Industry Strategy for Europe

On March 10, 2020, the Commission laid the foundation for an industrial strategy that would support the transition to a green and a digital economy, make EU industry more competitive globally, and strengthen Europe's open strategic autonomy. Right at the outset, the Commission stressed that Europe has always been home to industry, has pioneered industrial innovation. Underpinned by a strong single market, European industry has long been the engine of the economy, providing a stable livelihood for millions of people and creating essential social hubs in our communities. To enable European industry to remain at the forefront of the digital and environmental transformation and to restore and enhance its competitiveness even after the Corona pandemic is over, the European Commission updated its industrial strategy and published it in May 2021. The updated industrial strategy is also about the goals of competitiveness, climate neutrality and digitalization. However, the Covid-19 pandemic has added weight to these ambitions. However, the first industrial strategy was preceded by the so-called "Green Deal," which was also published first.

3.2.1 The European Green Deal and the Role of Industry

In 2019, the European Commission presented the Green Deal, its plan to make the European Union climate-neutral by 2050. As Neuhoff et al. (2021) point out that innovative, climate-neutral technologies which are typically based on electrification, green hydrogen, or the use of biomass already exist. But the authors see two challenges which have to be met: New technologies are and will likely remain more expensive than conventional methods and processes, both in terms of investment and operation. Additionally, they require large amounts of energy. For this reason, and because of the limited availability of renewable energy potentials, a successful transition requires material efficiency and a circular economy to reduce the demand for primary production of basic materials. This reduces the energy requirements and the costs of primary production, while simultaneously strengthening the resilience of value chains through lower resource requirements (ibd. 74). Transforming an economy to a greener version means redirecting all sectors and all actors, from public, to private and civil society. This requires a new toolkit; one that is more based on market shaping and market co-creating (Mazzucato 2017; Kattel et al. 2021). Parallel to the launch of the Green Deal, the European Commission immediately started to look at how to adopt an industrial strategy that would promote EU competitiveness and support the Commission's self-assigned 'geopolitical' role by boosting strategic autonomy (Renda & Schaus 2021: 2). In Spring 2020, when the Covid-19 pandemic was already leading the public agenda, the European Commission adopted a Communication on 'A New Industrial Strategy for Europe'[11]. This focussed on the twin transition of green and digital and claimed that it would be a unique opportunity for the EU to affirm its voice, uphold its values and fight for a level playing field, adding that this is about Europe's sovereignty (ibd.). In the view of the European Commission, industry must play a leading role in helping the EU achieve climate neutrality by 2050 - including all existing and future value chains are involved through proactive policy aimed at boosting 'lead markets' (ibd.: 5). The European Commission will need to „develop articulate and comprehensive indicators mirroring the economic, social, environmental and

[11] Making Europe's businesses future-ready: A new Industrial Strategy for a globally competitive, green and digital Europe https://ec.europa.eu/commission/presscorner/detail/en/ip_20_416

governance pillars“ of the transition even „towards Industry 5.0, centered on well-being (and thus, inter alia on alternative measures to GDP), on resilience (as a further elaboration on the first dashboard developed by the Joint Research Centre), and on sustainability (Renda 2021: 137)“. The European Commission sees industry as the core point of its strategy: „Industry 5.0 recognizes the power of industry to achieve societal goals beyond jobs and growth to become a resilient provider of prosperity, by making production respect the boundaries of our planet and placing the wellbeing of the industry worker at the center of the production process“ (European Commission 2021: 14).

3.2.2 Covid19 Pandemic

The COVID-19 pandemic is still a profound challenge to governments worldwide — from the provision of income support to citizens and aid to struggling companies, to strengthening frontline health services (Kattel et al. 2021). In Germany, the new industrial strategy agenda of the Government, the „Nationale Industriestrategie 2030“, launched in 2019, seems already outdated by the policies tackling COVID-19 (Kattel et al. 2021: 3). In the ESIR Policy Brief in January 2022 the European Commission underlines that Covid-19 crisis made clear „that relying on and stimulation a growth-oriented paradigm, based on value-extracting, highly energy-intensive, massively wasteful and polluting materials and resource use, as well as a very short-term approach to capitalism, will not help the world achieve sustainable development in ways that respect planetary boundaries“ (European Commission 2022). And the COVID-19 pandemic has intensively raised new questions regarding the future image of the innovation ecosystems, the relations between the main actors of innovation and the challenges they need to face to transform to new modes rapidly of operation related to digitalization, and to become resilient organizations. The global crisis has also accelerated widespread debate on related wicked and complex problems and challenges called Sustainable Development Goals that gained their momentum - “Green” and “Digital” have become “big ideas” and leitmotivs of this debate (Carayannis & Morawska-Jancelewicz 2022: 2). For Germany Kattel et al. (2021: 5) conclude that COVID-19 has forced German economic policy to rethink some of its foundations. The authors resume that economic policy fit for 21st century challenges should strive „to shape markets in order to address major societal challenges, coordinate a wide range of policy efforts and markets for sustainable and inclusive outcomes, and seek to leapfrog towards future transformational technologies“ (ibd.). Innovation policy and industrial strategies offer opportunities to structure strategic investments and interventions to support innovation-led economic growth in the recovery from the economic crisis triggered by the COVID-19 pandemic (Mazzukato & Dibb 2021: 1). For the European Commission (2022: 4) „the role of industry is pivotal“. Internationally, since the end of the 1990s there has been a return of industrial strategy and innovation policy, and a comprehensive focus on how economic growth can be delivered through innovation. This is all the more important now as countries attempt to stimulate economic recovery in a post-pandemic era (Mazzukato & Dibb 2021: 2). The coalition alignment of the new German government elected at the end of 2021 shows a main focus on research, science, development and innovation (Banholzer 2022a).

3.3 Industry 5.0 as a Strategy

Within the vision of a competitive sustainability, the European Commission sees industry as protagonist and a driving force for systemic transformation and planetary regeneration. Because in the eye of Directorate-General for Research and Innovation of the EC the Industry 4.0 paradigm is structurally aligned only with optimization of business models and manufacturing processes with a technical focus on reducing costs, this paradigm cannot be the basis of a transformation process (European Commission 2022: 5).

Industry 4.0	Industry 5.0
• Centred around enhanced efficiency through digital connectivity and artificial intelligence • Technology – centred around the emergence of cyber-physical objectives • Aligned with optimisation of business models within existing capital market dynamics and economic models – i.e. ultimately directed at minimisation of costs and maximisation of profit for shareholders • No focus on design and performance dimensions essential for systemic transformation and decoupling of resource and material use from negative environmental, climate and social impacts	• Ensures a framework for industry that combines competitiveness and sustainability, allowing industry to realise its potential as one of the pillars of transformation • Emphasises impact of alternative modes of (technology) governance for sustainability and resilience • Empowers workers through the use of digital devices, endorsing a human-centric approach to technology • Builds transition pathways towards environmentally sustainable uses of technology • Expands the remit of corporation's responsibility to their whole value chains • Introduces indicators that show, for each industrial ecosystem, the progress achieved on the path to well-being, resilience and overall sustainability.

Figure 4: Comparing Paradigms of Industry 4.0 and Industry 5.0 in the interpretation of European Commission. Source: (European Commission 2022: 6f.)

A new and future oriented industrial strategy has to include regenerative features of industrial transformation, an inherently social dimension and a mandatory environmental dimension – what can be summed up as a mission orientation or a normative approach for functional and fragmental differentiated societies. An Industry 5.0 approach has critical consequences for the EU industrial strategy writ large and addresses recent knowledge and learnings from the COVID pandemic and the fundamental need to build resilience across value chains and secure people's lives and livelihoods whilst living within planetary boundaries (European Commission 2022: 6). An industrial system that is more resilient to future shocks and can integrate social and environmental principles has to follow a much broader strategy than the common understanding of Industry 4.0 can offer. Even the increasingly popular notion of "stakeholder capitalism", following corporate responsibility concepts for ensuring that all relevant interests represented in the firm are catered for, is insufficient to enable a full transition to Industry 5.0 (European Commission 2022: 7.). Industry 5.0 centers around three interconnected core values of human-centricity, sustainability, and resilience and therefore is not a technology-driven revolution but a value-driven initiative that drives technological transformation with a particular purpose (Xu et al. 2021: 533).

Industry 5.0 enabeling technologies	New Challenges for Industry 5.0
Industry 5.0 identified six enabling technologies: • Individualized human-machine interaction technologies that interconnect and combine the strengths of humans and machines. • Bio-inspired technologies and smart materials that allow materials with embedded sensors and enhanced features while being recyclable. • Digital Twins and simulation to model entire systems. • Data transmission, storage, and analysis technologies that are able to handle data and system interoperability. • Artificial Intelligence to detect, for example, causalities in complex, dynamic systems, leading to actionable intelligence. • Technologies for energy efficiency, renewables, storage and autonomy	Industry 5.0 present some unique challenges that are not seen in the past: • Social heterogeneity in terms of values and acceptance • Measurement of environmental and social value generation • Integration from customers across entire value chains to SMEs • Interdisciplinarity of research disciplines and system complexity • Ecosystem-oriented innovation policy with agile, outcome-orientation • Productivity is required, while large investments are needed

Figure 5: Enabeling technologies and new challenges of Industry 5.0. Source: Own figure with data from Xu et al. 2021: 533.

3.4 Via Society 5.0 to Industry 5.0 – the Futures of Europe

The nature of the transformation required to capture the full potential of Industry 5.0 is systemic. And therefor a systemic Industry 5.0 approach will also necessitate a realignment of policy, what includes breaking down current policy and sector silos (European Commission 2022: 10) and implements answers to new demands on government, public policy and the interaction between industry and the state. Carayannis and Morawska-Jancelewicz (2022: 3) point out that Industry 5.0 and Society 5.0 have the potential „to generate new values to economy, society and the natural environment and to build new system of (eco)innovation that promotes in a systemic way open, social, digital, technical innovations for of people“. The authors underline, „this process is possible within Quadruple/Quintuple Helix Models of Innovations (Q2HM) where the universities as drivers of knowledge and the anchors of innovation play a crucial role in orchestrating the process of innovation and are pursuing the change“ (ibd.).

	Knowledge dimensions	Industry 4.0	Society 5.0	Industry 5.0
Triple Helix	University-Industry-Government relations Knowledge Economy	Techno-centric		
Quadruple Helix, fourth Helix	Media-based and culture-based public & civil society Knowledge society, Knowledge Democracy		Human-centric	
Quintuple Helix, fifth Helix	Natural Environment, natural environment of society Social Ecology			Balanced techno- and human-centric

Figure 6: Relationship between Industry 4.0, Society 5.0 and Industry 5.0. Source: Own figure with data form Carayannis and Morawska-Jancelewicz 2022: 7 and Carayannis & Campbell 2021: 2068).

Looking at R&I-policies Carayannis and Morawska-Jancelewicz (ibd.) refer to Mazzukato (2017 and 2018) and her concept of mission-oriented innovation which helps to improve society's welfare,

coross-disciplinary social innovations, cross-sectoral and cross-actor innovation including an important role of citizens as active participants of innovation process. As disussed above Industry 4.0, Society 5.0 and Industry 5.0 sometimes are used synonymously, sometimes they are set up as an evolutionary line or to have overlapping areas. Carayannis and Morawska-Jancelewicz (2022: 7) use the helix concept to explain the relationship.

Industry 5.0 can be seen as a concept that realizes to balance techno-centric and human-centric approaches. As mentioned above this balance needs as well new instruments in government as in knowledge creation for example within universities and research institutions.

3.4.1 Industry 5.0 needs Government 5.0

Industry 5.0 in a nutshell needs Government 5.0, so European Commission (2022) claims. Considering the paradigms of society described above in a simultaneous functional and fragmentary differentiation, adequate, new possibilities of reaction and action are also required from the state, authorities and politics. Industry 5.0 requires new policies and policy instruments, new partnerships, and new objectives for policies affecting industry. Additionally, a portfolio approach to research and innovation projects is needed, combined with the willingness and a mandate to take informed risks – in development paths and financing. Another point is agility, in the form of the ability to quickly allocate and reallocate budget and other resources, and in the form of an improved ability to respond quickly to changing circumstances. Last not least, it requires an ability to link policy processes, policy areas and governance levels in a more efficient and user-friendly manner, with users here defined as industry, citizens, and other stakeholders. This corresponds with the requirements of technological government ideas (Banholzer 2022a). The notions of agility, flexibility, governance, freedom, creativity, experimentation and individuality that predominate in the technological conception of government - as a distinction from the sovereignty approach - are also at the core of Industrie 5.0. The German EFI Commission of Experts also identifies the requirements for agility in politics and administration, specifically for R&I policy (EFI 2021: 46). These characteristics of the current times – long before Covid-19 pandemic had arrived - are uncertainty, instability and rapid change. That calls for „a degree of resource fluidity, strategic agility and leadership in the public sector, that is at odds with the existing budget processes, incentive structures, competencies and institutional rigidity that characterize policymaking today“ (European Commission 2022: 15).

Public sector decision-making and processes are out of sync with the pace, the speed, uncertainty and transformation imperative (European Commission 2022: 14). Policymaking needs

- A greater awareness of how to achieve ‘unlearning’, address lock-ins and overcome inertia of patterns, policies and processes that prevent necessary and desirable change,
- better governance of policy processes facing new, disruptive and system-changing actors and solutions,
- to react adequately to new actors and solutions, and
- to navigate a multitude of government agencies with different expertise and responsibilities, without anyone in government assuming a responsibility that the overall processes are effective, synergistic and time appropriate,
- new forms of public funding for research and innovation in service of creating new, sustainable economic models, new markets and industrial ecosystems,
- to break out of its current risk aversion.

3.4.2 Governance 5.0 and a New Enterprize Model

Another point is the question of governance. Governance can be defined as the totality of institutional arrangements for the coordination of collective action. Accordingly, governance describes processes of non-hierarchical coordination of actions in complex and often polycentric decision-making structures. In this respect, both state and societal actors are involved. This denotes a paradigm shift, which can be seen as a consequence of the insight that the state as a formal control instance can only achieve goals in negotiations with other actors of a larger network. Due to the network, the negotiations and agreements between actors, and the dependence of politics on public opinion, communication and discourse are becoming increasingly important. Governance processes with the participation of numerous actors with different interests will not only show characteristics of cooperation and consensus-seeking. Rather, it can be assumed that diverging interests or the different weighting of desires and fears will lead to dissent and conflict, which will be settled in discourse and thus also shape the governance process (cf. Viehöver 2014). On the other hand, the traditional, neoliberal separation of business and state, which accepts politics only as a framework setter, led to companies not expressing themselves politically beyond their own economic interests. This is changing in view of the growing importance of network structures, increasing frag-mental differentiation, and also the growing requirement for companies to behave in the societal context as a creation of society (Drucker 2002).

For years, political neutrality was the premise for companies and brands, especially in external communication via advertising, public relations or marketing. To set the course for systemic transformation, not only politics has to change its parameters, but also corporations need to change their mindset, and orient their action towards Industry 5.0 objectives. A paradigm shift is emerging here, and corporations understand themselves as corporate citizen (Kemming & Rommerskirchen 2019). Examples of active positioning are statements by the CEO of Siemens AG, Joe Kaeser, or the Telekom CEO, Tim Höttges, who both clearly positioned themselves against the political right-wing party AfD. As early as 2016, Dieter Zetsche, then CEO of the automotive manufacturer Daimler, appeared at the Green Party convention (cf. Mattias & Kemming 2019: 40).

Another example is the reaction of Siemens AG to protests of Fridays-for-Future in 2020. In January 2020, the then acting CEO of Siemens AG, Joe Kaeser, had offered climate activist Luisa Neubauer a seat on the Supervisory Board (cf. among others Höpner 2020). The reactions in the media, society and politics were numerous and broad in their assessment. It is now taken for granted that companies write sustainability reports and publish them as part of their CSR communication - but the offer by an industrial company to a leading figure in the Fridays for Future movement is so far unique. This example of Siemens and Fridays for Future points to the increased attention and mobilization capacity of stakeholder groups, also vis-à-vis industrial companies, which subsequently have to engage in issue-centered dialog with these groups. In the case mentioned, Siemens AG's involvement in a coal mine project in Australia had drawn criticism from environmental associations and also the Fridays-for-Future group. In the conflictual dispute, Siemens CEO Joe Kaeser had offered Luisa Neubauer, a prominent representative of the Fridays for Future movement, the opportunity to take on an important role at Siemens. Kaeser had offered her a seat on a supervisory board of Siemens Energy AG, which was being founded at the time, in January 2020. The specific position, whether on the supervisory board or within another body, Neubauer could decide for herself, according to Kaeser. Kaeser had emphasized at a press conference that he wanted young people to be able to

participate actively. The conflict between young and old had to be resolved[12]. However, the company had at the same time emphasized that an exit from existing contracts, which had been the cause of the protests, would not be possible without further ado. Specifically, Siemens was to supply a train signaling system for a planned large coal mine in Australia. The action of the Siemens boss was criticized[13] by the majority as an "impudent offer" or as a "PR stunt" and damage to the committees, but there was also the assessment that it should be interpreted as "approaching critics". Neubauer finally rejected the offer[14], and Siemens also maintained its position that it had to honor existing contracts[15].

The example of Siemens AG and its involvement in Fridays for Future illustrates a dilemma faced by industrial companies. On the one hand, they are bound by contracts and want to fulfill them under the economic maxim, on the other hand, these activities are observed more closely and often become the subject of high-profile controversies about social and ecological responsibility. In this specific case, the dilemma was solved by a paradox. Siemens' offer of participation to Luisa Neubauer sufficed as evidence of a corporate citizen strategy and ensured the fulfillment of the corporation's economic goals. According to Blühdorn's categories, this is not to be evaluated as symbolic (corporate) politics, but as simulative (corporate) politics it is an integral part of the social discourses of the third modernity. Following Baudrillard's concept of simulation, Blühdorn (2013: 176) speaks of a Simulative Democracy, which takes up values of the second modernity in a purely discursive way and combines them with actually opposing orientations of the third modernity. This describes a social practice that discursively takes up politically and democratically desired contents such as participation and discussion of values (i.e., characteristics of the second modernity), simulating them to that extent because their concrete implementation is incompatible with dominant contents of the third modernity.

The European Commission (2022: 18) claims that a new European Enterprise Model is needed, in which corporate progress and performance are measured coherently with the role businesses are expected to play in this ambitious, transformative plan. It is necessary that companies' board integrate sustainability aspects into the business strategy, and set measurable, specific, time-bound and science-based sustainability targets to measure progress along those objectives (ibd.). By introducing legal frameworks, minimum standards and certification/labelling, non-financial reporting on sustainability, mandatory due diligence and business model or strategic innovation to make CSR an effective tool to ensure that companies do not only act in a maximizing profit way but take proper account of social/ environmental/ general interest concerns as part of their 'license to operate' (ibd.). According to Drucker, a company is to be regarded as a creation of society and the national economy (Drucker 2002: 57), both of which are rapidly capable of ending the existence of the company if they question the "toleration" considering the lack of necessity and usefulness. Without a societal "license to operate", the existence of a company is threatened (Sandhu 2020: 2). In this context, society is not understood as an abstract entity, but it is concretized through specific constellations of stakeholders (Sandhu 2020: 3). Legitimacy is an attribution of the environment and thus the subject of communicative negotiation processes, i.e. socially and politically relevant topics

[12] Manager Magazin 10.01.2020. Siemens-Chef Kaeser bietet Klima-Aktivistin Neubauer Sitz in Aufsichtsgremium an. https://www.manager-magazin.de/unternehmen/artikel/siemens-chef-joe-kaeser-bietet-luisa-neubauer-von-fff-aufsichtssitz-bei-siemens-energy-an-a-1304032.html

[13] Handelsblatt 20.01.2020. https://www.handelsblatt.com/meinung/gastbeitraege/gastkommentar-kaesers-angebot-an-neubauer-beschaedigt-aufsichtsraete/25444190.html?ticket=ST-3314535-bRPYWfZU3AKUTFhp1QPw-ap1

[14] RND 10.01.2020. Siemens: Luisa Neubauer lehnt Aufsichtsratsmandat ab. https://www.rnd.de/politik/luisa-neubauer-lehnt-aufsichtsratsmandat-bei-siemens-ab-YIDV2OAZY5HADFGE3RTGTF64C4.html

[15] Reuters 12.01.2020. https://www.reuters.com/article/deutschland-siemens-adani-idDEKBN1ZC0CK

must be taken up and processed by companies. For that reason, politics or even society is asked to set a normative framework in which corporations can follow their business targets.[16]

3.4.3 Industry 5.0 and University 5.0

Scientific, social and industry-led paradigm shifts have triggered profound changes in mindsets, skills and capabilities over multiple generations both as a necessary consequence of difference and as an enabling condition for structural changes to take hold and scale, establishing a new set of norms and expectations. Work on industry 4.0 has increasingly highlighted the existence of skills gaps, the need for re-skilling and up-skilling across the board (European Commission 2022: 19). Strategic, systemic approaches to innovation should be deployed at the heart of Industry 5.0 to enable learning and to support deliberately adopted transformation of existing businesses, small and large, as well design of new industrial ecosystems and value chains, adopting principles of regeneration, circularity and resilience wherever possible. European research and innovation policy would need to change in turn, however, to encourage more flexible, genuinely experimental and risk-embracing approaches to innovation development and deployment in partnership with industry (European Commission 2022: 20). Industry 5.0 would present significant challenges and demand for new contemporary learning and education approaches that can scale and meet the needs of new entrants and re-skilling of the incumbent workforce; as well as a rapid reset of curricula and core tenets of business and economics for new generations of students.

Carayannis and Morawska-Jancelewicz (2022: 14) point out „that universities should take strategic measures and build comprehensive programs and models of cooperation with society within the new growing challenge of digital and green transitions". As digital and green transitions are interlinked, they pose both a challenge and opportunity for universities – „universities need to move beyond the future" (ibd.: 14). The authors see universities as the core of innovation ecosystems, „orchestrating multi-actor innovation networks in a non-linear innovation process requires a systemic approach to innovation, that is challengedriven, collaborative and interdisciplinary" (ibd.: 15). Third and fourth missions of universities (cf. Banholzer 2022b and 2020) should lead to a deeper cultural project of creating co-creation innovation spaces. Carayannis and Morawska-Jancelewicz (2022: 15) underline that the „fourth mission concept is particularly relevant as it emphasizes the universities roles in sustainable development".[17] The function and role of universities and the employees of universities in the (digital) social innovation process is threefold (Carayannis & Morawska-Jancelewicz 2022: 17):

- A university provides knowledge (existing or developed as part of the cooperation with the environment) which supports the creation of innovation.
- A university shares its tangible and intangible assets.
- A university supports (digital) social innovation development by advising social innovators and involving interested parties.

Universities should take the active role in creating and defining future visions and not only respond to them. Universities need to redefine their roles and the way they act. At this point, the approach of American pragmatism and one of its main representatives, John Dewey ([1927] 2016), should be

[16] One example of this was the call by German business and industry associations during the 2021 election campaign for binding regulation of environmental requirements. The demands were not directed substantively for or against measures, but exclusively with a view to setting generally binding regulations (Banholzer 2021b).
[17] See also Grau et al. 2017.

recalled. His democratic experimentalism (Antic 2017) calls for politics to be guided by science and for scientific findings to be made available to public discourse (through the media) (cf. Müller 2021: 128; Kloppenberg 2000: 69). This is relevant for the debates about the societal challenges facing pandemic or climate events and their political, journalistic and social accompaniment. In Dewey's approach, not only the natural sciences but also the social sciences take on a central role as agents of enlightenment. They reveal consequences of actions that cannot be assessed by individuals due to their complexity. According to Dewey, science and experts must be integrated into a "communicative feedback loop between laypeople and experts" (Selk & Jörke 2012: 264). According to Dewey, science cannot provide moral conditions for individual and social action, but only reasonable and rational patterns of judgment and reasoning (Kloppenberg 2000: 69). The key point in Dewey's philosophy is that all knowledge is uncertain, all claims to authority are suspect, and any claim to truth must undergo discourse by democratically constituted communities (Kloppenberg 2000: 54). Here, public spheres and thus media and journalism and journalism play a central role (cf. Parts to science communication in Banholzer 2021b and 2022a).[18]

3.4.4 Education and Engineering 5.0?

Since the concept of Industrie 4.0 was launched, there is also a discussion about qualification engineers require working within Industry 4.0-contexts. Future 4.0-employees will focus on creative, innovative and communicative activities rather than routine activities, as routine activities, including monitoring duties, will all be performed by machines as Nafea and Toplu (2020: 269) resume. Mahlmann Kipper et al. (2021) sum up requirements of Industry 4.0 for engineers. This research looking at literature up to publishing year 2018 showed that the main competencies needed include:

- skills as leadership, strategic vision of knowledge, self-organization, giving and receiving feedback, pro-activity, creativity, problem solving, interdisciplinarity, teamwork, collaborative work, initiative, communication, innovation, adaptability, flexibility and self-management;
- knowledge of contemporary fields like information and communication technology, algorithms, automation, software development and security, data analysis, general systems theory and sustainable development theory.

Looking at Industry 4.0 and the future engineers Nafea and Toplu (2020) see the need for a mix of technical, methodological, personal and social competencies:

- technical competencies like state-of-the-art knowledge, technical skills, process understanding, media skills, coding skills, understanding IT security, digital literacy, and
- methodological competencies as creativity, entrepreneurial thinking, problem solving, conflict solution, decision making, analytical skills, research skills, efficiency orientation, and
- social competencies like intercultural skills, language skills, communication skills, networking skills, teamwork skills, negotiation skills, ability to transfer knowledge, leadership skills, and

[18] A closer look at American Pragmatism and the role of journalism and science and science communication is given in Banholzer (in publication) „Repoliticization of Journalism – Roles and Tasks in an Agonal Democracy.
Perspectives on Journalistic Roles from a Poststructuralist Discourse and Hegemony Theory and American Pragmatism.“ M&K 1/2022, DOI: 10.5771/1615-634X-2022-1-1

- personal competencies as flexibility, ambiguity tolerance, motivation to learn, ability to work under pressure, sustainable mindset, compliance;

  and in addition

- network-competencies like interdisciplinary understanding of systems, production processes, information technologies, business processes, skills needed for cooperation and communication in interdisciplinary and intercultural groups,
- a value-oriented and ethical technology engineering (Longo, Padovano & Umbrello 2020: 1).

This looks like as if the requirements generated of Industry 4.0-contexts will also fit the requirements coming up with Industry 5.0, and also meet the new role of universities as described above. In 2018, the research institute ZEW launched a study and described requirements on education in times of Industrie 4.0 (cf. Arntz, Gregory & Zierahn 2018). But: Digitization is a process, and the question of the division of labor between humans and machines is far from being finally resolved. Automation and digitization simplify processes, but they also accelerate and change business models. Networking and acceleration inevitably increase complexity, which makes a vocational qualification at universities that is always oriented to the current demand and competitive situation as well as the respective innovation paths of the companies seem paradoxical. The ZEW sees a central condition for future-oriented labor market design: education and training must enable the mobility of skilled workers between occupations and sectors. This calls for universities to provide more training in basic skills and impart competencies to be able to build on specialized knowledge, pick up on new impulses and, when looking beyond the horizon, also recognize potentials and innovations (cf. Banholzer 2018). Looking at Industry 5.0 Chin (2021) argues that there will be needed other qualifications than in 4.0-contexts because contrary to the trends in Industry 4.0 toward technology, dehumanization, technological advancement and innovation best practices, Industry 5.0 will bend back toward serving humanity. From this point of view the fifth industrial revolution will shed greater light on the human intelligence and emotional intelligence, emotional recognition and expression and emotions direct cognition the author found to have a greater impact on the performance.

Considering the developments in society discussed above - beyond the development of technology - companies and employees alike are faced with the simultaneity of functional and fragmentary differentiation. The paradigms of a postmodern society call for creativity, flexibility, entrepreneurship and agility. As discussed, normative demands are added from the insights of crisis events such as the climate crisis, the Corona pandemic, or foreign policy dislocations. Companies face closer scrutiny and growing pressure to justify themselves in different communication arenas in the attention society. Transferring these contexts into a requirements profile for employees means that, in addition to the specializations, knowledge and skills of the job profiles due to functional differentiation and the framework conditions of digitization, it will also be necessary to be able to accommodate fragmentary differentiation, the more or less volatile network organization, cluster orientation, project nature and the experimental. This requires communication skills and team orientation. At the same time, the normative aspects also add the ability to place one's own person, one's own activity, one's own project and the company in a respective overall context, in normative specifications and cultural contexts. This sets the framework for school education, vocational training and universities. Germany in particular has deficits in this area, which were also clearly evident in the Corona pandemic. The education system still has too many elements of industrialization and

has not yet arrived in the context of the knowledge society and the requirements of a 5.0 society. A lack of digitization, a shortage of teachers, a poorly maintained infrastructure in some areas, and a lack of didactics in future-oriented subject areas are just a few key points that underscore the need to catch up. If the EU sets the priorities in the direction of a holistic Industry 5.0 concept, then the training systems must also be considered. To meet the qualifications and skills of Industry 4.0, Society 5.0 and Industry 5.0 educational systems have to evolve, and consider several promising trends. Education systems have to enable (Nafea & Toplu 2020; Carayannis & Morawska-Jancelewicz 2022; Banholzer 2022b):

- opportunities to learn at diverse times and places;
- personalized learning based on student's capabilities;
- the use of new learning devices, tools and resources;
- remote engineering labs;
- implementation of projectbased and problem-based learning approaches;
- use of experimental and collaborative learning;
- student involvement in curriculum design;
- increased mentoring approaches;
- social innovation development via third mission approaches;
- cluster centric and regional specific projects;
- learning factories and spaces for real experiments (to test results of technologies and social activities)
- an interdisciplinary and intercultural understanding of systems
- to develop the skills needed for cooperation and communication in heterogenous groups on complex challenges.

3.4.5 Ethical Technology Engineering 5.0, RRI and CTA

As argued above, the Fourth Industrial Revolution was characterized by a technocratic paradigm and also the discourses focussed on optimization and efficiency. Therefore, sociotechnical influence in industrial settings has been typically overlooked (Longo, Francesco & Umbrello 2020). Since Industry 5.0 can be described as a normative approach, innovations, research and development results must also be assessed from an ethical point of view. However, this is not limited to the evaluation of results, but also to the development phases. This means that ethical, technology-ethical and ethical technology assessment approaches must be integrated. In addition to classic TA, other disciplines are also involved in evaluating the effects of technologies. This also includes approaches such as social science-oriented Science and Technology Studies (STS) or Responsible Research and Innovation (RRI). Especially regarding Industry 5.0, these approaches are gaining in importance because the normative component is inherent in them. The discussions about responsible developments and innovations can be traced back to the beginning of the 2000s, even if the term RRI only appears around 2011 (cf. van de Poel et al. 2020). Whether RRI is based on CTA or emerged from it is irrelevant at this point. In any case, the proximity of these concepts is clearly recognizable (cf. Sand 2021), so that both of them can also be used for the implementation of Industry 5.0 concepts.

Kornelia Konrad (2021) emphasizes that CTA focuses on the processes of technology development and the social embedding of technologies and innovations. The central question is how these processes can be designed in such a way that the socially desired and hoped-for effects are achieved. The approach is based on the so-called Collingrigde- dilemma, which describes the fact that in early development phases there is a lot of leeway, but little knowledge about effects is available, in later phases there is a lot of knowledge and knowledge about path dependencies and effects that room

for maneuver is small or costly (Konrad 2021: 210). Politics and regulation are seen as actors among several actors in the pluralistic network. All actors are analyzed and integrated in their respective, legitimately individual position. The positions of the other network actors are not acknowledged or understood by everyone else. Despite the limited ability to forecast, co-evolutionary processes of technology genesis and its social implementation follow patterns that appear to be influenceable. RRI is about a transparent, interactive process in which social actors, together with actors in the innovation system, reflect on innovation processes and the products resulting from them with a view to their (ethical) acceptance, sustainability and social desirability to achieve a better to ensure that scientific and technological progress is embedded in society. [19] Through early participation and (interdisciplinary) cooperation between researchers, politicians, companies, civil society organizations and citizens, research and innovation should be aligned with the values of society.

The term RRI has become an increasingly important phrase within policy narratives, especially in the EU Horizont 2020 program. RRI seeks to align technological innovation with broader social values and supports institutional decisions making concerning the trajectories of research and innovation under conditions of uncertainty, ambiguity and ignorance (Forsberg et al. 2018). It is generally understood that RRI is an interactive process that engages social actors, researchers, and innovators who must be mutually responsive and work towards the ethical permissibility of the research and its products (Stahl et al. 2021). The RRI framework calls for contextually addressing not just research and innovation impact but also the background of research processes and specially the societal visions underlying it and even the norms, priorities and objectives that shape innovation agendas (ibd.). Sampath and Khargonekar (2018) claim that there is still a lack of awareness, ownership and responsivtivity from the technological community in the broaden set of socio-economic concerns surrounding artificial intelligence, automation and robotics. In their concept of SRA (Socially Responsible Automation) the authors address a human centric automation and refer to approaches that broadly emphasize the professional, social and economic wellbeing of humans in a world of ubiquitous automation. Wittrock et al. (2021: 7) operationalize RRI with five keys and four process dimensions.

RRI Keys	Dimension of RRI-processes
• Ethics; • Gender Equality and Diversity; • Open Access and Open Science; • Science Education, and • Societal/Public Engagement.	• Anticipation and Reflexivity; • Diversity and Inclusiveness; • Openness and Transparency, and; • Responsiveness and Adaptation.

Figure 7: Five Keys and four process dimensions of RRI. Source: Own figure with data from Wittrock et al. 2021: 7.

[19] René von Schomberg, niederländischer Agrarwissenschaftler, definiert RRI als “a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)” (von Schomberg 2013).

3.4.6 Artificial Intelligence and Digital Twins in Medicine as Examples for Ethics, CTA and RRI

A topic is now on the agenda which illustrates the needs for a discussion of ethics and the values societies want to be followed. Zhu et al. (2022) outline that during the last years, "AI continues demonstrating its positive impact on society while sometimes with ethically questionable consequences". As Hagendorff (2020) claims, the current AI boom is accompanied by constant calls for applied ethics. Therefore, a whole body of ethical guidelines has been developed recently collecting principles, which technology developers should adhere to as far as possible.[20] And Zhu et al. (2022: 15) assist that not doing AI responsibly „is starting to have devastating effect on humanity, not only on data protection, privacy, and bias but also on labor rights and climate justice". Hagendorff sums up (2020: 113) that AI ethics currently is failing in numerous instances because ethics lacks a reinforcement mechanism and deviations from the various codes of ethics have no consequences. Empirical experiments „show that reading ethics guidelines has no significant influence on the decision-making of software developers" and „in practice, AI ethics is often considered as extraneous, as surplus or some kind of ‚add-on' to technical concerns" (ibd.). To solve these problems the author suggests a transition „from a more deontologically oriented, action-restricting ethic based on universal abidance of principles and rules, to a situation-sensitive ethical approach based on virtues and personality dispositions, knowledge expansions, responsible autonomy and freedom of action" (ibd.: 114). This describes the principles of CTA and RRI as assisting processes in technology development, engineering and evaluation till example in reallabs.

That those questions and those challenges are quite timely and topical underlines a look at healthcare. AI systems are being more and more implemented in hospitals and health care in general. The technological possibilities of medical AI have spawned an important ethical debate that primarily focuses on technical features of medical AI and design requirements (Sand, Duran & Jongsma 2022). Central concerns in this debate are: How can these technologies be designed to protect privacy, to prevent bias and ensure fairness, to ensure explainability and to ensure accuracy of results? Solutions to these problems are often sought in the design and functioning of the AI system itself, as Hagendorff (2020) had described. Aside from concerns about their responsible design, „medical AI systems also raise questions regarding physicians' responsibilities once these technologies are being implemented and used" (Sand, Duran & Jongsma 2022: 162). The authors point at the question of how do physicians' responsibilities change with the implementation of medical AI, and which set of competencies do physicians have to learn to responsibly interact with medical AI? Another application of innovative technology in healthcare and medicine is simulation and the use of digital twins. As Braun (2021) points out, simulations are broadly used in medicine. An emerging development is the possibility of using simulations to obtain a more or less representative reproduction of organs or even entire persons, which are framed and discussed as 'digital twins'. Using simulations or digital twins, there are several questions with ethical implications. A central task, as Braun (2021: 399) highlights, is the challenge of the representation of a person by a simulation. „How can it be ensured that the person is represented in a way she decides and still has the opportunity to direct the representation in a way that serves her desires and enables her self-determination?" The given examples, both AI transforming job profiles and responsibilities and requirements on education of medics as well as digital twins as representations of patients underline that technology and innovations can not simply be seen as an improvement or incremental progress within technology but have to be evaluated by looking at consequences in jobs, job profiles, responsibilities and so on.

[20] In this cited paper (Hagendorff 2020) the author had analyzed 22 of the major AI ethics guidelines and issues recommendations on how to overcome the relative ineffectiveness of these guidelines.

3.4.7 Industry 5.0: Discussing Socio-Technical Futures

The success of innovation, transformation or technological change will depend less and less on technical brilliance, but more and more on economic criteria and increasingly on criteria that are sometimes referred to as 'soft', such as cultural fit, conformity with social values and lifestyles, and ethical responsibility, as Grunwald (2012a: 84) argues. As discussed above, expectations according AI or algorithms like ethical and responsible engineering depend on a discourse on desirability of development paths and expected results. Because technological consequences, as named in the Collingridge dilemma, can only be predicted at different points with greater or lesser uncertainties, they must be discussed as scenarios, forecasts or sociotechnical futures[21]. Konrad and Böhle (2019: 101) point out that sociotechnical futures are important elements in the governance of innovation processes - sociotechnical futures and widely debated technological promises, deeply rooted sociotechnical imaginaries, or carefully crafted scenarios. Sociotechnical futures as a concept refer to futures that couple techno-scientific potentials and prospects with envisioned societal change and new social arrangements (ibd.). Sociotechnical futures include not only the knowledge objects (like scenarios, roadmaps, imaginaries or narratives), but as well the practices and processes that contribute to the construction of sociotechnical futures and the ways they get a bearing on innovation and governance processes (ibd.).

Discourses are not a by-product that merely comment on technologies; rather, discourses shape a field of technology. As discussed above, sociotechnical futures also integrate projections or imaginings that address technical and social contexts, both implicitly and explicitly. These sociotechnical futures are generated and used by the different actors involved in the governance process. Following on from the study of actor constellations, the content and meaning of sociotechnical futures must also be analyzed. Sociotechnical futures, as a generic term for images of the future, visions of technology, scenarios or models, express the political and economic interests, wishes and fears of the respective producers and users. Konrad and Böhle (2019: 102) underline that promises and hypes of new technologies have been shown to mobilize researchers, industry actors, policymakers and media to move and invest into emerging technology fields, such as nanotechnology, graphene, synthetic biology or Industry 4.0 and to bring about alliances of the most diverse actors from different political and cultural backgrounds. Promises and hypes may also stir public debate on the desirability of what particular technologies might entail for society (ibd.). Thereby, it is also always about the conflict about who is enriched to be involved in the design of futures (Cf. Felt: 2010: 26). Sociotechnical futures are part of a narrative governance. Narratives serve to process the complexity of an innovation field, which is characterized by the multitude of actors involved (polycentricity) and their different and differently articulated interests (polyphony) (cf. Viehöver 2014: 124).

3.5 Industry 5.0-ready? The Policy oft he new German Government[22]

After the federal election in autumn 2021 Germany has got a coalition government made up of three partners, the results of which are less distant from one another than those of previous coalitions. The new coalition has described itself as a "progressive coalition" and, in the run-up to and in the coalition agreement itself, placed a focus on innovation, science, science transfer and research as the basis of the economy and the welfare of society (Banholzer 2022a). The newly founded

[21] Mager and Katzenbach (2020) explain that futures are of interest in every discipline of science. Narratives of the future and their relation to the present is a long-standing theme in the social sciences and humanities. In research that is concerned with the political quality of technology and imaginaries, the concept of "sociotechnical imaginaries" (Jasanoff and Kim 2015) has become one of the most prominent.

[22] For an analysys of the election campaign see Banholzer 2021c, fort he coalition agreement see Banholzer 2022a.

DATI agency as a central element of transfer-oriented R&I policy, which can also implement the social aspects of innovation as well as the requirements for transparency and participation, is also the appropriate framework for the concretization of the real-labs, experimental spaces and the program in the context of entrepreneurship. The comparative view of innovation leaders within and outside the EU can provide valuable impulses here. DATI is able to fill the vacant position of a transfer agency as well as advance the third mission of Universities of Applied Sciences and the connection to SMEs and the support of clusters and regions.

The new German Agency for Transfer and Innovation (DATI) defined in the coalition agreement combines the concepts of the coalition partners Bündnis 90/Die Grünen and FDP. Explicit reference is made here to both social and technical innovations, and the HAWs and smaller universities are named as cooperation partners for start-ups, SMEs and public organizations. These collaborations are to be strengthened as the core of regional and supraregional innovation ecosystems, as well as in application-oriented research. It is interesting to note that, despite the more comprehensive wording in the coalition agreement, the DATI agency is primarily perceived in the media as a technology agency. This is also the background to criticism from the higher education development community. With regard to the transfer university-society of social innovations, the CHE University Research Center calls for third-party funding, which should not automatically end with the publication of research results. Social innovations, such as new standards in care, new working time models, improved participation and transparency, concern as innovations behavioral changes of individuals, groups or entire organizations. However, the CHE cites studies showing that only about 15 percent of such social innovations come from universities. According to the CHE, funding ends too early for social innovations because such projects actually rely on repeated application (cf. Banholzer 2022a).

The agency for disruptive innovations Sprin-D will remain with a focus on key technologies. However, the promised reforms are central to its continued impact. Above all, the dual responsibility of two ministries - the BMWi and BMBF - must be eliminated. This was already the case in the 19th legislative period, when the agency was founded, this led to a loss of efficiency - even though both houses were under both the houses were under CDU leadership. Now, the FDP is responsible for the BMBF and Bündnis 90/Die Grünen are responsible for the BMWi. The latter has also claimed responsibility for the start-up sector. The "Reallabore" (real laboratories) addressed in the coalition agreement need to be defined in more detail, to be able to be more precisely located in the scheme outlined above. Depending on their conception, they can become the operational form of holistic approaches in cooperation with DATI.

4 Summary: Industry 5.0 as a Holistic Approach with Some Blanks

Industry 5.0 has been described as a holistic approach to implement mission-oriented policies that aim to align the EU but also societies outside the EU to achieve goals. These include achieving the climate targets under the Paris Agreement, achieving resilience to disruptions from the environment or the global economy, and the goals of the SDGs. The concept has been implemented by the European Commission, so it must be seen as an executive approach. With the Industrie 5.0 approach, however, Industrie 4.0 is not continued in a linear fashion, but integrates Industrie 4.0 technologies with the re-orientation towards people, as envisaged by the Society 5.0 concept.

4.1 Industry 5.0 as a normative framework

Carayannis and Morawska-Jancelewicz (2022) pointed out that concepts of Society 5.0 and Industry 5.0 are „not a simple chronological continuation or an alternative to Industry 4.0 paradigm“. Within the vision of a competitive sustainability European Commission sees industry as protagonist and a driving force for systemic transformation and planetary regeneration. In contrast to Industry 4.0 concept which focusses on technology and business Industry 5.0 integrates normative aspects of mission-oriented policy approaches. This can be seen as filling the normative gap in technological government approaches (August 2021b; Banholzer 2022a). Industry 5.0 can be seen as a concept that realizes to balance techno-centric and human-centric approaches. This balance needs as well new instruments in government as in knowledge creation.

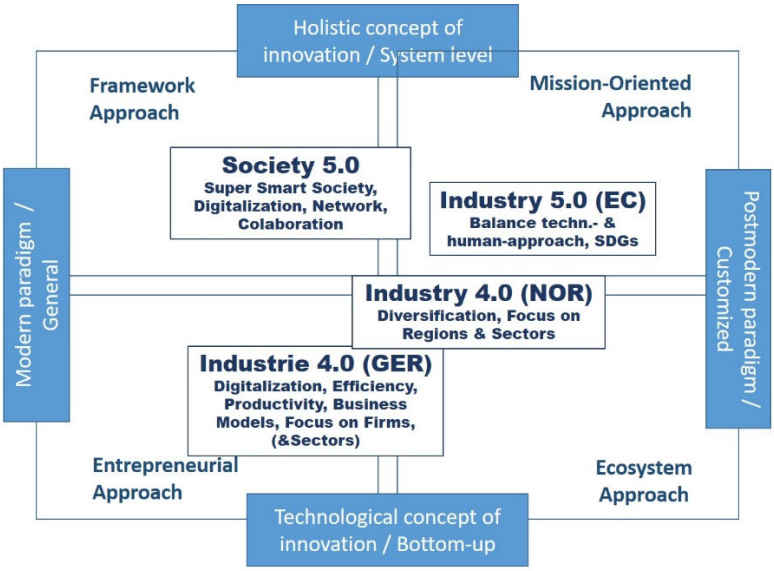

Figure 8: Positions of Industrie 4.0, Industry 4.0, Society 5.0 and Industry 5.0 as holistic and postmodern. The German Industrie 4.0 is a more technological oriented approach but realizing that its implementation has significant effects on society, law and business models. As discussed the adoption of Industrie 4.0 for example as Industry 4.0 in Norway (cf. Banholzer 2021a) shows differences in implementation depending on cultural contexts, Society 5.0 as a human-centered approach hast o be analyzed as a holistic approach but mainly focussing on social contexts. Finally Industry 5.0 in the sens of the European Commission (2021 and 2022) has to be described as a postmodern and more holistic approach which is able to balance human- and technology-centristic ideas. Source: Own figure.

The European concepts of „Green Deal“ or „Industry 5.0“ can be seen as an answer to the question what normative basis could be found for the governance of network-society. Therefore Industry 5.0 can be located in the segment oft he ideal type of mission-oriented approaches. Industry 5.0 adresses the changelles of a functional and fragmental differentiated society. Flexibility, agility, project-orientation, entrepreneurship are part of the concept. Industry 5.0 focuses on social heterogeneity in terms of values and acceptance, measurement of environmental and social value generation, partizipation and transparancy of customers or interest groups and NGOs, interdisciplinarity of research disciplines and system complexity, and ecosystem-oriented innovation policy with outcome-orientation. But: Industry 5.0 requires also new policies and policy instruments, a Governance 5.0, new partnerships, and new objectives for policies affecting industry, knowledge-society and economy. Additionaly a portfolio approach to research and innovation projects is needed, combined with the willingness and a mandate to take informed risks – in development paths and financing.

4.2 Industry 5.0 as a concept for Innovation sovereignty?

Both the individual member states and the European Union are feeling pressure to act, on the one hand to make up for or compensate for the unevenly distributed but nevertheless significant deficits of recent years - in digital infrastructure, digital business models, digital administrative processes, digital healthcare, data security and data analysis. And on the other hand, after innovations, whether of a technical or societal nature, have been identified as indispensable tools for dealing with the climate crisis as well as for disaster prevention and protection, they must also be implemented quickly.

The change from an innovation state concept with a focus on technology and technology sovereignty to a policy of an innovation society, oriented towards innovation sovereignty, is necessary in order to be able to meet the challenges of the current paradigm shift with the simultaneity of a socio-cenomic, socio-cultural and democracy-practical crisis. The understanding of future-oriented policy in general and of innovation systems in particular needs to be broadened in view of the challenges already described in order to also be able to integrate societal objectives, visions of the future and values, i.e. to take mission orientation into account as an instrument. Mission-oriented policy is the concept that, for example, commits innovations to solving the Grand Challenges. The German government's high-tech strategies and the EU's Horizon programs take up the approach of mission-oriented innovation policy. Thus, the contribution of an innovation to solving a problem moves to the center and the previously central aspect of novelty recedes. In addition, aspects of transparency and participation are given greater weight.

This is accompanied by an increase in the number of instruments and an expansion of innovation policy in a horizontal direction, which in turn requires intensive policy coordination between the numerous departments and policy levels involved. As stated several times, this requires a holistic approach to innovation and innovation orientation that formulates goals for both a state and a supranational organization such as the EU in terms of mission orientation (problem solving) on the one hand, and on the other hand creates the foundations for innovation sovereignty in order to be able to achieve and secure these goals in a volatile and dynamic environment. As stated in Banholzer (2021b and 2022a), following Edler et al. (2020), innovation sovereignty is defined thus:

> Innovation sovereignty is to be understood as a state or supranational organization like the EU shaping the basis for innovation and progress in such a way that it contributes to the preservation and further development of its sovereign tasks, the fulfillment of societal needs, and the establishment and safeguarding of economic competitiveness. This includes

not only the analysis of (future) technologies but also the cultural contexts and societal values as well as the formal and informal institutions in education, media or civil society.

Thus, the approach of innovation sovereignty goes beyond the institution-oriented concept of the innovation state, which includes measures and policies of governments that improve the conditions for the creation of innovations as well as takes formal institutions into account (Prange 2006: 216), but focuses primarily on competition in markets and also takes informal institutions less into account (cf. ibid.: 217). The current discussion of innovation ecosystems also lacks a view of intrasocietal competition, i.e., competitors and supporters, as well as artifacts, i.e., products, technologies, and services (Granstrand & Holgersson 2020: 3). This must not only include the actors at the core of the innovation competition, but also address the impact on society and the environment. After all, resources claimed by innovators are also relevant for other societal actors, who may then have to do without them and suffer disadvantages in their field of action as a result. And: Innovations have intended and unintended effects on other areas, such as jurisdiction, economy, ecology, etc., which have been given too little consideration in previous approaches (cf. Nordfors 2008).

4.3 Industry 5.0: Inherently Political but without a Concept of Public Sphere

Industry 5.0 as a value-based conception of society and mission-oriented policy design implicitly presupposes the discourse on values - on the desirability or undesirability of technological effects and the discussion of risks, opportunities and society's willingness to avoid the one and strive for the other - and on the willingness to bear the costs that arise. However, this is done without outlining a conception of the public sphere, political discourse, or deliberative, agonal, or pragmatist debate in plu-ralist democracies (cf. Banholzer 2022c), or referring to any relevant conception. Implicit or explicit, socio-technical futures are inherently political (Konrad and Böhle 2019: 102).

Technical development is always related to social development and is thus also connected with the allocation and control of power and can either act as "enabling structures" for population groups or confront them with new "constraints" (Mayntz 2001). This inevitably leads to controversies and conflictual discourses that need to be moderated. To this end, new intermediaries are also required in the policy field of R&I, which take account of the changed framework conditions and also question previous approaches to handling and solving problems. However, one central element of innovation systems does not yet seem to be anchored in the current discourse: The importance of intermediaries of innovation communication. Communication is central for the exchange within as well as with the environment, and for the fulfillment of transparency and participation expectations. The conceptions of innovation agencies or the improvement of technology assessment lack an elaboration of these components. Innovation ecosystems are elementary dependent on these services of intermediaries (organizational communication and journalism). Here, R&I policy has a deficit that needs to be addressed.

Mission-oriented R&I policy, which must also react agilely to changing issue situations, is confronted with the issue of ambidexterity, which can be countered by vision-oriented communication (Banholzer & Siebert 2021). In addition, the character of the political of innovation (Banholzer 2021b and 2022c) must be worked out and this must be considered through communication offers. In this sense, innovation policy is to be understood as a "policy of the innovation society" (Kauhanen & Noppari 2007: 9) and as such must also be represented in social discourse. This is particularly relevant because "the expansion of knowledge sources and application references necessarily implies the participation of a growing number of heterogeneous actors from different domains in innovation processes" (Botthof 2020: 3). In addition to experts from science from an increasing num-

ber of disciplines, representatives of (international) companies or start-ups and research policy actors will also be involved. Increasingly, however, consultants and intermediaries from associations and regional, municipal institutions, symbol analysts (cf. Koppetsch 2011), and representatives of civil society will also be present in the discourse. According to Botthof et al. (2020: 3), "this expansion of the circle of actors (...) can already be observed in Germany," but the process is still in its early stages.

5 Critics and Further Research – Industry 5.0 and the Consequences of the Normative Turn

The development and discussion of Industry 5.0 mark a "normative turn" in technology, innovation and economic policy. However, it should initially be seen as a top-down impetus by the Executive, which in the further course will require acceptance in the societies of the EU member states as well as national parliaments and the European Parliament in order to be successful. As explained at the outset, Industry 5.0 can close the normative gap that technological policy approaches inevitably offer.

The characteristic of a top-down-concept is the core point that leads to a very critical aspect. As argued above, Industry 5.0 as a value-based conception of society and mission-oriented policy design implicitly presupposes the discourse on values and on the willingness to bear the costs that arise. But this is done without **outlining a conception of the public sphere**, political discourse, or deliberative, agonal, or pragmatist debate in pluralistic democracies (cf. Banholzer 2022c). This circumstance is certainly due to the construction of the European Union and the fact that the concept was elaborated and introduced by the European Commission - i.e. it represents a concept of the executive. This again shows the democratic deficit of the European Union, which shows parliamentary representation as not yet fully developed. However, if transparency and participation are demanded in transformation processes and, in addition, the state and politics act as equal network actors on the one hand, while decisively defining the legal framework on the other, this creates a disproportion that has a counterproductive effect on the acceptance of mission orientation.

However, recourse to the norms and values of modernity offers the opportunity to adequately meet the demands on "the state" and "politics" that have once again become apparent in the pandemic. This **requires research in several areas**, which will be addressed here eclectically and briefly:

- The question of the respective roles of individual, organized, political, corporate actors in society. The debates about the common good and the understanding of corporate citizenship and the respective cultural frameworks (see below).
- The issue of technology assessment and the strengthening of parliaments in impact and risk assessment vis-à-vis the executives in the member states and at the EU level (see below)
- The importance of intermediaries, which include journalism, reallabs, innovation agencies, and actors as "policy brokers."
- The importance of the concept of the knowledge society, which must reflect the contributions of the social sciences and humanities in addition to those of the natural sciences and make them useful for policy.
- The question of the forecasting ability of societies with forsights, scenario techniques and the associated ability to discuss socio-technical futures, which both intermediaries and institutions of technology assessment must deal with.

The Common Good and the Understanding of Corporate Citizenship[23]: The recourse to norms and values of modernity in order to be able to fill normative gaps in technological policy concepts inevitably entails a debate about the relationship between the catagories of common good and integration of all actors in social contexts. Here, internationally operating companies and their understanding of corporate citizenship also come into focus. What is lacking here are international and intercultural comparative studies that examine the tensions between society and companies, organizations and institutions as a common good. The European Commission had discussed a new

[23] The EUKO research network is currently setting up an interdisciplinary and international research project in this context. http://www.wirtschaftskommunikation.net/

European company model in connection with Industry 5.0. This reciprocal relationship between business and society, which is reflected in the debates about content and impact on the common good, will gain in importance.

Cross Europoean TA and TA of the European Parliament: Technology assessment is an essential tool for democracies to weigh up alternative development paths, ethical implications and the assessment of possible opportunities and risks. Technology assessment has its origins in the growing demand in democracies for knowledge about the consequences of technology. Growing complexity of decision-making backgrounds as well as effects of decisions generally is still leading to an increasing need for scientific advice in parliaments. Critically, the executive, with its apparatus and financial resources, was seen to have easy access to science, non-university research centers as well as think tanks. To bring the parliament, the legislature, back on an equal footing, offices of TA at parliaments are important. But: As Peissl and Barland (2015: 73) resume „having an impact on decision-making and knowledge production in Europe should be the goal of European TA organizations". This demands more activity by PTA at every parliament and a strong presence in the European arena and at the European Parliament. The Panel for the Future of Science and Technology (STOA)[24] at the European Parliament and the network of European Parliamentary Technology Assessment (EPTA)[25] have to be more in focus. During the 2021 German election campaign, FDP politicians called for a reform of parliamentary technology assessment at the German Bundestag. The criticism was that technology assessment in the Bundestag no longer managed to initiate acute discourses and report on future topics with technically sound information at sufficient speed. The FDP's proposal for improvement is aimed at strengthening TAB's service function for parliament. TAB should act less than a scientific institute with its own scientific publications, but rather select and aggregate scientific research and findings on technological developments and incorporate them quickly and precisely into parliamentary processes (cf. Banholzer 2021b). Technology assessment and ethical considerations will gain in importance, especially regarding an Industry 5.0 concept. In the sense of a transparent and participatory technology assessment, both the TA competence of the EU Parliament and the national institutions of the PTA, as well as their network, must be strengthened. This is a long-term task considering the heterogeneous situation in Europe, but it will become a central element considering the "normative turn" in connection with Industry 5.0, the "Green Deal" and the SDGs.

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[24] https://www.europarl.europa.eu/stoa/en/home/highlights

[25] https://www.eptanetwork.org/

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