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MEGATRENDS AND THE TRANSFORMATION OF POLICY-MAKING: TOWARDS THE POLICY 4.0 PARADIGM

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Purpose: The aim of this article is to examine whether contemporary global megatrends act as drivers of deeper transformations in public policy theory and practice, leading to the emergence of Policy 4.0 as a new policy-making paradigm. The study considers these changes from the perspective of organizational change and change management in public governance. It addresses two questions: whether megatrends stimulate fundamental transformations in policy-making processes, and what distinctive features Policy 4.0 may develop in response to these trends.

Methodology and approach: The paper adopts a conceptual and analytical approach, based on a qualitative analysis of global megatrends and a literature review in public policy, governance, and management. Using deductive reasoning, it explores how megatrends may influence transformations in policy-making theory and practice and contribute to the emergence of Policy 4.0.

Findings: Technological, economic, environmental, social, and political megatrends influence the evolution of public policy-making and may lead to the emergence of Policy 4.0. Future public policies are likely to become more holistic, transnational, inclusive, and increasingly based on digitalisation, automation, and evidence-based governance, while also placing greater emphasis on environmental sustainability and security. The study highlights key dilemmas of Policy 4.0, concerning the democratic character of policy-making in the digital age and the inclusiveness of actors in globalised and complex policy environment.

Practical implications: Public organizations and enterprises must adopt adaptive governance, change management, and organizational flexibility to respond effectively to complex, fast-changing environments. Policies and strategies should integrate digital technologies, cross-sector collaboration, and sustainability considerations.

Social implications: The analysis highlights the growing role of technology, data, and automation in policy-making, encouraging engagement with digital governance and demand for transparency. It also emphasizes implications for corporate social responsibility, environmental policy, resource efficiency, public–private collaboration and democracy.

Originality/value: The paper shows how megatrends transform public policy, governance, and organizational practices, leading to the emergence of Policy 4.0 as a new paradigm. It is addressed to scholars, policymakers, and practitioners interested in policy innovation, governance transformation, and strategic responses to global megatrends.

Keywords: change management, governance transformation, megatrends, organizational change, public management.

Category of the paper: Conceptual paper, Viewpoint.

1. Introduction

Contemporary global trends, also known as megatrends, affect every aspect of state, economy and society. The term was introduced by J. Naisbitt (1982) who first defined it as socio-economic or structural processes that take shape slowly, but, once they occur, they affect all areas of life over a period of time. Several years later, Naisbitt further clarified them as "large social, economic, political, and technological changes [that are] slow to form, and once in place, influence us for some time – between seven or ten years, or longer" (1990). What distinguishes megatrends from ordinary trends and fashions is that they are more significant, last longer, and cause more profound effects (Mittelstaedt et al., 2014). They are also conceived as complex macro-scale phenomena, driving change that is broad, global and supra-regional in scope and occurs in a variety of areas.

The literature recognises a significant number of trends that are designated as megatrends. These include long-observed worldwide processes with various origins, dynamics, and variability in the fields of technology, the economy, the environment, society, and politics, as well as those induced by the recent Covid-19 pandemic.

Many of today's megatrends can be traced back to technological change occurring as part of the Fourth Industrial Revolution (4IR), which originated from the idea of Industry 4.0. The German term *Industrie 4.0* was first used at the Hanover Fair in 2011 (Drath, Horch, 2014) and in 2013 it was operationalised by a working group of the German National Academy of Science and Engineering (2013). The aim of *Industrie 4.0* is to generate greater productivity through resource efficiency and investments in people and technology (Buhr, 2015).

The Fourth Industrial Revolution (4IR) has become a focal point for analysis within scientific, economic, and public discourse, evidenced by an increase in related scientific publications and public programs evaluating its impacts. The designation 4.0 is used to describe various sectors affected by 4IR, e.g. Economy 4.0 for economic changes, Commerce 4.0 for trade, Finance 4.0 for financial services, and likewise for sectors like Service, Energy, Transportation, Agriculture, Telecommunications, Work, Skills, Education, Health, Science, and Social Policy. Furthermore, societal ageing and online security are captured in Ageing 4.0 and Cybersecurity 4.0, respectively, while Corporate Culture 4.0 reflects organisational changes. The public sector has also integrated the 4.0 designation through terms such as Government 4.0.

Despite the broad implications of 4IR, research on its influence on policymaking remains limited, highlighting a gap in understanding how contemporary megatrends may shape public policies and the advancement of policy sciences in the future.

The aim of the article is to answer two fundamental questions:

1. Do contemporary megatrends provide the impetus for deeper changes in policy-making theory and practice and the consequent emergence of Policy 4.0 as a new policy-making paradigm?
2. What distinctive features will Policy 4.0 have in response to the trends set by contemporary megatrends?

The author contends that contemporary megatrends of a technological, economic, environmental, social, and political nature redefine the rules of public policy-making, creating demand for new theories and leading to the emergence of Policy 4.0 as a new paradigm.

2. Determinants of Policy 4.0

The discussion below is based on the assumption that Policy 4.0 results from the interaction of three groups of factors:

1. The principles of policy sciences and public policy theory.
2. Public policy implementation practices.
3. Contemporary megatrends.

2.1. The principles of policy sciences and public policy theory

Policy 4.0 is unlikely to challenge the traditional assumptions of policy sciences or most existing theoretical concepts of public policy. The conceptual framework for policy sciences was established by H.D. Lasswell in his 1951 essay *The Policy Orientation of Political Science*, in which he provided a comprehensive account of its aims, methods, and tools (Lasswell, 1951). He derived the concept of public policy from an underlying understanding of politics, which he defined as "the most important choices made either in organised or in private life" (Lasswell, 1951). Later, T. Dye framed public policy as "anything a government chooses to do or not to do" (1987), whereas J. Anderson construed it as a "relatively stable purposive course of action or inaction followed by an actor or a set of actors in dealing with a problem or matter of concern" (2011).

H.D. Lasswell (1951) defined the expectations of policy sciences, which included making public-sector decisions as transparent and fully informed as feasible. He also mentioned evaluating the impact of the policies chosen for execution as one of the aims of public policy studies. In his opinion, policy sciences should combine theoretical knowledge in social sciences, the practice of governance, and the world of politics. In his view, public policy sciences should be characterised by:

- problem-orientation – a focus on the most relevant issues to be dealt with by public authorities,
- multidisciplinarity – drawing on all possible scientific disciplines whose methodologies and achievements can contribute to solving the key problems,
- methodological specificity – the individualisation of research methods in order to match them as closely as possible with the problems at hand,
- theoretical specificity – attempts to understand interconnected social, political, and economic systems in as much depth as possible,
- value orientation – maximising democratic values (Lasswell, 1951).

Theoretical concepts of public policy comprise a large and diverse collection of achievements in policy sciences or adapted to their needs. They are either descriptive, i.e. they assist in understanding certain public policy phenomena (explanatory concepts) or prescriptive, i.e. they recommend specific actions under given circumstances (normative concepts). Policy sciences identify a range of fields and their associated research questions (Smith, Larimer, 2009), such as public policy vs. politics (e.g. does politics determine public policy or vice-versa?), processes (e.g. how are public policy alternatives formulated?), analyses (e.g. what alternatives may contribute to solving a specific problem?), evaluations (e.g. what is the impact of implemented public policy?), models (e.g. whose values does public policy represent?), decision-makers and institutions (e.g. who makes public policy decisions?), and implementation research (e.g. why does public policy succeed or fail?).

Despite the fact that policy sciences have been around for several decades, their theoretical underpinnings and study domains remain relevant due to their universality. Therefore, it seems reasonable to expect that their objectives, areas of study, and some of their theoretical concepts will be suitable for examining the core ideas of Policy 4.0.

2.2. Public policy implementation practices

The concept of Policy 4.0 should also take into account some of the practical policy-making achievements. Policy implementation is not a static process; it embodies evolving knowledge, skills, and institutional memory that develop through continuous learning, experience, and iterative practice. Over time, public organizations refine their approaches by drawing on past successes and failures, adapting to changing conditions, and integrating new tools and technologies.

In this context, the aggregated knowledge base of policymakers, administrators, and institutions becomes a critical driver of Policy 4.0. It enables more adaptive, evidence-informed, and responsive policy processes, reinforcing the transition toward more complex and integrated governance models. Thus, Policy 4.0 is not only shaped by policy theory and megatrends but also emerges from the cumulative learning embedded in policy implementation practices, which strengthens its conceptual and practical foundations. Due to the fact that public

policy implementation practices are the subject of numerous scientific publications, their in-depth analysis falls outside the purview of this article.

2.3. Contemporary megatrends

The most commonly identified modern megatrends are traditionally classified into technological, economic, environmental, social, and political ones.

Technological megatrends

Technological megatrends are usually referred to by the term Fourth Industrial Revolution (4IR), which affects every aspect of state, economy, and society as the boundaries between the public, private, and non-profit sectors become increasingly blurred. The search for innovative ways to increase efficiency by public authorities leads to the growth of a mixed economy involving public, private, and non-profit public service providers, as well as increased participation of private and non-profit actors in addressing problems traditionally thought to fall under the purview of public policy (Barber, Levy, Mendonca, 2007).

A key driver of the policy-making transformation is the dynamic technological development taking place within the 4IR (PwC, 2016). This revolution stimulates the advances of science and technology, in which the Internet of Things (IoT) and its supporting technologies serve as backbones for a range of Cyber-Physical Systems (CPSs), and smart machines are used to optimise production chains (Liao et al., 2018). CPSs, which combine computer systems, software and humans in work processes (Baldassari, Roux 2017), have become the mainstay of the revolution (Liao et al., 2017). Self-learning robots, preventive maintenance technologies, self-reconfiguring machines or intelligent environmental technologies (Brekelmans, 2016) are just a few examples of these integrated systems.

Among the key technologies disseminated as part of the 4IR, two are close to achieving breakthrough status: the blockchain technology & artificial intelligence (Girasa, 2020). Both have the potential to significantly affect both our behaviour and daily lives. The technologies that characterise the 4IR also include: automated manufacturing and service processes, self-learning machines, sensors that collect a variety of information and data linked to supercomputers that process them, and the universally accessible internet. The 4IR manifests itself in the physical (autonomous vehicles, 3D printing, new materials, advanced robots), digital (Internet of Things, cyber-physical systems), and biological (genetic engineering and sequencing, synthetic biology and genome editing) spaces (Kuruczleki et al., 2016; Buhr, 2015). Such advancements transcend organisational and territorial boundaries, comprising agility, intelligence, and networking (Liao et al., 2018).

The 4IR is an era of learning, gaining and integrating knowledge (Puncreobutr, 2017). It provides strong incentives for the convergence of research disciplines, sciences and technologies, systems, information and communications technologies, production technologies or manufacturing systems (OECD 2017). This convergence is advancing particularly rapidly at

the nanoscale level in material sciences, condensed matter physics, and biology (Roco, Bainbridge, 2002). The interactions among key technologies such as nanotechnology, biotechnology, advanced materials and ICT has led to device-level integration with technologies combined in ways that offer new functions and applications (EC, 2015a). The convergence of information and communication technologies enables the networking and integration of numerous components of industrial and infrastructure systems (energy, transport, power, and factory and production networks) (OECD, 2017).

Future public policies will need to consider the technological, legal-ethical, and political consequences of the Internet of Things and its evolution into the Internet of Bodies. The latter involves the creation of networks of human bodies whose integrity and functionality will rely, at least in part, on the Internet and related technical solutions such as artificial intelligence (Matwyshyn, 2019).

The technological revolution is, moreover, an era of creativity and innovation (Puncreobutr, 2017), which is triggering profound changes in the work environment as a result of digitisation and automation (PTPS, 2021). These have been accelerated by the rise of remote working amid lockdowns and employer decisions in response to the Covid-19 pandemic as well as the spread of flexible employment (Gupta, 2020; Leonardi, 2021; Linthorst, de Waal, 2020).

On the other hand, the negative consequences of the 4IR include an increased threat of advanced technologies being used as weapons by states, terrorists, and hackers (Tan, Shang-su, 2017; Żuk, Żuk, 2016).

Economic megatrends

Economic megatrends are a consequence of both contemporary technological change and historical processes taking place in the global economy. Economists emphasise that the key distinctive feature of these processes is the shift of forces in the global economy (Linthorst, de Waal, 2020; PwC, 2016). The Western world is losing its hegemony, even as a new international order is being created around the so-called BRICs, comprising Brazil, Russia, India and China, or Asia conceived in broader geographic terms (Cox, 2012; Schwarzer, 2017; Khanna, 2019).

At the same time, the global economy is becoming more and more interconnected, as manifested by the growth of international trade and capital flows. Economic systems are becoming increasingly complex and unpredictable, leading to increased fragility in the economy and volatility across business ecosystems. The globalisation of value chains, accelerated production lifecycles, digitalisation and changing consumer habits are impacting manufacturing systems, constantly redefining the sources of competitiveness (Dickens, Kelly, Williams, 2013; UNIDO, 2013). The corporate sector is striving to respond by emphasising high value-added services, user participation, sustainability, and responsible innovation (OECD, 2017).

The prospect of increases in public debt has a significant impact on the uncertainty surrounding future government policies. It was already recognised in the middle of the second decade of the 21st century, when it was expected to become a major constraint on fiscal and policy options before 2030 and beyond (KPMG, 2016). This trend was exacerbated by the Covid-19 pandemic, which resulted in the highest levels of budget deficits as a share of GDP in EU Member States since the beginning of the millennium. According to Eurostat (2021), after reaching –6% of GDP in 2009 and 2010, the deficit-to-GDP ratio decreased to –0.4% in 2018 and –0.6% in 2019. Then, in 2020, the ratio rose sharply to –6.8%, mainly due to the effects of the Covid-19 pandemic. In 2021, the largest government debt ratios were observed in Greece (193.3%), Italy (150.8%), and Portugal (127.4%), whereas the lowest in Estonia (18.1%), Luxembourg (24.4%), and Bulgaria (25.1%).

Evolving cryptocurrencies compete with state-issued currencies (Şen, 2019), while the popularity of cashless payments reduces cash circulation. The growing demand for energy (PTPS, 2021) has economic, environmental, social and political implications.

Environmental megatrends

In this area, two megatrends are considered crucial. The first one is climate change (PwC, 2016) caused by increasing greenhouse gas emissions, which leads to unpredictable environmental changes and undermines the resilience of natural and artificial systems.

The other prominent trend in the near future will reflect the rising demand for natural resources (PwC, 2016), driven by population growth, economic growth, and climate change. The highest upward pressure on consumption affects such basic natural resources as water, food, agricultural land, minerals, and energy (Pieregud, 2015). The dramatic increase in global consumption over the past century, which has affected the demand for and use of natural resources, is considered a key reason behind their scarcity (Retief et al., 2016).

Environmental megatrends also include pollution, anthropogenic environmental decline, and biodiversity loss (PTPS, 2021; Z-Punkt, 2021).

Social megatrends

Demographic change is at the forefront of societal megatrends. Its main manifestation is the growth of the world's population (UNDESA, 2019; PTPS, 2021) as a result of increasing life expectancy and high birth rates in Africa and other developing countries. The global population is projected to increase to 9.7 billion by 2050, according to the 2021 edition of the World Population Data Sheet (2021). This represents a nearly 24% increase over 2020, although it is lower than was expected in 2020 (PRB, 2021). The global total fertility rate is 2.3, which is above replacement-level (2.1 births per woman), but lower than it was in 1990 (3.2). Global life expectancy is 75 years for women and 71 years for men (PRB, 2021).

At the same time, the ageing of populations in developed countries is progressing (PTPS, 2021). The number of older people worldwide is projected to grow from 901 million in 2015 to 1.4 billion in 2030 and to 2.1 billion in 2050 (UNDESA, 2015). The latter trend is already undermining the viability of welfare systems, including pensions and health care. Some countries also face the challenge of integrating large youth populations into saturated labour markets (KPMG, 2016).

Recent research suggests that the COVID-19 pandemic may affect some demographic trends. According to emerging evidence, densely populated areas are more likely to experience an early outbreak of COVID-19, though not necessarily a severe one; moreover, the coronavirus does not impact all population groups equally. Higher risk factors include older age, certain ethnicities, male gender, underlying health conditions, socioeconomic marginalisation, and specific occupations (Wahba et al., 2021).

Increasing migration will be a key factor in future public policies (UNDESA, 2019; PTPS, 2021; Wahba et al., 2021). The existing large flows of people will accelerate as shifts in both skilled and unskilled labour pose new challenges for both source and target countries (Linthorst, de Waal 2020). Migration patterns and demographic transitions will result in even more significant changes in labour composition (Rudolph et al., 2018).

The primary consequence of technological development and migration processes is growing inequality and social polarisation (PTPS, 2021). Particularly at risk are low-skilled individuals, whose jobs may disappear due to automation, as well as the self-employed and those with a migrant background (Rubery et al., 2018).

An important determinant of Policy 4.0 will be accelerating urbanisation (UNDESA, 2019; PwC, 2016; PTPS, 2021). It is estimated that currently, 180,000 people move to cities every day (Poblocki, 2017). In 2050, urban populations will have grown by 59% and will account for nearly 70% of the world's population. By that year, they will reach nearly 6.7 billion people, compared with 4.2 billion in 2020. By 2030, the world will have 43 megacities compared with 31 in 2020. Their populations will exceed 10 million each. Most of these megacities will be located in developing countries, with 22 in Asia (mostly in India and China). Africa will be home to six megacities of more than 10 million people by 2050 (Rabier, Djoufelkit, 2021).

Their ramifications for future public policies will include lifestyle diversification and the rise of individualism (KPMG, 2016). The latter is defined as the desire to distinguish oneself from others as a result of the transition from a collectivist to an individual-centred society, as well as the growing expectation of instant availability of goods and services (Linthorst, de Waal, 2020). On the other hand, diminishing food security will threaten the livelihoods of societies (PTPS, 2021).

Political megatrends

The boundaries separating the public, private, and non-profit sectors are becoming increasingly blurred. The search by public authorities for innovative ways to increase efficiency leads to the growth of a mixed economy involving public, private, and non-profit providers of public services, while promoting the participation of the latter two in addressing issues traditionally considered to be within the domain of public policy (Barber, Levy, Mendonca, 2007).

It is also becoming clear that as the 4IR moves through its many stages, high-tech businesses will become more and more influential in social, political, and economic terms. Government influence as it has historically been understood is gradually being eclipsed by a small group of these enterprises (Tan, Shang-su, 2017).

The complexity of problems facing states contributes to the tendency for national governments to engage in international, regional and judicial fora to resolve them (KPMG, 2016). Shifts in international balance and rising global tensions (PTPS, 2021) give rise to a new political (dis)order (Z-Punkt, 2021), democracy crises, and the emergence of new governance models. The consolidation of the European power centre occurs at the expense of diminishing sovereignty of the EU Member States, as aptly captured by the phrase "from Nation-States to Member States" (Bickerton, 2015).

3. Conceptualisation of Policy 4.0 Paradigm

In his discussion of the origins and essence of Policy 4.0, the author adopted the following conceptualisation (Figure 1), according to which Policy 4.0 results from the interaction of three types of factors:

1. The principles of policy sciences and public policy theories (policy-making continuity factors).
2. Public policy implementation practices (policy-making continuity factors).
3. Contemporary megatrends (policy-making transformation factors).

In the author's approach, the principles of policy sciences and public policy theories, and public policy implementation practices are seen as continuity factors, i.e. they also contribute, albeit to a limited extent, to the idea of Policy 4.0. After all, the concept itself cannot emerge in opposition to all the scientific achievements of policy sciences or the practical experience of policy-making.

Contemporary megatrends comprise the most significant transformations and processes that are global in scope and critical to the future of the world. In the author's view, they constitute transformative forces in existing policy-making theory and practice. The assumptions of policy

sciences and public policy theories encompass their objectives and methods as formulated by the discipline's founders and its theoretical output to date, whereas the practice of public policy-making is the body of existing experience accumulated through the implementation of detailed public policies.

How then should Policy 4.0 itself be defined theoretically? The author assumes that Policy 4.0 is a new paradigm, emerging from the interactions between the transformative factors and the continuity factors. In the proposed conceptual model, Policy 4.0 consists of the following elements (Figure 1):

1. Hallmarks
2. Theoretical concepts
3. Implementation practices.

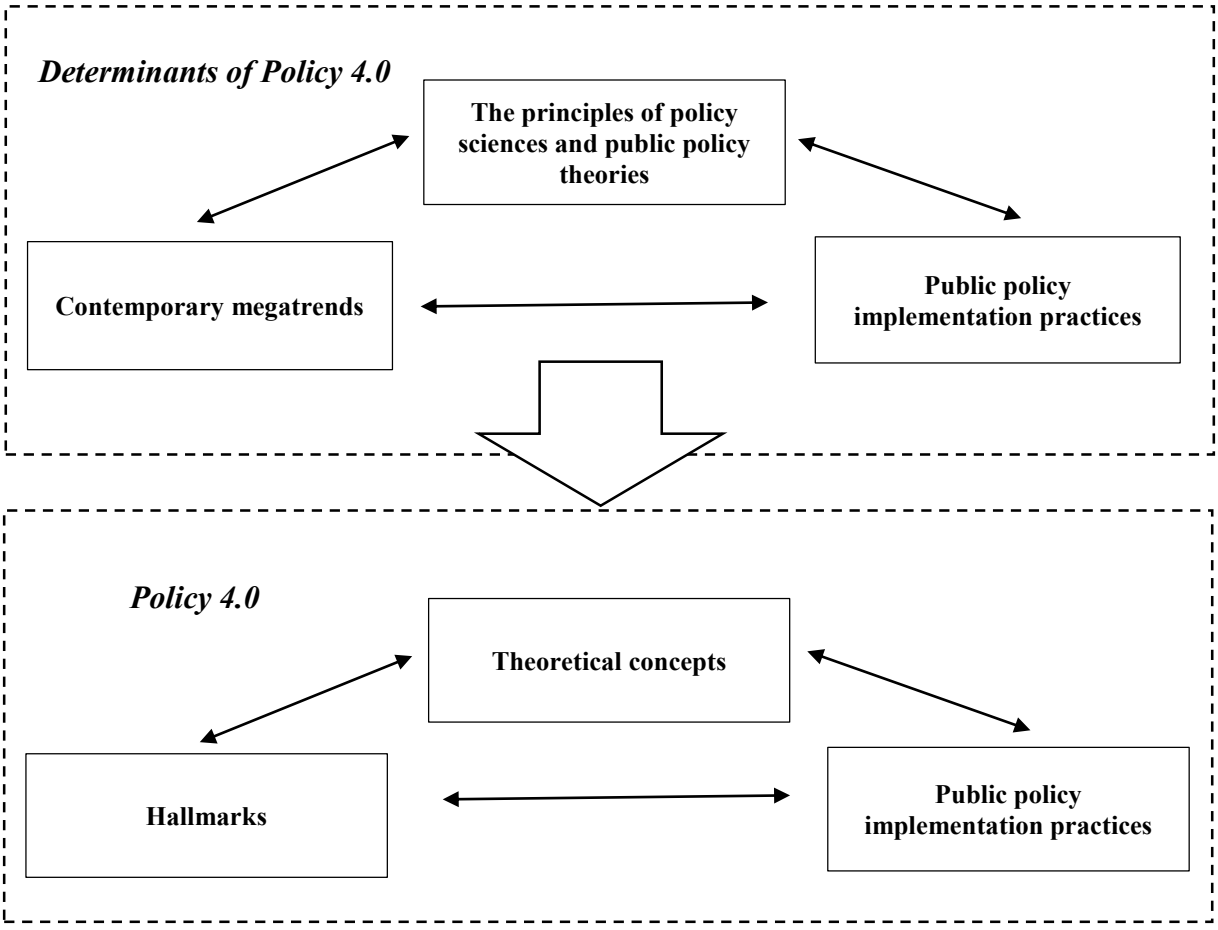

Figure 1. Conceptualisation of Policy 4.0 Paradigm.

Source: own study.

Policy 4.0's hallmarks are understood to be the key, distinctive and common features of all future public policies. They are horizontal in nature, which means that they will apply to a broad spectrum of detailed public policies in the future.

The theoretical concepts of Policy 4.0 are conceived as theoretical achievements of policy sciences resulting from the crystallisation of Policy 4.0 theory, arising from the revision of old theories and concepts, or the formation of new theories and concepts to meet future needs.

Policy 4.0 implementation strategies involve changes in how certain public policies are implemented as a result of its emergence.

The subsequent stages of the analysis will be carried out based on the proposed model of the conceptualisation of the Policy 4.0 paradigm.

4. Policy 4.0 Paradigm

4.1. Hallmarks of Policy 4.0

Contemporary megatrends drive the emergence of new patterns in policy-making. Analysing their nature enables us to identify certain characteristics shared by all public policies of the future, referred to here as Policy 4.0 hallmarks. The author identified twelve such hallmarks, whose names indicate the projected direction of change (more represents intensification, whereas less denotes weakening). However, the proposed selection is by no means complete and should only be viewed as the author's contribution to the discussion of the evolution of public policy theory and practice.

More holistic and integrated

Policy 4.0 is characterised by a holistic and integrated approach, driven by interconnections between economic actors and public authorities, the merging of public and non-public spheres, rapid knowledge advancement, and the complexity of social dynamics. This environment fosters collaboration between public and private sectors, aiming for inclusive and sustainable solutions that cater to various stakeholders. Interdisciplinary research aids in uniting scientific disciplines within policy sciences, as many societal issues require scientific and technological responses, such as strategies for climate change that blend adaptive and mitigating policies.

The push for comprehensive solutions is exemplified by contemporary industrial policies inspired by Industry 4.0, which combine traditional sectors like industry, economics, innovation, and education. Likewise, the emerging Ageing 4.0 policy reflects a comprehensive approach encompassing social, pension, health, labour market, and economic aspects (Leichsenring, 2018). Future trends are likely to involve greater integration of scientific and expert resources to address public challenges and convergence of technological and policy instruments, in response to a growing demand for multi-layered policies.

More transnational and global

Policy 4.0 is expected to be more transnational and globalised, as evidenced by recent EU proposals from 2021, including trans-European taxation, an EU finance minister, expanded competencies in health and education, and direct funding for NGOs by the European

Commission. By late 2023, discussions on federalizing the EU – transforming it into a single federal state – intensified. The transnationalisation of public policies is also driven by globalisation, which promotes international treaties aimed at equitable economic development and enhances competition. (KPMG, 2016).

Since the 1990s, globalisation has had an impact on public goods, resulting in the formation and consolidation of global public goods, which are defined as the emanation of public goods outside the boundary of a sovereign state (Kleer, 2016). These goods are classified into three categories: natural commons (e.g. Earth's atmosphere, seas, and oceans), man-made goods (e.g. internet, international regimes, norms, knowledge), and policy results (outcomes and conditions) (Kopiński, Wróblewski, 2020). Moreover, the recent Covid-19 pandemic has clearly empowered the World Health Organisation in its role as a coordinator of the fight against pandemic threats at the transnational level.

More public-private mix

It is reasonable to expect that Policy 4.0 will involve a greater public-private mix, which is primarily due to the fact that large transnational corporations and other private companies own the technological solutions needed to implement an increasing number of policies.

International NGOs, such as the Bill and Melinda Gates Foundation, implemented public health projects in the first half of the 2000s, prompted by, among other things, unsuccessful intergovernmental efforts. There are also various examples of the commercialization of policies enacted for sustainable development, including access to potable water, microfinance instruments, and low-carbon technologies (Beshouri, 2006). A strong impetus for mixed public-private efforts was provided by the Covid-19 pandemic, which was contained thanks to coordinated efforts of state governments, transnational organisations, as well as pharmaceutical and technology corporations.

More inclusive

Policy 4.0 will have to meet the expectations for inclusiveness in the face of growing inequality and social diversity. The threat of technological unemployment and the economic deterioration of certain groups of workers highlight the importance of social and legal protection for vulnerable people (Colombino, 2019). On the other hand, the implementation of regulations mandating firms to protect workers at risk of losing their jobs (e.g. by training programmes) increases labour costs and administrative burdens (Kiss, 2017). A common challenge for many public policies of the future in both developed and emerging countries will be addressing skills shortages and gaining access to new labour resources (Barber, Levy, Mendonca, 2007).

Another factor driving future more inclusive governmental policies is the melting away of majority groups, mostly due to migration and the introduction of new cultural trends. Whereas in recent decades democratic choices in public policy have been based on the voice of the

majority and respect for minority positions, Policy 4.0 will have to face increasing pressure to make decisions that take into account the dispersion and diversity of society, including in terms of race, ethnicity, language, religion, culture, and material circumstances. The rules for the implementation of Policy 4.0 will thus have to reflect societal changes, such as increased fragmentation, in which majority groups disappear or play less significant social and political roles.

More personalised

Individuals and organisations increasingly expect tailored products, services, and other solutions (Tinnilä, 2012). The growth of digital technology has significantly increased the number of options available for customising all electronic public services. Their delivery is changing as a result of new technologies, both in terms of content (administrative, social, and technological) and process (public procurement). Typical recommendations for the personalisation of administrative services include (Andrzejewska et al., 2018):

- electronic application forms pre-filled with the data already held by the service provider,
- in the case of services where no application is necessary, the relevant office automatically handles the case to the extent appropriate to the life situation of the service recipient,
- where a payment is required, the service provider redirects the recipient to the appropriate intermediary while preserving the event's context; the service provider's system automatically completes all necessary fields, such as transfer data.

Personalisation is thus defined as the individualisation of services and the automation of delivery procedures. The 'tailor-made' approach as opposed to 'one-size-fits-all' tactic broadens the range of options for implementing all individual-oriented policies, which, according to T. Lowie's (1972) typology of public policies, are regulatory and distributive ones. Personalisation will thus advance not only in e-government, but also in the area of social and technical services. Various personalisation technologies have already been successfully employed in interactions with taxpayers, insured individuals, patients, road users, and municipal service recipients, hence further progress in this area appears inevitable.

Personalisation technologies are also becoming crucial to Education 4.0, which entails providing individualised tuition and freedom of choice. Pupils and students will be given the opportunity to learn at their own pace (asynchronously), whereas learning tools will be adaptable, allowing those with advanced skills to learn faster and accomplish more challenging tasks, while beginners can take their time mastering basic skills. Since learning styles vary considerably, students will be able to select their own combination of tools and approaches from various available devices, programmes, and methodologies (Fisk, 2017).

Personalisation technologies also have an enormous potential for use in the healthcare sector. First and foremost, Internet of Bodies technologies make it possible to evaluate each patient's health in real time. The available functionalities include monitoring, cloud-based

collection and processing of data on patients' lab test results, treatment administered, medications taken, and therapy prescribed, patients' health parameters, and compliance with medical recommendations (e.g. medication dosage monitoring).

More oriented towards digitalised, automated, and robotic work

Policy 4.0 must adapt to emerging employment trends resulting from digitalisation, automation, and robotisation within manufacturing and services. The Work 4.0 revolution is expected to greatly impact public policies due to the displacement of routine jobs by robots and the potential rise in technological unemployment. While new technologies may create new professions and enhance productivity, they also necessitate policy responses to the challenges of future labour markets, especially as many children today will be employed in jobs that have yet to be defined. As machines take over repetitive, routine physical and mental tasks, humans will need to focus on areas such as interpersonal collaboration and creative problem-solving. Technical skills may become less relevant, emphasising the need for individuals to learn how to work alongside machines. The anticipation of a diverse array of working arrangements, including self-employment and flexible gig economy roles, further complicates the employment landscape. Future policies must therefore accommodate these shifts, ensuring they support evolving work practices and arrangements (Anani, 2018; Anthes, 2017).

The growing influence of technology companies raises various expectations of governments, one of which involves preventing the negative consequences of technological unemployment.

More environment- and resource-oriented

Policy 4.0 will have an even greater focus on environmental issues. Climate change is expected to have a significant detrimental effect on future economic growth. Mitigating it will necessitate major investment to lessen the environmental impact of people and businesses, as well as addressing migration from nations at risk of flooding and sea level rise (Peetz, 2019).

More urban and less territorially balanced

Policy 4.0 will also have to address the transformation of settlement patterns, particularly increasing numbers of metropolises coupled with the depopulation of peripheral areas and small/medium-sized cities. Predictably, urban areas will have greater development potential than less urbanised locations. Rural communities are already dealing with the challenge of outflow of qualified workers. This gap will not be easily bridged by remote work, because it will be hampered by the lower accessibility of services outside urban areas. However, urbanisation will provide opportunities for both skilled workers, such as those employed in the professional services sector, and less skilled ones, e.g. in construction. On the other hand, in congested metropolises, the cost of living and competition for jobs are rising, with

unsustainable living conditions producing a number of health concerns (Malik, Janowska, 2018).

Rapid urbanisation also poses new challenges for public policies of the future. These concern, above all, the provision of public services to growing populations, the search for new territorial development models and administrative policies that can successfully address the loss of functions of peripheral areas, including through a policy of controlled shrinkage, the provision of public services in areas at risk of depopulation (e.g. welfare, health care, transport, municipal services), reforms of the territorial division, and the public administration system to adapt them better to the consequences of migration to big cities.

According to analysts who see globalisation as inevitable, it is the cities that are the biggest contributors to it. As J. Bartlett argues, "Power in the 21st century belongs to the problem-solvers. National governments debate and dither. Cities act, cities do". He also proposes that the remedy to the historical underdevelopment of nation-states may be the restoration of the city-state (Bartlett, 2017).

More security-oriented

The risks associated with employing modern technologies as weapons will raise expectations of the state to ensure security. Whether these dangers come from nations, terrorists, or hackers, the state's role in providing security will become increasingly vital in the future. Security is a public good, hence private firms are unlikely to be able to supersede state authorities in their provider function (Tan, Shang-su, 2017). In the future, this role may be taken over by supranational political power structures if integration processes that transfer nation-state competencies to transnational and global power structures continue.

It will also be necessary to develop solutions that protect stakeholders using specific technologies. This includes the security of technology, information systems, transactions, data, as well as individual and collective rights. Challenges in this area will have far-reaching implications of a geopolitical nature for many governments worldwide.

Public policy of the future will have to develop proactive and reactive legislation (Berger-Walliser, Østergaard, 2012) that should keep pace with innovative solutions emerging in various economic sectors and public services. For example, physical and digital security standards should be continually updated to meet the changing needs of consumers.

Specific expectations of public authorities are also generated by the growing dominance of private enterprises, which by their nature focus on maximising profits rather than the well-being of citizens. Mitigating adverse effects of technological unemployment is one example. These expectations cannot be met by technology companies, as the policy tools and planning capabilities to contain mass unemployment, if it occurs, remain solely in the hands of government (Tan, Shang-su, 2017).

Rising public debt will likely make it much more difficult for governments to provide acceptable levels of public security while simultaneously expanding the range of public services. Additionally, it will increase pressure on governments to raise taxes and limit their capacity to address pressing social, economic, and environmental issues.

More evidence-based

Policy 4.0 is expected to be far more evidence-based than its current counterpart. This will be aided by the continued development of monitoring and data processing technologies such as sensor networks based on the Internet of Things, the Internet of Bodies, and AI-powered supercomputers. Policy 4.0 will be executed using sophisticated information resources gathered from numerous databases and integrated online. For several years, there has been a growing demand for high-quality, evidence-based policies based on accurate data and advanced analytics (KPMG 2016). The outcomes of this research will be used to identify issues of public concern, track policy implementation, and assess policies.

The post-truth pandemic, which promotes an emotive perspective of social reality and blurs the lines between fact and fiction, will be a barrier to the spread of evidence-based policy. The impact of this factor will be difficult to reduce due to its significant role in the political arena.

Less inert and more responsive

Policy 4.0 can be expected to be less inert and more responsive than the policies implemented so far. This will be fostered by Internet of Things and Internet of Bodies-based sensor systems integrated in networks with supercomputers collecting various data and analysing and processing them in real time based on algorithms. In this way, more and more Cyber-Physical Human Systems (CPHS) (Sowe et al., 2016) will be ‘communicating’ across space and time, and allowing other systems, devices, and data streams to connect and disconnect (Smirnov et al., 2014).

CPSs are used, among others, in transport, energy, environment, weather monitoring, and utility infrastructure management systems, whereas CPHSs are most commonly found in health and security. CPSs and CPHSs enable fast responses to requests for action, resulting in less inertia and more agile public policies.

Less democratic

The development of e-democracy and the digital tools used in this area not only can, but already has undermined the fundamental tenet of democracy, which is government for and by the people. A very serious and present threat is the prospect of skewing election results by exploiting vulnerabilities in voting machines, hacking electoral rolls, and using divisive propaganda or social media to question their validity (Unruh, Kiron, 2018).

A source of insightful and timely observations on the threats posed to democracy by the digital revolution is the report Many Experts Say Digital Disruption Will Hurt Democracy prepared in 2020 by the Pew Research Center and Elon University based on a survey of 979 technology innovators, developers, business and policy leaders, researchers and activists. According to the study participants, their greatest concerns about the future of democracy are due to the following (Anderson, Rainie, 2020):

- empowering the powerful – corporate and government agendas generally do not serve democratic goals and outcomes, but rather the goals of those in power,
- diminishing the governed – a lack of digital fluency and a high level of apathy among public procedures an ill-informed and/or dispassionate citizenry, weakening democracy and the fabric of society,
- waging info-wars – technology will be weaponised to target vulnerable populations and engineer elections,
- trust issues – the rise of misinformation and disinformation erodes public trust in many institutions,
- sowing confusion – tech-borne reality distortion is crushing already-shaky public trust in the institutions of democracy,
- weakening journalism – there seems to be no solution for problems caused by the rise of social media-abetted tribalism and the decline of trusted, independent journalism,
- responding too slowly the speed, scope and impact of the technologies of manipulation may be difficult to overcome as the pace of change accelerates.

Kevin Gross, one of the participants in the study, summarises his concerns: "Technology can improve or undermine democracy depending on how it is used and who controls it. Right now, it is controlled by too few. The few are not going to share willingly. I don't expect this to change significantly by 2030. History knows that when a great deal of power is concentrated in the hands of a few, the outcome is not good for the many, not good for democracy" (Anderson, Rainie, 2020). A similar view of the future of democracy in the digital age is held by Y.N. Harari (2018): "Artificial intelligence could erase many practical advantages of democracy, and erode the ideals of liberty and equality. It will further concentrate power among a small elite if we don't take steps to stop it".

The emergence of legally and morally dubious Internet of Bodies technology raises serious concerns about the democratic nature of future public policies. Linking human bodies together and entwining them with bits, hardware, software, and algorithms puts existing social norms and values to the test, and it most importantly threatens human autonomy and people's right to self-determination (Matwyshyn, 2019).

4.2. Theoretical concepts of Policy 4.0

The transformations unleashed by contemporary megatrends create a demand for theories in policy sciences that respond to the challenges facing public policies of the future. Here, only two theoretical fields will be identified, where the need to reflect on the validity of the theories and concepts is clearly visible.

Policy process

The development of CPSs and CPHSs offers a new perspective on the concept of the public policy process as a sequence of heuristic stages. Indeed, new technologies enable the integration of public policy analysis (diagnosis, selection, approval for implementation) with monitoring and evaluation, and thus their simultaneous performance in real time. In this way, ongoing monitoring of the implementation of various public policies by means of CPSs and CPHSs, thanks to their rapid and algorithm-based analysis, will inform each and every evaluation domain – from on-going and mid-term to ex-post and ex-ante. Consequently, due to the potentially unlimited number and frequency of iterations of public policy cycles (analysis-implementation-monitoring-evaluation), it will be possible to modify or update on the fly many parameters of Policy 4.0 automatically – read: without human intervention.

These developments will be extremely important in explaining the nature of the public policy process under Policy 4.0. The new technological capabilities of implementing public policies undermine not only the point of their axiological staging, but also the role of the human being as an indispensable participant in the activities undertaken at each stage of the process.

Public policy actors

Contemporary megatrends also prompt a rethinking of theories explaining the structures and roles of public policy actors. Technology corporations, which have traditionally been treated as interest groups vying for influence from the position of co-creators of the public agenda, are at the same time becoming key creators of the media agenda and, above all, co-creators of the political agenda, which until now has been the exclusive preserve of public authorities and other political circles. Large corporations' growing influence in each of the three fields is not only perceptible at the transnational and global policy level, but also at the nation-state level, and, in the case of the media agenda, whose proliferation through social media and ICTs is virtually unrestrained, at every level of public policy from local to global.

Another group of actors whose agency in public policy is steadily increasing are transnational and international political, military, economic and social organisations (e.g. EU, UN, NATO, WTO, WHO) and NGOs with a global reach. Like technology corporations, transnational and international organisations also co-create the political agenda, including at the nation-state level.

The rise of social diversity and individuality, which exacerbates social and political atomisation, provides additional justification for redefining the theory of public policy structures and actors. Both factors limit civic participation to collective political actions and, more importantly, impede the processes of developing public policy goals that have the capacity to unite increasingly diverse social groups.

The automation of public policy implementation processes also inspires reflection on the future of actors and decision-makers. The roles of political, administrative, and social agents in the implementation of public policies are clearly evolving – in the future, they will likely set the system parameters and supervise the implementation processes.

What appears indisputable, however, is the further entrenchment of network theory as fundamental to the overall theoretical concepts of the policy sciences explaining the implementation of public policies of the future. Nevertheless, in this area, the space for new analyses still remains open.

4.3. Policy 4.0 implementation practices

Contemporary megatrends have an impact on a wide range of detailed public policies. Let us review some examples of these policies using one of the traditional typologies, which divides them into substantive and procedural categories.

Substantive Policies 4.0

Substantive policies are concerned with the content of public policies and are implemented with the purpose of accomplishing specified objectives in specific areas of intervention (Birkland 2011). Starting from this definition, the totality of public policies implemented with the purpose of attaining the stated objectives in specific areas of intervention and informed by the hallmarks of Policy 4.0 will be called Substantive Policies 4.0.

The material scope of Substantive Policies 4.0 will be determined, above all, by specific public policies addressing the challenges posed by technological change. An attempt to identify such policies was made by a team of Brazilian researchers (Liao et al. 2018), who analysed the content of 18 4IR-related programmes prepared by the European Union and 17 highly industrialised countries in North America, Asia and Europe[1]. These programmes included, among others, the US *Advanced Manufacturing Partnership* of 2011 and 2014, China's *Made in China 2025* of 2015, Germany's *Industrie 4.0* of 2013, and Mexico's *Crafting the Future* of 2016. The policies considered as key in the context of the new civilizational challenges (Liao et al., 2018) are as follows:

[1] These countries are: Canada, China, France, Germany, India, Japan, Malaysia, Mexico, Netherlands, Singapore, South Korea, Spain, Sweden, Taiwan, United Kingdom, and the United States.

- research and innovation – to develop cutting-edge technologies, enable interdisciplinary cooperation and create new industrial production testbeds,
- work, education and training – to organise and design work, instruct engineering students, and prepare skilled workforces,
- infrastructure modernisation – to support the digital transformation of small and medium enterprises and build best-in-class manufacturing infrastructure,
- business environment – to develop policies and provide preferential policies to support organisations that either embrace or are most impacted by the Fourth Industrial Revolution,
- reference architecture, standards, and norms – to standardise Machine-to-Machine communication and create new infrastructure for the manufacturing sectors,
- green manufacturing – to enable sustainable value networks and increase energy efficiency,
- legal framework – to protect Intellectual Property and data,
- security of networked systems – production data security and cyber security,
- internationalization – to promote international collaboration and create national production brands,
- industry showcasing – to promote national industrial excellence abroad.

Substantive Policy 4.0, exemplified by the concept of Education 4.0, is currently under examination regarding the necessary competencies, educational programs, and methods essential for future learning at all educational levels. There is a consensus among policymakers that existing education systems require modernisation, although approaches vary due to differing national educational frameworks, curricula, and teaching traditions. In higher education, policies are adapting to better align with the needs of future graduates, emphasizing flexibility, individualised learning, choice in study materials, project-based approaches, and field experiences. Key trends include the incorporation of e-learning, flipped classrooms, and adaptive technologies that cater to diverse abilities. Moreover, there is a shift from traditional memorisation to practical application in assessments, empowering students to take ownership of their learning journeys (Fisk, 2017).

As the exact consequences of technology development are difficult to predict, the role of the state will be to devise policies that reduce the uncertainty caused by the development of new technologies in the social, economic, political, and security spheres. These policies, without being tied to specific technologies, should respond to the following key concerns (Tan, Shang-su, 2017):

- social: income inequality, erosion of privacy,
- economic: technological unemployment, disruption of traditional business, monopolisation,

- political: increasing xenophobia, fomenting instability, leaking sensitive data abroad, becoming dependent on one or two sources of essential resources,
- security: citizens adopting alternative views, increase in online fraud, proliferation of weapons, digital sabotage, terrorism, espionage, human trafficking.

Procedural Policy 4.0

This group of policies provides a framework for the implementation of substantive policies and determine the mechanisms of action of public authorities in individual public policy areas (Birkland, 2011). They may include rules and technological solutions for e.g. administrative procedures, public procurement, consultation, and public participation.

The evolution of ICT and big data leads to modifications in numerous procedural regulations. A2A, A2B, and A2C public e-services require progressive digitalisation of administrative processes through the creation of public databases and registers, the streamlining of data exchange between public administration units and their clients, the reduction of processing times, and the limitation of abuse opportunities. Changes in internal procedures and administrative procedure codes in public organisations are prompted by new technology and affect case handling deadlines among other things.

ProZorro, Ukraine's electronic procurement system launched in 2016, exemplifies an innovative application of blockchain technology in Procedural Policy 4.0. It is a hybrid, public-private electronic system based on open source code. 'Hybrid' means that while all transactions take place in a central public database, any number of certified private marketplaces can interact with end-users, upload tender documentation, and support the tender process. All tender notices are available online without any restrictions as soon as they have been published. Once the tender is completed, all data are disclosed and made available online, and no registration or login is required to view it. Cooperation between companies, the state, and civil society that participate in the system guarantees independence and establishes a system of mutual checks and balances (Prozorro, 2021). The cost of implementing the system was approximately €4.69 million (Vissapragada, 2017), which does not seem excessive considering that the procurement market in Ukraine is worth approximately 15% of GDP (Kovalchuk, Kenny, Snyder, 2019).

The digital revolution is also driving change in many aspects of e-democracy. Its fundamental goal is to promote and develop democracy, democratic institutions, and processes through digital means. E-voting, such as e-elections and e-referendums, and various forms of e-participation, including e-complaints, e-consultations, e-discussions, e-legislation, e-petitions, and e-spatial planning, are just a few of the numerous instances of the application of information technology in the field of e-democracy. In the Council of Europe's *E-democracy Handbook* (Council of Europe, 2020), the number of listed e-democracy tools exceeds thirty.

5. Summary

Today's megatrends, as a vehicle for profound civilizational change, are global in scope and affect everyone. Technological developments are increasingly obliterating the borders that have hitherto separated the real and virtual worlds, nature and technology, humans and machines, and the public and private spheres. They also provide a strong impetus for changes in policy-making theory and practice, resulting in the emergence of Policy 4.0 as a new paradigm.

The paper presents arguments supporting the hypothesis that contemporary megatrends of a technological, economic, environmental, social, and political nature are changing the rules of public policy-making to the point where new public policy theories, collectively known as Policy 4.0, are required. As a result, the new detailed public policies will become: (1) more holistic and integrated, (2) more transnational and global, (3) more public-private, (4) more inclusive, (5) more personalised, (6) more oriented towards digitalised, automated, and robotic work, (7) more environment- and resource-oriented, (8) more urban and less territorially balanced, (9) more security oriented, (10) more evidence-based, (11) less inert and more responsive, and regrettably, (12) less democratic.

The emerging Policy 4.0's dilemmas, particularly those concerning the democratic nature of public policy in the digital age, public policy decision-making mechanisms implemented in an increasingly globalised world, and the agency and inclusiveness of actors in an increasingly fragmented public policy arena, appear to be its critical aspects that require further analyses leading to creative solutions.

Promising directions for advancing its conceptualisation also include the development of measurable criteria enabling empirical verification, as well as the construction of theoretical models that explain the causal mechanisms linking specific megatrends to transformations in policy-making processes. Advancing this line of inquiry requires moving beyond descriptive accounts toward more structured classifications and explanatory frameworks that clarify how and why particular megatrends influence institutional change, governance mechanisms, and policy outcomes.

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