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Knowledge Ecosystems in the Digital Age on Reshaping Administrative and International Law

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Abstract
Knowledge ecosystems and the cyber public domain play a central role in reshaping administrative and international law. This article explores how the digital space, characterized by global accessibility and timelessness, is redefining the traditional legal framework, generating both opportunities and challenges. Through an inter-, multi- and trans-disciplinary approach, the research highlights the impact of digital technologies on administrative processes and international relations, analyzing concepts such as digital governance, data protection, digital sovereignty, and equity of access. The case study of Estonia and the exploration of the literature provide a set of premises for research on the practical and theoretical aspects of the transformations brought about by digitization. The conclusions emphasize the need to continue the search for tailored regulations that protect individual rights and encourage international collaboration in an expansive cyber environment.

Keywords: Knowledge Ecosystems, Digital Age, Reconfiguration, Administrative Law, International Law, Legal Innovation, Digital Transformation, Technological Regulation, Converging Disciplines, AI Impact, Fundamental Rights

Introduction

Our discussions start from reality and converge on our desire as researchers to adapt existing fields to the technological transformations of the last decades that have reshaped the global social, economic, and legal landscape. All these dynamics have required not only the adaptation of rules and policies but also a fundamental rethinking of the traditional legal framework. This process is far from complete. Knowledge ecosystems, defined as interconnected networks that facilitate the generation, distribution, and use of information, have become essential components of progress in the Digital Age.

In this article, we focus on how these ecosystems are reshaping administrative and international law, emphasizing the confrontations, struggles, and opportunities generated by new technologies. We analyze the structural changes brought about by digitization, the use of big data, artificial intelligence (AI), and their effects on administrative regulation

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and international collaboration.

An original endeavor is our attempt to test the possibility of accepting an (international, why not?) cyber public domain, starting from some older documents, some 25-year-old. We refer to the *Declaration and Recommendations: What University for Tomorrow?* Signed in Locarno, Switzerland (April 30 – May 2, 1997), this document strongly recommends in article 12 to "foster and develop all available technical means to give the emerging transdisciplinary education the necessary universal dimension and, in general, to promote the public domain of information (virtual memory of the world, information produced by governmental organizations, as well as information related to the copyleft regime)".

In this place, the Lucarno Declaration strongly recommended UNESCO and interested countries to encourage and develop pilot experiments which, like the OEUF (Observatory for the Study of the University of the Future created by the Federal Polytechnic School of Lausanne in collaboration with CIRET: http://www-uf.epfl.ch/UF/), build on the extension of networks such as the Internet and 'invent' the future by ensuring a planetary activity in continuous feedback, thus establishing for the first time interactions at a universal level. Unfortunately, the ignorance of transdisciplinarity has only today made us reconsider these recommendations, seemingly more than ever. Perhaps, if the world's specialists had 'jumped together' (E. Wilson's idea of 'jump together' – the one who stated the unified theory of knowledge in disciplines. Wilson, 1998) for this purpose, the level and quality of evolution would have been different.

The CIRET-UNESCO Project on the Transdisciplinary Evolution of the university summarised, admittedly in a critical way, the danger of disregarding transdisciplinarity, stating that: "But the sum of the best specialists in their field can obviously only generate generalized incompetence, because the sum of competencies is not competence: technically, the intersection between the different fields of knowledge is a whole void. But what is a decision-maker, individually or collectively, if not one who is capable of taking into account all the facts of the problem he is examining?" (CIRET-UNESCO, 1997).

Article 6 of this Project has tried to guide us towards a definition of this public domain, but our aim as specialists is to, first of all, obtain a definition as uniform as possible by extracting the main characteristics from Article 6: "The emergence of *a cyber-space-time* represents, more than the fall of the Berlin Wall, a fabulous opportunity for democracy, for individual and social development and for the *universal sharing of knowledge*. Provided, of course, that this cyberspace time is not perverted into a huge financial pump." The medium of the creations broadcast in this cyber-space-time has the texture of the depths of matter, being close to the quantum world. In other words, scientifically speaking, cyberspace is of a radically different nature from our ordinary space. If the earth can be divided into territories, whose borders separate the various nation-states and peoples of the world, such a division of cyberspace would simply be against nature. This is the scientific basis for the need for a radically new vision of the evolution of the public domain, in terms of its purposes, its extent and its quality. In cyberspace time, the public domain is planetary and not national in nature. If national and international organizations have the courage and intelligence to bring to the surface a new vision of the public domain, cyberspace could become a fabulous reservoir of energy and dynamism for the development of universities worldwide.'

Literature Review

This chapter reviews the academic literature relevant to the topic of knowledge ecosystems and their impact on administrative and international law. The review focuses on identifying key concepts, the existing theoretical framework, and gaps in the literature,

in order to provide a solid basis for further research.

Knowledge ecosystems: definition and characteristics

Knowledge ecosystems are commonly described as interconnected structures that enable knowledge to be exchanged, produced, and harnessed in an efficient way (Carayannis and Campbell, 2012). They are built on digital technologies and collaboration between various entities such as private, and public institutions and international organizations. Carayannis and Campbell (2012) emphasize that knowledge ecosystems are essential for innovation, being built on the pillars of transdisciplinary perspectives and leading-edge technologies. On the other hand, authors such as Freeman and Louçã (2001) emphasize the importance of technological infrastructure and legal regulations for the functioning of these ecosystems.

The digitization of public administrations mentioned by Mergel et al. (2019), which has transformed the interaction between citizens and institutions, creating new possibilities to access data and services. However, the literature points to an ongoing concern about associated challenges, such as security risks and the ethics of data use (Mergel et al., 2019).

The impact of digitization on administrative law

The technological transformations of recent years have reshaped the functioning of public administrations, leading to a reconfiguration of administrative processes and decision-making. Studies by Veebel (2024) highlight Estonia's success in implementing digital government, which has led to increased efficiency and reduced bureaucracy. Estonia is recognised as a global model in implementing digital government, thanks to its integrated ecosystem known as e-Estonia. Notable innovations include *the e-Residency* system, which allows anyone in the world to access Estonian digital services, including business registration, and the *X-Road* platform, which facilitates secure and efficient data exchange between government databases. In the health sector, *E-Health* digitally centralises medical information, giving both patients and doctors quick access. Estonia has also pioneered *i-Voting* for national elections, contributing to transparency and civic participation. For this country, the digital dynamic has led to savings of around 2% of the country's annual GDP, reducing bureaucracy and increasing the efficiency of public administration. Estonia's success is a clear example of the strategic use of technology to improve the relationship between citizens and government.

Estonian courts use the 'digital docket', a platform that allows for fully electronic case management, including public access to court records through an e-file portal. In certain administrative and civil cases, paper files are no longer formatted and the aim is to fully extend this system to all cases by 2020. This digitization increases the efficiency of the processes and makes it easier to search, comment and organize documents directly online. Furthermore, Estonia has experimented with the use of artificial intelligence for the automated resolution of minor criminal cases with damages below €7,000 and has developed a voice recognition tool for transcribing lengthy hearings, reducing the need for human clerics. As an inspiration for other countries, the measures outlined in this short case study speed up legal processes, helping to reduce waiting times for the resolution of cases and freeing up human resources for more complex cases. In step with these developments, one can see how technologies do not replace the human factor, but support it, strengthening the reputation of the Estonian judiciary as a leader in digital innovation.

At the same time, the literature emphasizes the problems generated by technology. Hildebrandt (2019) raises questions about the use of artificial intelligence (AI) in administrative decision-making, drawing attention to the risks of discrimination and

systematic errors. Recent studies recommend the development of clear legal frameworks for the integration of AI in the administration to support accountability and transparency.

International law now in the digital context

What we call 'digital globalization' has redefined international interactions. According to Schabas (2020) corroborated by the official website, the International Criminal Court (ICC) has started to use digital evidence in its investigations, marking a transition towards faster and more efficient justice. Our example reflects an adaptation of the legal framework to new technologies, in one direction.

However, studies emphasize the need for international regulations to address the use of digital technologies in international relations. The United Nations (UN) has proposed a number of initiatives for the creation of a global digital treaty, but its implementation remains a matter of debate for the time being (UN, 2021). However, this fall, at the Future Summit in New York, world leaders adopted the Compact for the Future, a landmark agreement that includes the Global Digital *Compact* and the Declaration on Future Generations. The Compact is the culmination of an inclusive process over several years to adapt international cooperation to current and future challenges. The UN Secretary-General emphasized that 'we cannot create a fit future for our grandchildren with a system built by our grandparents'. The Digital Compact promotes global connectivity, the governance of artificial intelligence through a science panel and global dialog, and the protection of fundamental rights in the digital space, with the aim of building an inclusive and secure digital future for all. The Digital Compact was preceded by an inclusive process, attracting thousands of participants and financial commitments of over USD 1 billion for digital inclusion. With this agreement, the UN reaffirms the importance of international institutions, highlighting the need for reforms to reflect current realities (United Nations, 2024).

Gaps in the literature

Much of the existing literature focuses on the opportunities offered by digitization, but relatively few studies analyze the associated risks from a detailed legal perspective. The impact of technology on state sovereignty and administrative autonomy remains insufficiently explored. One research criticism is the lack of comparative research between international and national legal systems on the integration of digital technology. Or, precisely what we call in law contemporary comparative research, by its very nature, can be considered an interdisciplinary, multidisciplinary, or transdisciplinary approach, depending on its method, its aims, and the level of integration of perspectives from related disciplines.

In reality, endless links can be made on a comparative level between law and other disciplines. Among the myriad examples is the comparative study of civil and common law systems, based on elements of the economic theory or analysis of law (popularised in particular by economists and jurists such as Ronald Coase, Richard Posner, and Guido Calabresi, and criticized for its tendency to prioritize economic efficiency over other social and moral values such as equity or justice). However, there are some sub-areas of law that can be substantially developed by applying the most appropriate method, in this case, environmental law, criminal law, contract law, and international investment law. It is important to understand the effectiveness of the different legal systems. The disciplines interact in many ways, they may remain distinct in their contributions or new paradigms may be created that transcend traditional methods.

Methodology

The methodology of this study is based on an inter-, multi- and trans-disciplinary approach, combining qualitative and quantitative methods to investigate how knowledge ecosystems influence administrative and international law in the Digital Age. Our study adopts an exploratory design, aiming to identify and analyze the interactions between knowledge ecosystems and legal regulation. Exploratory design is suitable for emerging topics that require an understanding of the complex dynamics and variable impacts of the factors involved (Creswell, 2014). This research aims to achieve the following objectives:

1. Identify the mechanisms through which knowledge ecosystems influence administrative processes.
2. Analyse in general how digital technologies are changing international and national norms.
3. Assess the existing legal framework and propose solutions for its improvement.

The first step was to conduct a systematic review of the existing literature, with a focus on academic studies, international reports, the Estonian case study, and some relevant legal documents. The systematic review method described by Petticrew and Roberts (2006) was used to select relevant sources. In order to understand the impact of digitization on administrative law, the case of Estonia, which is considered a global leader in the implementation of digital governance, was chosen. The case study focused on analyzing legislation, government reports and statistical data on administrative efficiency.

Statistical data on technology adoption in public administrations and the impact on efficiency were used. These were collected from open source international databases such as the OECD and the World Bank. The analysis was carried out using descriptive and inferential techniques to highlight relevant correlations. Our research has some time limitations. The rapid dynamics of digital technologies may render some conclusions obsolete in a short time span. Some data sources may be restricted, limiting the analysis of certain aspects.

Results and discussion

Knowledge ecosystems and their modern definition

Knowledge ecosystems are complex structures that combine technological, social, and organizational elements to support information-based decision-making. They include digital databases, collaborative platforms, research infrastructure, and legal frameworks that facilitate open access to information.

Key characteristics of knowledge ecosystems

Modern knowledge ecosystems are distinguished by:

- *High connectivity* as technologies such as the Internet of Things (IoT) and 5G networks ensure users and devices are instantly connected.
- *Adaptive dynamics* as these ecosystems are constantly evolving in response to new technological developments and societal demands.
- *International collaboration* as international platforms allow the exchange of information between countries, institutions and citizens.

According to a recent report by the Organization for Economic Co-operation and Development (OECD), the adoption of digital technologies in public administrations has increased by more than 40% in the last decade, facilitating the formation of robust knowledge ecosystems (OECD, 2023).

The importance of knowledge ecosystems in law

Knowledge ecosystems have a direct impact on the creation and implementation of legal rules. In administrative law, digitization enables greater transparency and efficiency. In international law, digital cooperation facilitates conflict resolution and treaty implementation (Popa Tache and Wiviurka, 2024).

Reconfiguration of administrative law in the Digital Age

Administrative law has been significantly influenced by the transition to digitisation. Public administrations around the world are absorbing digital technologies to meet the increasingly complex demands of citizens and the global economy.

Technology and administrative efficiency

Digital technologies simplify bureaucratic processes, reducing the costs and time needed to deliver public services. For example, e-government platforms allow citizens to interact with public institutions directly and efficiently. In Estonia (according to our case study that we have embedded in each chapter) considered a world leader in e-government, more than 99% of public services are available online and administrative efficiency has increased by 25% since 2015 (Espinosa and Pino, 2024). Analyzing big data allows authorities to make evidence-based decisions. For example, the use of mobility data for pandemic crisis management has demonstrated the potential of this tool. During the COVID-19 pandemic, governments used aggregated data to monitor compliance with restrictions (Parker et al., 2020).

Ethical and legal issues of digital ecosystems

One of the main issues remains ensuring and guaranteeing the protection of personal data privacy. The European Union's General Data Protection Regulation (GDPR) has set a global standard for data protection. However, there are questions about how these rules can be uniformly implemented in cross-border digital ecosystems. AI raises issues of legal liability in cases where algorithms generate erroneous or discriminatory decisions. In administrative law, the use of AI in decision-making can create the risk of systematic abuses or errors, calling into question the legitimacy of public decisions (Hildebrandt, 2019).

International law in the age of digital ecosystems

Digital globalization has radically changed the way countries collaborate and conduct international business. More than a decade ago, there was some talk of a global digital treaty that could unify international standards and regulations on the use of technology. The United Nations (UN) has suggested a coordinated approach to manage the global impact of digital technology (*United Nations*, 2021).

Since September this year, we have the *Pact for the Future*, *Global Digital Compact*, and *Declaration on Future Generations (United Nations, 2024)*. The discussion on the legal force of the documents adopted at the Future Summit, such as *the Pact for the Future*, the *Global Digital Compact* and the *Declaration on Future Generations*, brings with it the analysis of the duality between *soft law* and *hard law*. These international instruments, although essential for adapting international cooperation to contemporary and future challenges, differ in their legal impact.

The Pact for the Future and its annexes largely contain political commitments, declarations of intent and guidelines for states and other stakeholders. *Soft law* elements are present in the commitments on digital cooperation, human rights and gender equality, where a flexible governance framework rather than binding rules is established. They facilitate cooperation and provide a starting point for the development of further legal rules. In some cases, the Pact contains concrete commitments, such as Security Council reforms and climate neutrality goals, which can evolve into binding rules through the adoption of international treaties or binding Security Council resolutions. For example, regulations on the use of lethal autonomous technologies and data governance could generate binding instruments in the future if formalized through treaties. Thus, we can conclude that the documents adopted at the Summit represent a mix of *soft law* and potentially *hard law*, emphasizing the need for a balance between flexibility and strict obligations to address global issues.

On the economic front, but separately at the regional level, Digital Economy Agreements (DEAs) have emerged to regulate trade between digital economies, providing coherent frameworks and easy access, with major benefits for small and medium-sized enterprises (SMEs). Agreements such as the Digital Economy Partnership Agreement (DEPA), the first one open to all WTO members, respond to the fourth industrial revolution, in the context of the rapid growth of digital payments, data flows and digital services. At this level there are still obstacles such as growing digital protectionism and the lack of a unified global agreement on digital trade. For these reasons, the focus is on the need for international coordination to prevent lost trade opportunities and to support the equitable development of digital economies.

With regard to international justice, we see how technology has simplified the management of international disputes. The International Criminal Court, for example, uses digital evidence in cases of crimes against humanity, bringing a new dimension to the judicial process (Schabas, 2020). Even with the emergence of these international conventions, we criticize them based on the lack of any provisions in their bodies relating to the public cyber-space-time domain. There is no specific provision relating to this concept in the existing conventions. While these conventions and discussions are significant in shaping international norms for cyberspace, none defines or regulates a 'public domain of cyberspace time'. The notion of cyberspace as a regulated common domain remains a subject of international legal debate and development. In the context of international law, there is no 'international public domain' in the sense in which we understand the notion of 'commons' or 'public domain'. It provides a framework for the regulation of common domains, such as the international seas or the atmosphere, regulated by agreements such as the United Nations Convention on the Law of the Sea or international climate agreements. These set rules for the use of shared resources and the protection of areas essential to human survival. But the concept of a global 'public domain' in general legal affairs remains a matter for national or international regulation in the context of specific agreements, rather than a universal 'international public domain' of universal law applicable to all countries. It remains to search for an answer to the question whether cyberspace might at some point form a very special category of common resources of all humanity, and what might they be? First, this concept could encompass both physical domains (such as the electromagnetic spectrum, which can be used for digital communications) and virtual domains (data and information transmitted and stored on the Internet).

The electromagnetic spectrum, although regulated by international agreements, could be conceived as a common resource, accessible and regulated by international regimes to ensure equitable access and to support global digital development, especially in remote areas. It is not impossible to argue that access to open information and data could become

a 'commons'. We are talking about government data, scientific information, or data needed for research and technological innovation to benefit all humanity. International initiatives such as Open Data and Open Government are already promoting the concept of universal access to public data.

Telecommunication networks, cloud servers, or data processing infrastructure could become common resources in this respect. Creating a 'trusted global internet' that is accessible to all would contribute to strengthening an inclusive and equitable digital economy. It is not difficult to take our logic further and look at user interfaces and digital standards. They, as sets of rules and protocols that guarantee the interoperability of technologies and platforms, could be subject to international regulation of digital standards. In this case, cyber fragmentation can be prevented and a common framework would be created that supports fair access and use of digital technologies by all users. In all scenarios, an international public domain of cyberspace-time can only be regulated to support the equitable and sustainable development of all humanity.

Future directions

Knowledge ecosystems are on an exciting trajectory and adapting the legal framework must be a continuous process. The digital education of public officials and the creation of universal (international) ethical standards for the use of technology are essential for the success of this endeavor. In the context of rapid technological advancement, the notion of the 'cyber public domain' is becoming central to understanding social, economic and legal interactions in the Digital Age. The cyber public domain transcends traditional boundaries of space and time, providing a global platform for information sharing, collaboration and innovation. Here we set out to dissect the meaning of this concept, its theoretical and practical implications, and how it is redefining the legal and administrative framework.

The cyber public domain and its conceptual definition

The cyber public domain is a digital space where information and resources can be freely accessed by the public, without geographical or temporal constraints. It is the virtual equivalent of the physical public domain, but with unique characteristics:

1. Universality of access applied to the fact that anyone with internet access can participate, regardless of location.
2. Information persistence because data and resources are continuously available without time limitations.
3. Interconnectivity through the synergy of users around the world who can interact in real time or asynchronously.

According to Castells (2009), the cyber public domain is a 'space of flows' in which information circulates freely, overcoming the spatiotemporal constraints of the physical world.

Spatial relevance

The cyber public domain redefines space in the traditional sense. In cyberspace, the physical location of users becomes irrelevant. This has profound implications:

1. Transnational cooperation in that the cyber public domain enables collaboration between states and organizations regardless of borders. Examples include digital platforms that support initiatives such as global efforts on climate change (UNFCCC, 2022).
2. Wider accessibility in that people in remote regions can access resources and information available only in large urban centers.

Sassen's (2013) studies highlight that global cities increasingly function as 'nodes' in

this cyberspace, integrating information flows and digital resources that transcend geographical boundaries.

Temporal relevance

Persistence and timelessness are the defining features of the cyber public domain. Unlike the physical realm, where activities are limited by working hours or day/night, cyberspace enables:

1. Continuous operation because digital activities are not affected by time restrictions, providing constant access to resources.
2. Permanent archiving through the cyber-public domain information regime, which can be kept indefinitely, allowing users to access the history of decisions, debates and relevant data.

On the other hand, this persistence raises issues of updating information and removing outdated or harmful content, a topic explored by Hildebrandt (2019).

Implications for administrative and international law

The concept of the cyber public domain has multiple legal implications:

1. Ensuring equitable access to digital resources is becoming an obligation for states and international organisations. Regulations such as those imposed by the European Union through the Open Data Directive (the EU, 2019) set a precedent for guaranteeing universal access. Perhaps this will be a new fundamental right included in the constitutions of states.
2. In a borderless space, the protection of users' data and identity is becoming an international regulatory issue. GDPR is an example of regulation that seeks to address these issues at an international level.
3. The cyber public domain may conflict with national interests, especially in terms of sovereignty over data stored in the cloud and digital infrastructure.

Some Issues and Opportunities

Issues:

- Persistent fragmented regulation due to the lack of a coherent overall legal framework for the cyber public domain creates implementation problems.
- The digital inequalities created by unequal access to the cyber public domain, which is inherently influenced by factors such as technological infrastructure and levels of digital literacy.

Opportunities:

- International collaboration by creating an open cyber public domain can facilitate international cooperation in areas such as education, research and public health.
- Legal innovation propelled by the adaptation of legal rules and principles to this space provides opportunities for the development of new legislative and procedural instruments.

Future perspectives

As the public cyber domain continues to evolve, a proactive approach to developing tailored legal frameworks is ideal. International projects such as the UN's digital governance initiatives (UN, 2021) emphasize collaboration between states, the private sector, and civil society organizations.

Conclusions

In the Digital Age, knowledge ecosystems are the main pillars of the reconfiguration of

administrative and international law. While technology offers enormous opportunities for streamlining processes and international collaboration, issues of privacy, accountability and fairness should not be neglected. It is imperative that legal rules are quickly adapted, working with all these possibilities, to respond to these new realities, thereby strengthening the trust of all actors in administration and international law.

But we cannot make progress along these lines without making a change in education. The Delors Report, produced by the UNESCO-linked International Commission on Education for the 21st Century and chaired by Jacques Delors, clearly outlines the four pillars of a new kind of education: learning to know, learning to do, learning to live together and learning to be. In this context, the transdisciplinary approach can make an important contribution to the emergence of this new type of education. Finally, 'Learning to Know' is essentially about developing the ability to distinguish between reality and illusion, giving us access to the exceptional resources of contemporary knowledge. This ability, fundamental to human progress, is based on the cultivation of a sound scientific mind, one of humanity's most valuable legacies. Early initiation into science is of paramount importance, as it allows access, from the earliest years of life to the unique dynamics of the scientific mind, based on curiosity, questioning, and the refusal to accept predefined answers or certainties incompatible with factual reality.

However, the scientific spirit should not be confused with an excessive volume of information or an overly formalized approach to science education. Such excesses run the risk of turning this spirit into a new dogmatism, replacing the prefabricated answers of the past with the other, apparently 'scientific' but equally rigid ones. The essence of the scientific spirit lies not in the quantity of knowledge imparted, but in the quality of that knowledge and the way in which it is imparted. Quality means facilitating direct access to the core of the scientific method, which involves constant interrogation of facts, images, representations, and abstractions. Genuine science education must therefore develop not only knowledge but above all a critical mindset, capable of questioning and constantly re-evaluating what is taken for granted. This approach contributes not only to individual progress but also to the creation of an open society based on knowledge and rationality. For this, the first step to be taken is to maintain a focus on unlimited thinking.

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