Roles of Government and Private Sector in Digitalization: A New Conceptual Framework and Typology

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I. Abstract

Digitalization sets new trends across the world in many sectors – ranging from public administration to industrial development, from communication to financial systems. But what kinds of digitalization are out there? Combining different research streams from political economy, public policy, and communication studies, this thesis develops a process-centric typology of digitalization. The paper concentrates on the roles of governments and businesses in this process. It bases the typology on the dimensions of inputs (i.e., how businesses, governments, and their interactions shape the process of digitalization) and outputs (i.e., the scale, extent of digitalization). The paper then empirically showcases the developed digitalization types through a sample of countries from the Eurasian region. Based on the results of the empirical showcasing, it suggests possible refinement of the suggested typology, discusses potential implications of this conceptual framework, also from a normative perspective, and generates several hypotheses related to the relationship between digitalization types as well as state capacities, regime types, and market structure.

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Introduction

If one looks at the results of the last Information and Communications Technology (ICT) Development Index from 2017, one might be surprised to see that Ukraine and China landed on very similar places (79 and 80 respectively, with close scores – 5.62 and 5.60). While the output of digitalization in both countries might seem similar[1], the inputs (or drivers of digitalization) are certainly distinct. Empirically, this is reflected in the fact that state-business relations differ vastly in these two countries. In Ukraine, which is a market economy with several oligarchic pyramids, the government is significantly less powerful than in the case of the Chinese state-driven capitalism. Politically Ukraine can be classified as a hybrid regime leaning more towards a democracy, while China is more of a closed authoritarian regime. Considering these massive differences, is it possible that the story of digitalization at the national level is slightly more nuanced than merely that of measuring outputs? Cases like that of Ukraine and China illustrate the insufficiency of the existing digitalization measurements and demand further qualitative investigation into the phenomenon of digitalization and its types. *What are then the different types of digitalization?*

There are two theoretical and conceptual problems which this thesis addresses in the field of political economy of digitalization. The first problem is that despite a rapidly increasing political and academic attention to the process of digitalization itself, as well as to its political, societal, and economic implications, the conceptual discussion surrounding it remains very unstructured and fragmented across different disciplines. There is significant confusion about

[1] Through additional operationalization lenses, one cannot even rule out potential qualitative differences in the output of digitalization as well.

the concept formation of digitalization vs. digitization, with both concepts having dozens of definitions (Reis et al 2019, pp. 443-445). So far, conceptual exercises related to the study of digitalization have been limited to differentiating three distinct concepts of digitalization, digitization, and digital transformation (Brennen and Kreiss 2014, p. 8; Habibi and Zabardast 2020). By contrast, the concept of "digital transformation" is used exclusively in the context of the private sector, while a completely different concept of "e-governance" is applied in the context of the public sector as a subset of digitalization. While the concept of e-governance has a distinct nature, the other three concepts are often used interchangeably, which necessitates a systematic review of these concepts.

The problem is further exacerbated by the fact that the meanings might somewhat overlap each other (see Figure 1 below). It is further exacerbated by the fact there are, indeed, different processes described by those terms and their hierarchical nature is not entirely clear. Specifically, social science has to differentiate between the process of converting information from mechanical and analog electronic technology to digital electronics technology and the process of growing application of digital technologies in a broader context, for example, in a society (Reis et al 2019; Zhao, Liao, and Sun 2020). As illustrated by Figure 1, the method of converting information into digital formats does not fall into the hierarchy of meanings related to the processes of developing and adopting electronic tools and system.

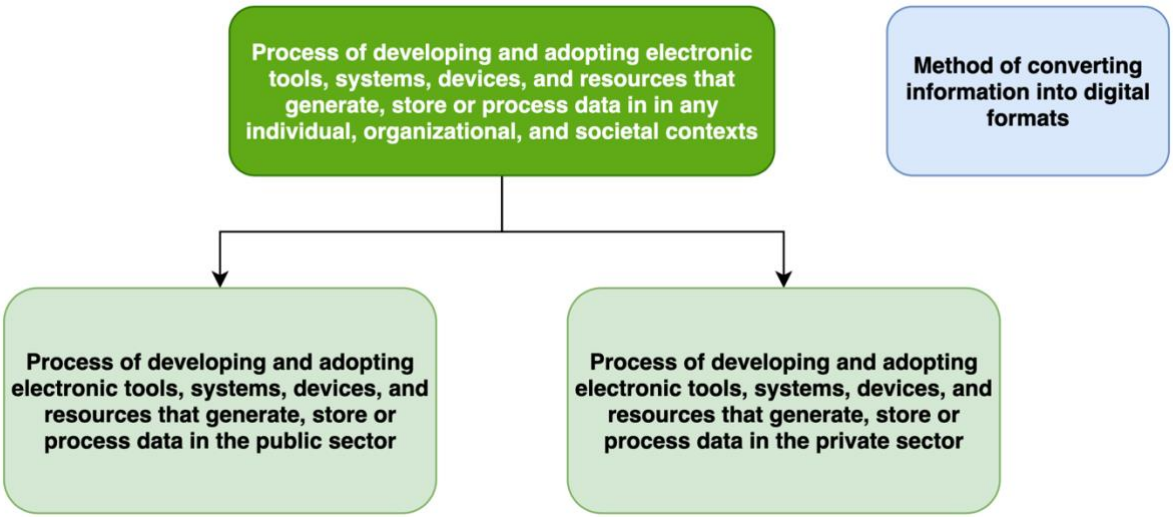

Figure 1. Hierarchy of meanings in the conceptual discussion surrounding digitalization

Source: Own elaboration.

The second problem is that digitalization is often perceived as a homogeneous phenomenon happening similarly across different countries (e.g., Habibi and Zabardast 2020). However, this is not the case because, as suggested by recent studies (e.g., for a study of digitalization across Central and Eastern Europe, see Ivanova and Putintseva 2020), the methods/strategies and scale of digitalization differ significantly across societies. Usually both the government and private sector contribute to the process of digitalization, but there is always a difference in extent to which they do so. In some exceptional cases like North Korea or Turkmenistan the digitalization process is almost exclusively government-driven, but businesses play a much greater role in other countries. Indeed, at the other end of the spectrum there are cases like the United States, where digitalization can be largely attributed to the activity of private businesses and large corporations (McKinsey 2015).

Another example is the scale of digitalization, where the differences are evidenced by a variety of indexes (such as, for example, the ITU ICT Development Index), which rank

countries from least to most advanced. The existence of such contrasts naturally makes one question whether digitalization is an internationally homogeneous phenomenon and, more importantly, what different types of digitalization are out there.

There are three arguments underpinning the need for developing a typology of digitalization that follow from the existing literature, especially when looking at the question of potential causalities. First, the absolute lack of a comprehensive typology of digitalization at the country level poses a serious problem to the existing efforts aimed at organizing and analyzing data in the academic literature, which deal with political phenomena or developments in a digital context. For example, when researching impacts of the increased usage of digital technologies on coercive capacities of governments across the world (Feldstein 2021), different types of digitalization might result in different impacts depending on what role the government/business play in digitalization. Second, developing a typology will sharpen the existing measurements because developing categories is an essential first step before proceeding with higher levels of measurement (Collier, LaPorte, and Seawright 2012, pp. 217-219). Existing measurements like the ICT Development Index of the ITU or the EU DESI Index account only for the outputs of digitalization (i.e., its scale). However, they ignore the inputs (i.e., the role of governments and/or private businesses in shaping the process of digitalization as such). The VDem Digital Society Index, on the other hand, has a different problem – it completely lacks any dimensions and overly focuses on the government's regulatory capacity. Third, typologies of similar phenomena such as industrialization already exist in both academic and 'grey' literature (Pollard 2013; Warwick 2013).

Thus, making a process-centric typology of a similar phenomenon would be reasonable and justified. The thesis presents a typology that is based specifically on inputs (i.e., driving

factors) and outputs (i.e., scale) of digitalization. For now, the developed typology foresees only four analytical cells based on whether digitalization is state- or business-driven, and on the scale of its outputs – whether it is large or small-scale. These are then illustrated through empirical showcasing. Naturally, the typology proposed in this paper is only the first step in both conceptualization and classification of digitalization processes across different countries and will have to be developed further.

This paper proposes a four-step approach to solving the aforementioned problems (need for better conceptualization and typology development), which is reflected in the overall thesis structure. The first chapter reviews the existing conceptual and measurement approaches focused on digitalization in the existing literature. The second chapter, based on the results of the systematic review, proceeds with the development of a typology of digitalization by using the conceptual approach of Collier, LaPorte, and Seawright (2012). The third chapter applies the developed typology to a number of countries for the purposes of testing and illustration and discuss its implications for state-business relations, as well as for business and state capacities. The fourth chapter concludes by discussing theoretical and normative implications of this conceptual work and by generating hypotheses for testing them in the future.

Chapter 1. Literature review and theoretical framework

This theoretical chapter reviews the existing conceptual approaches to defining and measuring digitalization in different fields of science (e.g., digitalization as a policy outcome; as a business process; as a technological method of format conversion; as a policy process, among others). To do so, it applies a modified version of the systematic review method as outlined by Petticrew and Roberts (2008). For the methodological details of the systematic review, see Annex I.

1.1. Reviewing approaches to conceptualizing digitalization

The concept of digitalization has long suffered from a very fragmented field of conceptualizations as evidenced by the academic literature (Vial 2021). Digitalization has often been confused with digitization, as well as separated from the concept of digital transformation, which seems to be interpreted in a similar fashion. There are several cases of different definitions being applied to the same meaning (e.g., digitization vs. digitalization). Finally, there is also a concept of e-governance/e-government, which is also indirectly relevant to the ongoing conceptual debate. To gain a better understanding of how one can refer to the multi-level process of the ever-increasing level of usage of digital technologies, I have mapped the existing conceptualization approaches. The full results are presented in Annex II, while this section discusses some of the most typical approaches to conceptualization.

As can be seen from Table 1 below, there are three approaches to defining digitalization in the academic literature. The first two groups are process-centric but disagree on the issue of scope, while the third one method-centric. The first group of authors identifies digitalization as a process, which involves an increased usage of digital technologies in all sectors of society. The interpretations of the latter part ("sectors of society") differ somewhat from author to

author. For example, an “increase in use of digital or computer technology by an organization, industry, country” (Brennen and Kreiss 2016) versus “the integration of multiple technologies into all aspects of daily life that can be digitized” (Gray and Rumpe 2015, p. 1319) are very different in terms of precision. While a broad definition of digitalization like the one by Gray and Rumpe might seem more appealing, a more clearly specified approach that can apply to organizations, industries, and countries is better because it prevents confusion and expands on the second group of definitions.

The second approach stems from the business and management literature. This business-centric group of definitions (Group 1.2 in Table 1) interprets digitalization as a process of adapting digital technologies to change the business model of companies and sees it only in the industrial/business context (see e.g., Isensee, Teuteberg, Griese, and Topi 2020; Jovanović, Dlačić, and Okanović 2018). According to this group, digitalization is largely driven by companies themselves to create revenue, improve business and value-producing opportunities. While this approach does not necessarily reject the broad scope of digitalization (e.g., digitalization of the government and the public sector), such a narrow conceptualization certainly ignores it.

The third less pronounced approach is that of “the action or process of digitizing; the conversion of analogue data” (Parviainen et al., 2017). Although this trend has been in decline in recent years, it still occasionally resurfaces in defining “digitization”, which leads to a conceptual confusion of “digitalization” vs. “digitization” (see Table 10 and Table 11 in Annex II).

Table 1. Typical definitions of "digitalization" in the academic literature by research streams

Reference	Definition
Group 1.1. Digitalization as the process of developing and adopting digital technologies[2] in individual, organizational, and/or societal contexts (N=15)	
Brennen and Kreiss, 2016.	Digitalization, by contrast, refers to "the adoption or increase in use of digital or computer technology by an organization, industry, country, etc."
Urbach and Röglinger, 2019.	Digitalization reflects the adoption of digital technologies in business and society as well as the associated changes in the connectivity of individuals, organizations, and objects.
Mammadli and Klivak, 2020.	Digitalization […] is the adoption of digital services by both public and private sectors.
Group 1.2. Digitalization as the process of increasing usage of digital technologies specifically at the company level for a competitive advantage (N=13)	
Jovanović, Dlačić, and Okanović, 2018.	Digitalization is [an era of digital transformation] where digital technologies are used to change business models, create revenue, improve business and value-producing opportunities.
Isensee, Teuteberg, Griese, and Topi, 2020.	Digitalization is defined as "the transformation of business models as a result of fundamental changes to core internal processes, customer interfaces, products and services, as well as the use of information and communications technologies."
Group 1.3. A technical process of converting information into digital formats (N=1).	
Parviainen et al., 2017.	The action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form.

Source: Own elaboration based on the systematic review (see Annex II for the full details of the systematic review)

Overall, the quantitative results of conceptual mapping demonstrate that there are three main meanings, three corresponding terms, and a degree of overlap between them. The results are concisely summarized in Table 2 below and visualized in Figure 2. Broadly speaking, digitization and digitalization have the most significant overlap across different meanings. Naturally, using these interchangeably is both a logical and conceptual fallacy. As indicated in

[2] Electronic tools, systems, devices and resources that generate, store or process data.

Annex II, most definitions suffer from various problems (most of conflation between the concept and its impacts/causes or usages of unclear terms), while conceptualizations themselves are spread over at least six broad scientific fields (economics; business and management; IT and communications; philosophy; archival research; and natural sciences).

Table 2. Conceptual matrix: digitization vs. digital transformation vs. digitalization

Concepts	**Meanings (from narrowest to broadest)**		
	Method of converting information (very narrow)	Process of developing and adopting digital technologies in a company (narrow)	Process of developing and adopting digital technologies in any context (broad)
Digitization	58% (11 out of 19)	0% (0 out of 19)	42% (9 out of 19)
Digital transformation	0% (0 out of 26)	100% (26 out of 26)	0% (0 out of 26)
Digitalization	3% (1 out of 29)	45% (13 out of 29)	52% (15 out of 29)

Source: Own elaboration based on systematic review.

"*Digital transformation*" is the only concept with a clearly established definition based on a scientific consensus across disciplines (largely dominated by management, business, and communication journals). As for the other two terms – digitization and digitalization, the situation is more complex because the field is fragmented in its approaches as shown by Table 2. The indicates shares show that digitization is more often defined as a process of converting information as opposed to digitalization, which has a much broader meaning.

Based on Table 2 and bearing in mind the list of conceptual shortcomings of the existing definitions listed in Annex II, the paper proposes to adopt the following approach to defining the three concepts in question. *Digitalization* should refer to the process of developing and

adopting electronic tools, systems, devices, and resources that generate, store or process data (i.e., digital technologies) in any individual, organizational, and societal contexts. The review clearly shows that it is necessary to understand digitalization as a continuous process, where there are certain inputs and outputs. The governments and businesses provide inputs[3] (e.g., infrastructure, education, and training) to generate outputs (e.g., increased uptake of digital technology).[4] This is particularly important because the conflation of impacts with the term itself is a very common (see Annex I for more details). Before digitalization itself produces some outputs (such as the increased level of use of digital technologies by individuals and/or organizations; accessibility of these technologies; their quality, etc.), both the public and private sector must provide some inputs. These are discussed in the following subsections.

As for other terms, *digitization* should be treated as a method/process of data conversion, a term way more technical in nature and much less process-centered than digitalization. Finally, *digital transformation* can be treated as a subset of digitalization, i.e., the same process, which occurs specifically within a company context. In that sense, the concept of digital transformation is extremely close to that of *e-governance,* which is a similar phenomenon, but happening in the public sector exclusively. The results of the systematic review and conceptual mapping are visually illustrated by Figure 2 below.[5]

The concept of e-governance is placed into the figure for mere illustration, but it was not a part of the systematic review since it does not overlap either with the concept of digital transformation or digitization. Thus, there was no need for a review to address a conceptual

[3] While the share of inputs usually varies.
[4] I leave out the results and impacts of digitalization out of the scope of this discussion.
[5] Since e-governance does not overlap with the concepts of digital transformation or digitization, it was excluded from the systematic review, but was presented in the figure for explanatory purposes.

problem (due to the lack of a problem per se). A systematic exploration of the academic literature defines e-governance as "the use of information and communication technologies (ICTs) in government…" with three difference goals: "(1) alter governance structures or processes in ways that are not feasible without ICT and/or (2) create new governance structures or processes that were heretofore not possible without ICT and/or (3) reify heretofore theoretical ideas or issues in normative governance" (Bannister and Connolly 2012). Thus, e-governance can be certainly seen as a subset of digitalization specifically in the public sector. Some parallels can be also drawn with the concept of digital transformation (i.e., juxtaposition of public and private sectors).

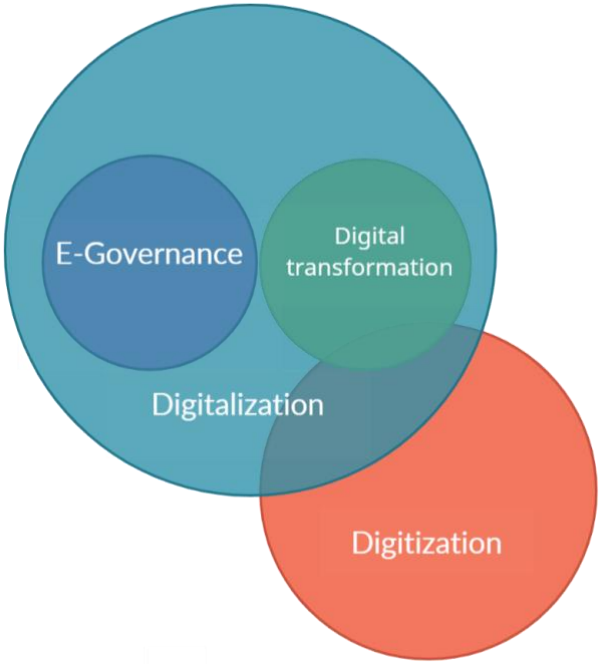

Figure 2. Relationship between the different concepts of digitalization, digitization, digital transformation

Source: Own elaboration based on Annex II and e-governance literature.

1.2. Inputs of digitalization: function of businesses and governments

Having defined digitalization, the paper proceeds with reviewing its constituent dimensions. While the existing approaches focus a lot on measuring the outputs (i.e., scale) of digitalization, it is extremely important to understand digitalization's *inputs* – what and who drives it. As shown by the conceptual discussion above, digitalization may happen in different contexts – both institutional and societal. This is also implied in the definition of digitalization developed in this paper. Indeed, in socio-economic terms digitalization could involve both the public and private sectors.[6]

There is a significant body of literature on the role which private businesses play as drivers of digitalization. There is both quantitative and qualitative evidence (Khan, Khan, and Aftab 2015; Degryse, 2016; Parviainen et., 2017; Durkiewicz and Janowski 2018; Kattel and Mergel 2019) suggesting that progress in digitalization strongly correlates with economic growth, improvements in the quality of management and governance, and higher degree of business competitiveness among others. As the conceptual discussion above related to "digital transformation" at the level of individual companies (as a subset of digitalization) shows, the process of developing and adopting digital technologies can also be used as a business strategy to acquire competitive advantages (Garcia-Muiña et al., 2018).

[6] Naturally, digitalization might also be fostered by individuals as well. However, the isolated impact of one individual on the process itself is usually negligibly small, which is why it has been left out of this discussion aimed at identifying drivers. Nevertheless, it constitutes a serious avenue for potential future research.

Theoretically, there are five avenues of how businesses foster the process of digitalization. First, businesses are the key drivers of development and uptake of digital technologies from both supply and demand sides. The ICT sector is becoming increasingly influential in many industrial and post-industrial economies worldwide as more and more innovations (both digital products and services) are developed in its industries. If not developing, then at least adopting digital technologies helps businesses to get an edge over their competitors as the increased usage of digital technologies is usually associated with more effective and efficient communication, data collection, and analysis at the company level among other things (Bekkhus 2016; Demirkan, Spohrer, and Welser 2016; Chanias 2017). Second, apart from the digital products and services themselves, businesses (often in partnership with government) also create the necessary conditions for a digital uptake by developing the infrastructure (e.g., telecom companies, providing access to Internet; energy suppliers.

Third, the private sector can contribute to the improvement of digital literacy from both supply and demand side. On the supply side, there is an increasing variety of learning opportunities offered by private businesses that help to improve digital skills (e.g., Coursera). On the demand side, businesses themselves are becoming increasingly interested in hiring digitally qualified personnel especially in countries that are highly advanced economically (EC 2022). Fourth, the private businesses have a financial role – i.e., that of investing, providing the necessary capital. This function can be exercised even by non-tech firms to foster digitalization through additional financial inputs. Finally, in some cases, businesses might even self-impose industry standards on themselves to better cooperate with other players in the market, increase the quality of their products or increase consumer's trust (Gunningham and Rees 1997).

The role of the public sector and government is the flipside of the coin, in many ways mirroring that of the private sector. Developmental literature provides us with the necessary foundations to understand the essential role of governments in fostering digitalization (Mazzucato 2011; Evans and Heller 2015; Vasilev et al., 2020). From the perspective of the "developmental state" theories (Evans and Heller 2015), digitalization can be seen as a method for national governments to ensure "capability extension" (including the improvements in both human potential and cohesiveness of bureaucracy) because it allows for more effective and efficient accumulation and analysis of information. This stream of literature shows us that there are several ways through which the state shapes digitalization along with the businesses. The role of the state in fostering digitalization has been discussed in a variety of within and cross-case studies (Kattel and Mergel 2019; Chen et al., 2021), as well as in some large N studies (Sabbagh et al., 2012; Mubarak et al., 2020), albeit the causal mechanisms and research questions in these studies varied significantly. Finally, the discourse of digitalization might very well fit into the ongoing discussions among modernization theorists. Below the paper proceeds with the discussion of five key functions of the government, which somewhat mirror those of the businesses.

The first function of the state is to create a regulatory regime, which touches upon both development and usage of digital technologies (Vasilev et al., 2020). Sometimes, this framework is described as "digital governance" (Milakovich 2012). This function is important, even if we adopt a very *laissez faire* approach and turn a blind eye on the issues of taxation, production limitations imposed on the market players, or import/export restrictions. The reason for that is rooted in the need for some unified technical and safety standards both at national and international levels to facilitate information exchange.

The second function of the state is the usage of various fiscal and administrative stimuli to contribute to digitalization (Mazzucato 2011; Chen et al., 2021). This might take various forms such as usage of the R&D funds and/or targeted subsidies to create more innovative solutions for developing new digital technologies[7] (Mazzucato 2011) or, alternatively, relieving tax pressure and providing broader financial support for the companies that adapt and/or develop such technologies (Chen et al., 2021). In certain cases, state-owned enterprises or institutes might receive direct funding to develop digital technologies and services on their own.

Third, the state takes up a large burden in providing the necessary education and training for the general populace (Vasilev et al., 2020; EC 2022). The public education system in most countries (including both schools and universities) are seen as the main providers of basic digital skills. Fourth, the states also contribute to digitalization by digitalizing their own services and processes or developing their own digital technologies as we see from the emerging concept of e-governance (Trček 2019). A particularly illustrative example is that of the Internet, which emerged from the research programs of the US Department of Defense, and not as a company product. In some cases, as recently evidenced by the COVID-19 pandemic, development of digital technologies by the state (e.g., green pass applications) might also come as a necessary response to internal or global crises (Handley 2019).

Fifth, the state is also responsible for extending the backbone telecommunications infrastructure and securing access to an inclusive and affordable Internet (ITU 2017; UN 2022). However, this function is often exercised jointly with the private businesses and in many

[7] The examples of how Google's first algorithm was supported by the National Science Foundation grants is certainly illustrative (even though the Silicon Valley is usually considered to be the heart of venture capital sector).

countries, it is hard to see a clear cut. That said, in the international dimension, the state has an opportunity to exchange experiences with other governments as well as learn more about the existing national good practices, which help to foster digitalization (EC 2022; Cohen and Fontaine 2020). Table 3 below summarizes the key functions of governments and private businesses in digitalization.[8]

Table 3. Summary of business and government functions in digitalization

Functions	**Sectors**	
	Private sector	***Public sector***
(Self-)regulatory function	Self-regulation (in some cases)	Regulation
Developmental function	Development and uptake of digital technologies	
Infrastructural function	Developing the necessary infrastructure	
Educational function	Improvement of digital literacy by supplying and/or purchasing training modules (mostly complementary function)	Improvement of digital literacy through education and training at schools, universities, and public institutions (mostly dominant functions)
Financial function	Private investment in profitable projects involving digital technologies	Subsidies supporting public goods (i.e., administrative and financial stimuli within its own jurisdiction)

Source: Own elaboration based on the literature review.

1.3. Outputs of digitalization: relevant measurement approaches

Despite the conceptual mess with the definition of digitalization, ironically there is a plenitude of measurement systems for digitalization (at least, when it comes to digitalization as defined

[8] The discussion omits what might be described as the "external relations function" – e.g., private businesses can also contribute to digitalization not only domestically but also in other countries and expanding to new international markets, while governments might conclude agreements, exchange good practices in the field of digitalization and development, etc. The reason for that because it can well be integrated into other functions and, arguably, represents a dimension of all other functions rather than a separate function of its own.

by this paper).[9] While there are several academic frameworks for measuring digitalization, public policy efforts (e.g., reports developed by international organizations such as the UN, the EU, or their subcontracted consultancies) have also been extremely active in both developing and applying such frameworks. Similar to the systematic review, the literature review has been focused either on highly cited approaches or those that have produced significant panel data. Interestingly, both streams, despite some minor differences, focus on similar dimensions. A concise summary of these indexes and approach is presented in Table 4.

[9] I.e., the process of increasingly developing and adopting electronic tools, systems, devices and resources that generate, store or process data (i.e. digital technologies) in any individual, organizational, and societal contexts.

Table 4. Summary of business and government functions in digitalization

Indexes / Categories of information	Objectives and context	Nature	Data collected	Geographic scope	Components
Kotarba 2014	Develop a theoretical framework for the assessment of digitalization outputs	Academic	No data	N/A (Global)	Digital: • Economy • Society • Industry • Enterprise • Client
Katz and Koutroumpis 2013		Academic	No data	N/A (Global)	• Affordability • Infrastructure Reliability • Network Access • Capacity • Usage • Human Capital
ICT Developments Index	Develop and apply a hands-on global policy tool for digitalization output measurement	Policy output	Panel data (limited)	Global	ICT: • Access • Use • Skills
WEF Index		Policy output	Cross-sectional	Global, partial	• Access • Affordability • Reliability • Speed • Usability of digital technologies • Skills of the citizens
BBVA Index (DiGiX)		Policy output	Cross-sectional	Global, partial	• Infrastructure • Costs • Regulation • Users' adoption • Enterprises' adoption • Digital content
DESI	Develop and apply a hands-on global policy tool for the measurement of digitalization outputs in the EU context	Policy output	Panel data	European	• Human capital • Connectivity • Integration of digital technology • Digital public services • Research & Development in ICT

Source: Own elaboration based on the literature review.

Purely academic measurement frameworks are somewhat broader but also more abstract in nature, if compared to the ones produced by the public policy sector. Kotarba approaches the measurement of digitalization through five metric categories – top-to-bottom – of how different institutional levels adopt digital technologies. These include economy, society, industry, enterprise, and client – from broadest to narrowest (Kotarba 2017), with individual metrics. Specifically, the "Economy" category examines macro-economic indicators such as the national level of connectivity or the global use of Internet in a country. The "Society" category looks at the citizen's contributions through such metrics as the level of ICT investment, number of Internet users, development infrastructure, or cybercrime. The "Industry" category further narrows down the scope through the metrics aimed at digitalization in specific industries, and so on. A disadvantage of this measurement framework is that it does not provide us with comparable cohesive indicators across different levels. Furthermore, it has not been applied to any cases and there is no database based on this framework. Nevertheless, the approach demonstrates the diversity of outputs of digitalization in many sectors of society.[10]

A different approach is employed by Katz and Koutroumpis (2013), revolving around six "constituent elements" of digitalization rather than levels. Those dimensions are ubiquity, affordability, infrastructure reliability, network access, capacity, usage, and skills. Ubiquity refers to the adoption of mobile and fixed broadband networks accounting for broadband accessibility and ownership of data devices, such as PCs. Affordability is essential and derives from the relative access costs of providing such access. Reliability of networks depends on the

[10] The question of broader society-level digitalization is also a relevant topic for the future research and could be studied separately, especially if one considers individuals as actors relevant for digitalization as well. In this case, it might very well be that both business and state-driven digitalization have spillover effects into societal digitalization.

annual network investment per subscriber and the faults reported per line. Speed is proxied by the performance of country level international links and the capacity of wireline 'last mile' offerings. Usage refers to utilization and adoption of all commercial activities, government services, social media adoption and data usage. Skills contribute to digitization both in terms of development of local service offerings and usage capacities. While it addresses one of the key flaws of Kotarba's measurement, the approach of Katz and Koutroumpis has still not evolved into producing panel data measurements.

By contrast, measurements produced by regional and international organizations seem are used more actively for data collection and, in some cases, have even produced panel data. The broadest framework was developed by the International Telecommunications Union (ITU) – ITU Index of ICT Development.[11] One of the objectives of the ICT Development Index is to measure "progress in ICT development in both developed and developing countries"; and "the development potential of ICTs and the extent to which countries can make use of them to enhance growth and development in the context of available capabilities and skills" (ITU 2017). Its essential components somewhat overlap with the approach of Katz and Koutroumpis. Rather than focusing on different levels, the ICT Development Index focuses on dimensions such as ICT infrastructure and access to it; ICT usage; as well as digital skills – with every dimension having its smaller indicators / metrics. Conceptually, the ITU index assumes that impact of digitalization stems from three stages of digital "evolution" (ITU 2017). The index's authors argue that ICT readiness (i.e., infrastructure and access) lead to higher ICT usage, conditioned on ICT skills. Only combined with the skills, readiness can lead to any impact. An

[11] Conceptually, it does not use the term "digitalization", but rather ICT development, but its scope corresponds to that of the digitalization definition (specifically, its outputs) adopted in this paper.

important advantage of the ICT Development Index is that it covers a huge sample of countries (the last 2017 edition covered 112 countries), remaining the most comprehensive global measure of digitalization. However, it has never been updated since 2017.

The World Economic Forum (WEF) experts also developed a similar approach (Sabbagh et al., 2012) even though it has not produced any panel data so far. This index, which focuses on five dimensions, provides useful conceptual insights as it reflects some patterns in how digitalization is measured. The index's dimensions are ubiquity (or accessibility, i.e., "extent to which consumers and enterprises have universal access to digital services and applications"), affordability, reliability, speed, usability of digital technologies as well as the general skills, which is something that overlaps with the approach of Katz and Koutroumpis (2013). The criteria of affordability, reliability, speed, and usability refer to the "quality" characteristics of digital technologies and can, therefore, be put under the umbrella of the ICT usage since they are direct determinants of the uptake of these technologies.

The EU Digital Economy and Society Index (DESI), which was developed by the European Commission to measure advancements in digitalization in individual EU Member States, follows a logic similar to that of the ITU but it is more elaborate and in-depth. DESI also examines what it sees as constituting dimensions of digitalization, which are (infrastructural) connectivity, digital skills of the population, usage of Internet by the general populace, integration of digital technology in businesses, as well as digital public services (EC 2022). Each dimension consists of a larger number of indicators if compared to the ITU Index. DESI is also published annually, unlike the ITU index, which improves the precision of measurements. Unlike many other indexes, DESI particularly stresses the role of government in some of its metrics such as the digital public services measurement as well as development

of infrastructure (incl. creation of a positive regulatory environment that fosters investments from the private sector too).

Finally, the role and responsibilities of government is also stressed in the BBVA index. Apart from the usual dimensions that we have already seen in the previous indexes such as the infrastructure, users' and enterprises' adoption (i.e., accessibility), and affordability, there is one more dimension, which focuses on the governmental regulation of the digital sector (Cámara and Tuesta 2017). This, however, falls more into the dimension of inputs rather than outputs. The "Regulation" dimension in this index focuses on the quality of laws related to the ICT, effectiveness of the law-making bodies, and effectiveness of the legal system in challenging regulations among others. The authors particularly stress a crucial role that the government plays in ensuring an environment that is favorable to fostering digitalization. While this standpoint is correct, the need to differentiate between inputs and outputs is also evident, as reflected in this paper.

To conclude, it is evident from this overview of measurement tools, there are certain overlapping metrics in all these indexes. Specifically, these are: a) the accessibility of digital technologies and services (incl. their accessibility); b) integration of offered digital technologies and services; c) quality and presence of the necessary infrastructure; d) digital skills of the population; and e) provision of digital public services. Interestingly, category c) "quality and presence of the necessary infrastructure" measures input of digitalization, according to the conceptual framework developed in this paper. As for the other three metrics, the first two specifically refer to digitalization outputs, while digital skills more relate to long-term results or impacts.

It also becomes obvious that digitalization is a two-dimensional phenomenon, which can be characterized not only by scale (i.e., uptake and usage of digital technologies; measurements of relevant infrastructure), but also by drivers (i.e., the role of businesses and governments that varies from one national context to the other). This practically means that the suggested conceptualization will work in different national contexts with no regard to normative aspects (i.e., both in democratic and autocratic countries). It also allows for placing various metrics in the existing academic literature under either of the two dimensions, thus, effectively going up the level of abstraction. Based on this conceptualization, the next chapter proceeds with the development of a typology of digitalization.

Chapter 2. Typology development: methodological aspects

This chapter first describes the details of the typology method, with a specific focus on its utility. Then it applies the classificatory typology method to the overarching concept of digitalization based on the two dimensions identified during the systematic review in accordance with the standards developed by Collier, LaPorte, and Seawright (2012). Specifically, these dimensions are based on the previously discussed inputs (i.e., largely state-driven vs. largely business-driven) and outputs (i.e., large-scale vs. small-scale) of digitalization. The dimensions of the proposed typology are operationalized through concrete indicators based on the theoretical discussion in the previous section as well as specific functions of businesses and governments related to digitalization.

2.1. The need for a typology of digitalization and its utility

Typologies are powerful tools used in the qualitative tradition of social sciences, which help researchers to better understand the nature of the phenomenon in question and sharpen the measurement tools targeting it. There are various types of typologies,[12] with conceptual and explanatory typologies being the most prevalent ones. A conceptual typology establishes a property space, where the cell types are in relation to the overarching concept (digitalization), while row and column provide the defining attributes (input and output) (Collier, LaPorte, and Seawright 2012). By contrast, in an explanatory typology, the constituent attributes would be extracted from the variables of a preexisting theory, while the dimensions of the property space would reflect alternative values of the independent variable (Elman 2005). Thus, the cell types

[12] Pun unintended.

are outcomes hypothesized to be explained by the row and column variables (Collier, LaPorte, and Seawright 2012).

This paper employs the method of developing a conceptual typology of digitalization rather than an explanatory one. In this specific typology, categories or cells have to be collectively exhaustive and mutually exclusive, but not ordered so as they could form a nominal scale. However, this does not imply the absolute lack of potential for hybridity in the proposed typology as it can be presented through more parsimonious or more expansive measurements of inputs and outputs.

There are three strong theoretical reasons explaining both the theoretical and empirical utility of a typology of digitalization. First, typologies might be helpful for introducing conceptual and theoretical innovations, sometimes drawing together multiple lines of investigation or traditions of analysis (Collier, LaPorte, and Seawright 2012). This means that the future research using digitalization as either explanatory or outcome variables, will be able to draw better comparisons or focus on specific types of digitalization rather than overgeneralizing. Second, the potential rigor and conceptual power of qualitative analysis through typologies can also provide new insights into underlying dimensions of a phenomenon, thereby strengthening both quantitative and qualitative research (Collier 2008; Collier, LaPorte, and Seawright 2012). In the case of digitalization, it could draw closer attention to the role of inputs (i.e., functions of state and private businesses in digitalization as well as state-business relations in general) since the role of outputs is already emphasized enough in both academic literature and policymaking.

Third, conceptual typologies can also help with mapping out variation in the outcomes of a phenomenon being explored (i.e., outcomes and explanation are not placed in the same

matrix) (Collier, LaPorte, and Seawright 2012). This is also relevant in the case of digitalization, where differentiating between inputs and outputs is important since there are instances of confusion in the existing measurement tools (e.g., assigning infrastructure development to outputs rather than inputs, even though infrastructure itself is not really the output of digitalization, but merely preconditions it).

Empirically, typologies help to introduce further refinements to the overarching concept, especially if it is not necessarily static (Collier 2008; Collier, LaPorte, and Seawright 2012), which is the case with digitalization. In its case, a typology can also help to refine measurement by creating categorical variables that will represent distinct qualitative (nominal) scale. This means that one would not have to pile up all countries (such as e.g., Ukraine and China) into one group, allowing for better and more precise comparisons. Developing nominal scale is the first and most basic step before proceeding with more complex levels of measurement. Finally, according to Collier, LaPorte, and Seawright, typologies can also be employed for research design purposes – for example, to establish an appropriate set of cases for detailed study in the future, overcome an impasse in statistical analysis, and synthesize conclusions (2012). To see whether this is going to be the case, however, the developed typology would need to be applied in empirical research.

2.2. Dimensions of the proposed typology

Having defined the overarching concept (digitalization), its dimensions (inputs and outputs) and having explained a typology's utility, the paper proceeds with typology building. The unit of analysis in the typology of digitalization would be the cases of digitalization in individual countries. Below, the paper proceeds with qualitative operationalization of each of the dimensions – input and output. Operationalization of the input dimension will be centered

around the respective roles of government and businesses based on three categories – a) control of resources; b) regulatory capacity of the government; and c) institutional control. By contrast, operationalization of the output dimension will rely on the existing measurement tools. Specifically, it will include four dimensions, which have been identified in the theoretical chapter: a) accessibility of digital technologies and services; b) integration of digital technologies and services in the private sector; and c) digital public services. The paper first discusses each of the operationalization areas and respective indicators and then summarize them in tables.

2.2.1. Input operationalization

Operationalization of inputs is far less developed in the academic literature than operationalization of outputs. Therefore, operationalization of inputs is based on some theoretical assumptions coming from diverse academic literature in fields such as political economy, public policy, and public administration. It also specifically focuses on dimensions, which are conducive to better understanding the role of governments vs. businesses in digitalization, which is why some of its indicators are tailored to governments or businesses only (see Table 5 below for more details).

Operationalization of inputs is centered around the following dimensions: resources, coordination capacity, and institutional control. Each dimension of operationalization is also connected to the business and government functions discussed in the previous chapter. The "resources" dimension assesses the extent of the private sector vs. government's control over key resources (such as capital and infrastructure) necessary for IT development. Specifically, it stems from the financial and infrastructural functions of both businesses and government

discussed before. Indeed, the role of capital and other resources is fundamental to any idea of development (Agénor 2010; Esteva 2010). Ideally, to understand the extent of government vs. business control over resources in the IT sector, one could examine such indicators as the share of government investment into the IT sector; the share of government-owned companies in ten top-performing national IT companies; and the share of the government owned-ICT infrastructure. However, due to the empirical lack of such detailed data, this typology will use the index of economic freedom – specifically, such indicators as business freedom (a proxy for understanding how well businesses might control the existing infrastructure and other relevant resources) as well as tax burden (the extent to which the businesses are burdened by the government with the tax regime).

Furthermore, a qualitative assessment of the structural power of businesses as key investors into specific sectors of the economy would clarify the broad extent of businesses' role in resource aggregation and distribution (Fuchs and Lederer 2007; Kesarchuk *forthcoming*). An additional complementary indicator would be the assessment of the overall market access situation (i.e., to what extent businesses are free to enter the market in a specific country or whether it is highly restricted by the government). Finally, the last indicator will be a qualitative assessment of the presence or absence of monopolies in the ICT market as well as their nature. Here, understanding whether monopolies are state-owned or private will be a key determining factor for assessing the input.

The second dimension of "coordination" weighs the regulatory power of the government as opposed to the private sector's ability to self-regulate and/or impact the regulatory process. This dimension stems from the (self-)regulation function of both governments and businesses. It is more challenging to operationalize because there are no

ready-made measurements for regulation even outside of the digitalization research field. Indeed, most of them focus on the quality of government regulation rather than on its extent (Schleifer 2005; Parker and Kirkpatrick 2012), not to speak about self-regulation of businesses. Examining only the legal texts themselves might also not be the best solution because most of the time it is unclear whether the legislation is the product of business advocacy, state efforts, or both. Therefore, here operationalization would have to rely on the triangulation of qualitative analysis of secondary evidence and expert assessments more heavily than with other areas based on three indicators.

The first indicator would be a variety of the capitalist system (or even more precisely, the kind of economic system) observed in a specific country. The kind of capitalist system in place is strongly associated with how extensively the state coordinates economic matters or how free businesses are to act at their own will (Hall and Soskice 2001; Haagh 2019). Thus, one would expect a much stronger role of the state in coordinated market economies or in state capitalist economies, while a much stronger role of businesses in liberal market economies. The second indicator will be to establish whether there are private and/or state-owned programs fostering digitalization in a given country. Dominance of one or another type of scheme will be indicative of the input's nature. The third indicator is whether ICT and/or general business associations in a given country are government-affiliated/controlled or independent. Coherence and independence of business associations as coordinating, representative, and consultative institutions is directly associated with the coordination capacity that any industrial sector wields in dealing with the government (Newmark 2017; Haufler 2013). If these associations are not present and independent, the collective ability of businesses to resist the government regulations falls significantly.

Finally, the third dimension of "institutional capacity" measures the dominance of government or businesses in the institutional setting of the IT sector (Bennet 1998) through four indicators. The first indicator of the information control capacity determines the ability of the government to limit the circulation of information through digital means. Specifically, it measures the government's ability to filter out or censor certain types of information and to shut down the Internet, which represent significant threats to independent functioning of the IT sector. Measurement of information control capacity will be based on some of the existing indexes such as the VDem Digital Society Index.

The second indicator of judicial effectiveness indicates to what extent the government is constrained by the judiciary and whether there is evidence suggesting that the judiciary is biased (whether to the government's side or the private sector's side). The third indicator is whether there is a public regulatory body that specifically targets the IT sector and whether this body is politically and legally independent since market regulation is often referenced as one of the most important economic tasks performed by the government (Schleifer 2005). Presence of such an institution and, especially its political dependence, can be indicative of moderate or high levels of the government's institutional influence in the market. By contrast, any evidence indicating the presence of self-regulation practices in a given country (esp., in the absence of a strong government regulator), would indicate a stronger business-driven input.

The final indicator will be the lobbying power of businesses, which represents the extent to which businesses in a given country can influence the process of decision-making and/or impact the content of adopted regulations. This indicator will be helpful to understanding the extent of businesses' ability to counter-balance the government's

information control and regulatory capacities. Table 5 succinctly summarizes the proposed input operationalization approach.

Table 5. Summary of operationalization dimensions and indicators for digitalization inputs

Concept	**Operational dimension**	**Indicators for:**		**Data sources**
		Government-driven inputs	**Business-driven inputs**	
Inputs of digitalization	Resources	Tax burden	N/A	Index of Economic Freedom; secondary sources on the market structure; country expert's assessments (interviews; focus groups; surveys)
		Business freedom		
		State monopolies	Private monopolies	
		Market access		Secondary literature on the country; country expert's assessments (interviews; focus groups; surveys).
		N/A	Structural power of businesses	
	Coordination capacity	Variety of a capitalist system in a country		
		State programs supporting digitalization	Private incubators or funds supporting digitalization	Secondary and grey literature on the country; national ministries' and incubators' websites; country expert's assessments (interviews; focus groups; surveys)
		Affiliation of business associations		Assessments of experts or association members (interviews; focus groups; surveys); secondary evidence from news reports and NGOs.
	Institutional capacity	Information control by the government	N/A	Relevant indexes (VDem Digital Society); expert assessments; secondary evidence from news reports and NGOs.
		Presence and independence of a market regulator	Established practices of self-regulation	Expert assessments; secondary evidence from news reports and NGOs.
		N/A	Lobbying power of the businesses	
		Judicial effectiveness		Index of Economic Freedom.

Source: Own elaboration.

2.2.2. Output operationalization

Operationalization of digitalization outputs has been developed in the academic and grey literature significantly better than that of inputs, as it was illustrated by the theoretical chapter. Therefore, the proposed operationalization relies on the key findings of the literature review and reuses most applied indicators from the existing indexes. Operationalization of digitalization of outputs will be centered around the dimensions of accessibility, as well as uptake in the private and public sector. Each dimension is connected with the functions of governments and businesses in the digitalization process discussed in Table 3 above.[13]

The "accessibility" dimension specifically looks at the basic uptake of digital technologies and services in society. This dimension stems from the infrastructural function of governments and private businesses. Unlike the "integration" dimension, it aims to understand whether the population of a country has sufficient conditions to access digital technologies and services. Similar to DESI and ICT Development Indexes, this dimension relies on a variety of indicators including the share of households with a computer; with Internet access; and with fixed-broadband subscriptions; as well as on the number of mobile-cellular telephone subscriptions per 100 inhabitants.

The "uptake in the private sector" dimension examines how well digital technologies and services are integrated in the private sector. This dimension stems from the developmental function of private businesses. The first key indicator is the capacity and readiness of the

[13] The proposed operationalization approach omits the "digital skills" dimension, which would examine how well-prepared is a certain population for the uptake of digital technologies and services in terms of education, due to its contested nature. On the one hand, it can be viewed as an input of digitalization, but on the other hand it can also be interpreted as an output or, even more correctly, a long-term result. However, it is hard to interpret it as an immediate output, which is what is directly relevant for this operationalization.

national economy to adopt and explore digital technologies for economic and social transformation. Another important indicator is the fixed broadband subscriptions as shares of the total population, which is an important tool for accessing high-quality and high-speed Internet. Finally, as for digital services, the number of people using social media as a share of the population is a relevant indicator. The reason for that is because social media are one of the most widespread digital services used globally, for which data is relatively accessible.

The "uptake in the public sector" dimension examines how well digital technologies and services are integrated in the public sector. This dimension stems from the e-governance literature discussed in the theoretical chapter (i.e., e-governance as a conceptual subset of digitalization specifically in the public sector) and from the developmental function of the government. It is complementary to the "integration" dimension (i.e., stems from). Relevant indicators here, therefore, would include provision of online public services, ICT connectivity in the public sector, and human capital in accordance with the UN E-Governance Index. Table 6 below succinctly summarizes the proposed output operationalization approach, relevant indicators, and provides examples of potentially relevant data sources.

Table 6. Summary of operationalization dimensions and indicators for digitalization outputs

Concept	Operational dimension	Indicators	Data sources
Outputs of digitalization	Accessibility of digital technology and digital services	Share of households with a computer	ICT Digital Development Index; Data Reportal Digital Index; DESI Index; IMD Database.
		Share of households with Internet access	
		Share of households with fixed-broadband subscriptions	
		Mobile cellular subscriptions per 100 inhabitants	
	Uptake in the private sector	Digital competitiveness	ICT Digital Development Index; Data Reportal Country Fiches; Digital Competitiveness Index.
		Number of fixed broadband subscriptions per 100 inhabitants	
		Share of population using social media	
	Uptake in the public sector	Online public services	UN E-Government Knowledgebase
		ICT connectivity in the public sector	
		Human capital	

Source: Own elaboration.

2.2.3. Typology matrix

Based on the operationalization details discussed in the previous sub-sections, Table 7 below presents the developed typology matrix. In total, it foresees four different types of digitalization based on the scale of outputs and the type of inputs (i.e., whether digitalization is government or business driven). The produced typology offers several analytical categories, which rather function as containers but not as strict, ideal types of digitalization. The individual cells of the typology matrix are mutually exclusive, in line with the methodological discussion above (i.e., a country cannot experience a large and small-scale digitalization process at the same time). Finally, while often typologies assume stability, I stress that this specific typology is process-centric; it investigates a dynamic phenomenon, which is why countries could potentially move

from one type to another within the typology cells. While this typology most certainly acknowledges the possibility of developing quantitative approaches to measuring digitalization, it offers a broad balanced qualitative paradigm as a steppingstone for these measurements. The empirical showcasing, therefore, will proceed in a qualitative fashion.

Table 7. Proposed typology of digitalization: parsimonious version

Dimensions		**Outputs**	
		Large-scale outputs	**Small-scale outputs**
Inputs	**State-driven inputs**	Large-scale state-driven digitalization – LSD ("Leviathan type")	Small-scale state-driven digitalization – SSD ("Flagging type")
	Business-driven inputs	Large-scale business-driven digitalization – LBD ("Corporate type")	Small-scale business-driven digitalization – SBD ("Tinkering type")

Source: Own elaboration.

Chapter 3. Empirical showcasing

This chapter applies the proposed typology to several country cases. Each of the developed digitalization types is illustrated with typical cases. While choosing countries for empirical showcasing, I have concentrated on the Eurasian and, specifically, post-Soviet region. This was done to make sure that while there is sufficient variability in cases, they would also stem from, historically speaking, a similar socio-economic background. Furthermore, this choice also limits my ability for "overfitting" (i.e., choosing only cases that fit the typology). Nevertheless, I have still chosen the most typical and illustrative cases rather than borderline ones to stress the conceptual value of this typology. Questions related to the future potential for hybridity in and expansion of this typology are discussed in the concluding section.

Methodologically, in terms of data aggregation, I have collected relevant evidence from a variety of secondary sources including a variety of already existing indexes such as the ICT Development Index of the ITU, World Bank Development Data, Data Reportal, and other datasets (the detailed assessment of secondary sources can be found in Annex III, where quantified scores are also specified). In rare cases of missing data, approximations based on my regional expertise were given. Temporarily, data collection was limited to 2021, unless up-to-date data was not available. While assessing the data, a method of qualitative scoring has been applied to both the indicators and operationalization dimensions themselves on a scale from 1 to 5 ("very low", "low", "moderate", "high", "very high). Quantitative scores for separate indicators have been converted into these qualitative descriptors using the method of proportional conversion (unless the thresholds were set by the index authors differently). Final qualitative scores individual dimensions were given using the weighted averages of scores for

separate indicators with an assumption of equal weighting (see Annex III for all the details).[14] The paper will start with the cases of state-driven digitalization first: Russia (large-scale digitalization) and Turkmenistan (small-scale digitalization). Comparatively, Turkmenistan is a relatively extreme case of government's dominance regarding inputs, while Russia represents a more generalizable and/or externally valid case.[15]

As of late 2021, the Russian government maintained a moderate degree of control over resources (see Annex III for a detailed summary). On the one hand, Russia boasts a relatively liberal flat taxation system and moderate levels of business freedom. The rise of many Russian IT giants such as Yandex, VK, and Avito throughout the 2000s and 2010s has been partly attributed to a relatively free ICT market and to the government support (Lowry 2020). The level of business freedom in 2021 was moderate. While the market is not directly controlled by state monopolies, it is being increasingly subsumed by state-affiliated oligarchs (e.g., Alisher Usmanov and the VK Group). On the other hand, Russian businesses enjoy this freedom unless they come into dispute with the government. Their structural power also remains rather low (Kesarchuk *forthcoming*), while market access can be problematic if the government sees a certain sector or (sub-)sector as critically important (US ITA 2021c).

As for the second dimension of coordination, the Russian government still plays a significant dirigiste role in the framework of state-driven oligarchic capitalism (Djankov 2015). The government clearly sees IT development as one of the key economic priorities, providing

[14] The author admits that the idea to not assign individual weights automatically assumes equal weighting. However, the topic of examining specifics weights of individual indicators and/or operationalization dimensions can be explored in future research. This will naturally necessitate leading further adjustment of indicators and/or operationalization dimensions.
[15] Or, at least, it did so until the end of 2021, which is the end point of data collection.

it with various tax concessions, state-funded educational programs, and administrative deregulation. At the same time, the private sector also offers some opportunities for incubation and startup development too. Despite this, the government exercises control over a network of government-affiliated business associations. These are controlled by the people very close to the top Russian leadership (e.g., the Russian Union of Industrialists and Entrepreneurs is headed by a high-ranking member of the polit-bureau of the governing party).

Finally, to be able to stir the direction of digitalization, the Russian government maintains a strong institutional grip through the market regulator (Roskomnadzor). The regulator has a high level of institutional power but is not politically independent. In fact, it routinely exercises censorship functions. Little to no evidence of business self-regulation is observed. Theoretically, some businesses have lobbying power, but these are largely dependent on their affiliation with the government (Kesarchuk *forthcoming*; Djankov 2015). A poorly functioning judicial system demonstrating systemic evidence of biases towards the state as well as extreme levels of corruption exacerbates the situation for businesses even further. The Russian legislation provides the government with legal tools to effectively restrict information flows. Theoretically, the government's ability for Internet shutdown remains quite high (with the government developing the project of a "Sovereign Internet" functioning without any external connections to the Worldwide Web). The filtering capacity is also theoretically very high, but it has not been used in practice as actively as in the case of Turkmenistan, for example (at least, until 2022).

The government's efforts have been paying off in terms of digitalization outputs. Accessibility of digital technology and digital services is relatively high in Russia, especially by regional standards (even though it is quite uneven across the country. The uptake of digital

technologies both in the private and public sectors is rather high as well, even though Russia does not perform as well in terms of broadband connections if compares to the EU Member States such as Estonia. The outputs of digitalization in the public sector have been particularly impressive, with the country climbing in the UN E-Government Development Index from the 60th position in 2008 to the 32nd in merely ten years (UN 2022). Nevertheless, Russian businesses demonstrate relatively low performance in terms of digital competitiveness, which might be correlated with some of the input-related challenges listed above. Overall, the Russian case demonstrates that the state can be both genuinely interested in digitalizing the country and pour significant resources into this endeavor, but still try to limit any potential "unnecessary" political implications of digitalization (e.g., through a relatively high degree of control – filtering and Internet shutdown capacity).

By contrast, as illustrated by the collected evidence, the case of Turkmenistan is a clear example of how the government might not be interested at all in digitalization as an economic opportunity but merely as a vanity project. The Turkmen government maintains a strong hold over resources. Business freedom remains extremely limited in Turkmenistan with the government being fully in control, while structural power of the practical sector remains very low. The fact that business freedom is so low could also be one the factors preventing Turkmenistan from developing the necessary IT infrastructure to a higher standard. There is significant evidence suggesting that state-owned monopolies like Turkmen Telekom and Altyn Asyr dominate the ICT markets (OCCRP 2022). Market access in Turkmenistan remains challenging (US ITA 2021a), even though some smaller private operators do exist in the ICT or affiliated markets.

In terms of coordination capacity, Turkmenistan's government is also extremely powerful. Like Russia, Turkmenistan has also officially adopted a strategy of digital development, but the government has been prioritizing only easily achievable quantifiable targets that could propel it through the international rankings (such as increasing the number of websites in the public domain or the number of online banking transactions). No evidence of private funding schemes supported by the private sector has been found. Little has been done by the government to address systemic problems such as "the societal digital divide, the knowledge and skills gap, and the lack of a competitive business environment" (Muhamedov 2021). While the state does not actively fund IT businesses or projects conducive to digitalization inputs (e.g., infrastructural or educational), it remains the sole arbiter in a system of clan-based crony capitalism. There is evidence suggesting that key figures in the business associations and large businesses are directly related to the top Turkmen leadership (OCCRP 2022).

In terms of institutional capacity, the government's ability to shut down the Internet and filter information online are extremely high. Finally, the degree of institutional control in the country is extremely high – there are no government-unaffiliated business associations, and the ICT regulator is completely dependent on the government. Turkmenistan's regulator also actively exercises censorship functions, but unlike in Russia, it does in a unsystematic and arbitrary fashion. Naturally, the government does not actively encourage any competition, even though it reflects poorly on the quality of digitalization outputs. There is no evidence of established self-regulation practices either. There is, however, some evidence of moderate lobbying power of the business (EurasiaNet 2019), but the extent to which it is intertwined with the government is very high, which makes it unclear to what extent this would be a business-driven input. Finally, the judiciary has no control over the executive, and its

effectiveness is one of the lowest in the world accordingly – even lower than in Russia (see Annex III).

Unsurprisingly, Turkmenistan performs poorly in terms of digitalization outputs – on both the uptake of digital technologies both in the public and private sectors. Unsurprisingly, digital competitiveness of Turkmen businesses, while unquantifiable, is likely very low, since the country has not even been included in the respective index in the first place. Only half of the households in Turkmenistan have access to a computer or the Internet. While the government is trying to digitalize the public sector (Muhamedov 2021), the uptake of digital technologies and services among the general populace remains extremely low. Only 5% of the general population have access to social networks in Turkmenistan. Broadband subscriptions are practically non-existent. Despite all the desperate attempts of the central leadership to digitalize at least the public sector, Turkmenistan's digital public services indicator in the UN E-Government index (0.17 out of 1) demonstrates that the country still has a long road ahead. The contrast of the Turkmen case with Russia also begs the question about under which conditions state-driven digitalization might produce better outputs than the business-driven one and which factors are more/less conducive. In terms of normative questions, a perspective research avenue would be to examine whether and what differences in digitalization processes and strategies exist between authoritarian regimes.

Having taken a look at the example of state-driven digitalization, I proceed with the examples of largely business-driven digitalization – that of Estonia (large-scale) and Mongolia (small-scale). The case of Estonia is particularly interesting not only because today it is a typical example of business-driven digitalization, but also because of how quickly the country has been digitalizing compared to its neighbors and the role the state has played. Estonia started

shifting away from state-driven to business-driven digitalization throughout the 1990s, as the government has been relinquishing both institutional and resource control. In the dimension of resource control, state-business relations today function differently in Estonia if compared to Russia or Turkmenistan since there are no government-affiliated and/or rent-seeking oligarchs, while the level of business freedom remains very high. Neither is there any presence of state monopolies on the ICT market (Estonia privatized many of its state-owned companies like Eesti Telekom almost in the immediate aftermath of independence), while some big private businesses like Telia stepped in. Although the tax burden in Estonia is slightly higher than in all three other cases, it is still extremely low according to the Index of Economic Freedom (The Heritage Foundation 2022). There is no evidence of systematic market access barriers in Estonia (US ITA 2021b). while structural power of businesses to invest and shape the digitalization processes is very high (Heller 2017).

In the coordination dimension, ever since its independence Estonia has embraced the concept of a liberal market economy, with the government dropping its dirigiste functions and creating comfortable conditions for ICT businesses. Digitalization has become a national priority for Estonia, similar to Russia but at a much earlier stage since Estonia launched its Tiigrihüpe (Tiger Leap) program in the schools to provide children with digital skills as early as in 1996. However, by 2021 the state had practically stopped any interferences in the sector, while focusing more on attracting qualified labor from abroad (Startup Estonia 2022). Today there is a variety of private start-ups and business incubators specifically tailored for the IT industries (some of the existing public schemes are usually co-funded by the EU). Business associations in Estonia remain independent actors and there is no evidence of the state control over those, which allows the businesses to effectively coordinate their actions at the industry level.

As for the institutional capacity, the Estonian government still has a moderate level of control, since its ability to filter and / or shut down the Internet is much higher, if compared to other EU Member States. In fact, among the selected cases, Estonia is closer to Russia and Turkmenistan in this regard rather than to Mongolia (see Annex III), but there has not been any systemic evidence of the government misusing this capacity (VDem 2022). Nevertheless, the market regulator remains politically independent from the government, there is no evidence suggesting any systemic power malpractices. An effective judiciary system keeps the government in check. There are some instances of developing industry self-regulation practices with sectoral agreements becoming a good practice (see Annex III). While it is difficult to precisely assess the lobbying power of Estonian businesses, there are established legal frameworks for lobbying to restrict excessive corporate influence (Šimral 2020).

Outputs of Estonian digitalization are generally hailed as an economic miracle in policy circles (Heller 2017). By the end of 2021, Estonians had an almost universal access to both computers and Internet – while the level of broadband penetration is extremely high too (90%). In terms of uptake of digital technologies and services in the public sector, Estonia is one of the world leaders, ranking 3rd in the most recent 2020 version of the UN E-Government Index. Its digital competitiveness rating is also relatively high (25th place), indicating strong performance both in terms of technology and future readiness. Estonian businesses are known for producing renowned applications such as Skype or Wise, while Tallinn is quickly becoming is a center of gravity for many IT specialists (Heller 2017). The uptake in the private sector is rather high across other operationalization dimensions both the number of broadband subscriptions and share of people using social media is extremely high. The government has even been trying to rebrand the country as E-Estonia to make it more attractive for digital nomads (e.g., through e-residency programs). Overall, the private IT sector in Estonia has

become a powerful driver of digitalization although the government still maintains some coordinating functions, while having given up on most resources.

The last case, that of Mongolia, is also interesting because although the government has not been actively pursuing policies of fostering digitalization so far, it is getting increasingly interested in doing so (Access Solutions 2019). Thus, the case shows some potential for transitioning/hybridity. As of now, however, Mongolia represents a typical case of small-scale business-driven digitalization. In the resources dimension, Mongolian businesses enjoy relatively a high degree of freedom. The state does not overburden them with taxes according to the Economic Freedom Index. Unlike Estonia, Mongolia does have some state corporations in the ICT and related sectors, but these are usually part of oligopolistic markets and have to compete with some private big businesses as well (Communications Regulatory Commission of Mongolia 2022). Market access in Mongolia is not heavily restricted (AIFC 2020), but it remains challenging to access the structural power of businesses due to the rapidly developing nature of the industry as of 2021. Overall, however, the nature of state-business relations in Mongolia, which are not as hierarchical as in Russia or Turkmenistan, but also not as cooperative as in Estonia.

In terms of institutional capacity, the Mongolian government is not particularly powerful. The control that the government exercises over information flows (i.e., either filtering information or capacity Internet shutdown) is practically non-existent (VDem 2022). Although there are no practices of self-regulation among businesses themselves, the government regulator remains relatively independent and does not exercise any censorship functions. While not exactly ideal, the Mongolian judicial system certainly performs much better than its counterparts in Russia or Turkmenistan, thus, being better at protecting business

interests (The Heritage Foundation 2022). Unfortunately, the data on the lobbying power of the businesses in Mongolia remains limited, but this does not hinder the assessment of the overall situation.

Finally, in terms of the coordinating capacity, there is mixed evidence on the inputs. On the one hand, Mongolia remains a mixed economy, but the government efforts to develop a comprehensive digital strategy are only at their inchoate stages. There is no evidence of systemic support programs for IT businesses implemented so far either from the public (such as subsidies or grants) or private sectors (such as private business incubators). At the same time, business associations remain independent and there is no evidence suggesting that the government either directly or indirectly controls them.

The outputs of digitalization in Mongolia have been relatively small so far. Accessibility levels remain much lower, if compared to Estonia and on some indicators even to Turkmenistan.[16] In terms of uptake of digital technologies in the private sector, Mongolia performs does not perform too well, especially in broadband subscriptions, which remain very low. Mongolia also landed on the 62nd place in the Digital Competitiveness Index out of 64 countries, showing poor performance on technological development and future readiness of Mongolian businesses. As for the uptake of digital technologies and services in the public sector, the indicators are not extremely impressive either. While Mongolia performs much better than Turkmenistan, it is far away from Estonia and Russia. Despite a relatively small scale of digitalization outputs, their future development in Mongolia might be interesting as the country will eventually cross the threshold of small-scale digitalization, if compared to

[16] The overall socio-economic performance of Mongolia is relatively low even though the income gap might not be as high as in Turkmenistan.

cases like Turkmenistan, as the government prepares to act with assistance of international organizations. This again raises the question of whether an expansion of the typology and integration of some potential for hybridity is possible in the light of cases like Mongolia.

Chapter 4. Discussion and conclusion

This section draws conclusions based on the work related to conceptualization and empirical showcasing discussed in the previous sections. Specifically, it reflects on the potential for hybridity and expansion of the typology as well as possible relevance of normativity in the study of digitalization (i.e., whether specific types of governments or business setting as well as their interactions in individual countries might result in specific types of digitalization) and interactions between different dimensions of digitalization. Based on the results of theoretical work and empirical showcasing, it proposes several hypotheses for testing in the future. The last section comments on the limitations of the approach developed in this paper, outlines avenues for future research, as well as summarizes the key contributions the paper has made.

What is immediately visible from the process of empirical showcasing is that normativity could play some role in the process of digitalization after all. One question is whether authoritarian regimes are more likely to demonstrate cases of state-driven digitalization, while democratic regimes are more likely to demonstrates cases of business-driven digitalization (e.g., Turkmenistan and Russia vs. Estonia and Mongolia). The answer might not be so evident since some democratic cases like Estonia, for example, transitioned from a state-driven to a business-driven type. A different question, by contrast, is whether oligarchic economic structures might be then associated with business-driven digitalization. Naturally, a combination of these cannot be ruled out. Thus, testing the following hypotheses would be prudent:

- *H1: Type of regime is strongly associated with the input dimension of digitalization.*

- *H1a: Authoritarian regimes are more prone to experience state-driven digitalization.*
- *H1b: "Leviathan" digitalization is more likely to happen in authoritarian regimes.*
- *H1c: Competitive authoritarian regimes with oligarchic economic structures are more prone to experience business-driven digitalization.*
- *H1d: Democratic regimes are more prone to experience business-driven digitalization.*

Another trend that the empirical showcasing has demonstrated is that both inputs and outputs of digitalization might have spillover effects for the overall state effectiveness and state capacity (e.g., through strengthening digital public services). In fact, this might become an emerging trend in the literature on political economy of digitalization with some publications emerging already (Collington 2022).

In terms of outputs, connections can also be made at lower levels of abstraction as illustrated by Hypotheses 2a and 2b – for example, large-scale digitalization as illustrated by the case of Russia might also be connected with the repressive capacities of the state. However, it is hard to establish whether there are any complex causalities at play here (i.e., when the large-scale output must be combined with state-driven inputs; or whether this can only happen in exclusively authoritarian contexts). For this purpose, a potential investigation through the prism of Qualitative Comparative Analysis (QCA) could be useful. In broader terms, a less complex investigation of the state effectiveness in the provision of public goods and services could be an alternative research avenue (i.e., whether improvement in digitalization outputs

also results in improvement of provision of public goods and services). In this case, the problem of complex causalities might not be as evident.

- *H2: Large-scale outputs of digitalization have spillover effects in strengthening the overall state capacities.*
    - *H2a: Large-scale outputs of digitalization are associated with stronger coercive capacities of the state.*
    - *H2b: Large-scale outputs of digitalization strengthen the overall state effectiveness in the provision of public goods.*

Another area worth exploring in greater detail is the relationship between state capacities for coercion and digitalization inputs, which might suffer from the problem of reverse or even cyclic causality. On the one hand, the question of whether state capacity as an explanatory variable could have an impact on digitalization input (i.e., whether digitalization is state-driven or not) largely stems from the studies of how autocracies try to introduce "pockets of efficiency". Governments, when unable to produce a complete societal upheaval or transformation, could try to make digitalization inputs more government-driven through mobilization of their state capacity (Evans 1989, p. 577; Huskey 2010). This also fits well into the empirical showcasing of the Russian case, where the government has actively prioritized the development of digital technologies and the IT sector as a "pocket of efficiency" that it could control. On the other hand, increased state capacities might as well result in higher levels of state control over whether digitalization is becoming even more state-driven or not (Frantz, Kendall-Taylor, and Wright 2020; Feldstein 2021, pp. 12-16). A potential causal mechanism linking the two would then be a stronger degree of state control of digitalization outputs, which would have to be operationalized in greater detail in the future research. The problem here is

that both hypotheses are not necessarily mutually exclusive. Therefore, it would be plausible to test both, including the potential causal mechanisms (Z). These could first be examined through the prism of digitalization types in a large N observational study (H3a), while a more in-depth qualitative examination (H3b and H3c) helping to explore the presence and nature of a causal relationship:

- *H3a: "Leviathan" and "flagging" digitalization types are more strongly associated with a stronger state capacity than "corporatist" or "tinkering" types.*
- *H3b: A more state-driven nature of digitalization inputs (X) results in a stronger state capacity (Y) through a stronger degree of state control over digitalization outputs (Z).*
- *H3c: A stronger state capacity (X) results in a more state-driven nature of digitalization inputs (Y) through the creation of pockets of efficiency by the state (Z).*

Finally, another important confounder could be the market structure of business-driven digitalization – i.e., whether one is dealing with a case of big tech-dominated market, or a market largely populated by small and medium-sized enterprises (SMEs). From the perspective of interaction between the government and businesses, the cases of Russia and Estonia show diverging evidence in this area. In Russia, where the market is more dominated by larger corporations that are easier to co-opt politically, the country has still achieved relatively high levels of digitalization outputs. In Estonia, by contrast, the market is much more diverse and more competitive, but the high levels of digitalization outputs are present too. Thus, further investigation is needed on whether market structure have any impact on the digitalization outputs. It is quite likely that we might be dealing with the issue of complex causality and there are several possible causal pathways to the same outcome of large digitalization outputs (e.g., an interaction between the regime type; digitalization inputs).

One note of caution: apart from the scale effects on the outputs of digitalization, the existing studies demonstrate that side-effects of SMEs-driven digitalization might have different coloring. For example, on the one hand, in some contexts SMEs play a big role in digitalization efforts to combat corruption (see the BIT-ACT project, for example, University of Bologna 2022), while in other cases their efforts can be misused by the governments for undemocratic consolidation (see the case study of Vasileva 2018 on how Russian SMEs fall into "the informality trap" and end up supporting a statist-patrimonial and authoritarian system). The hypotheses, therefore, are formulated in the broadest terms (i.e., without prejudice to the nature of the effect and focused only on the scale of digitalization). These can then be narrowed down after additional investigations:

- *H4: Market structure is strongly associated with the output dimension of digitalization.*
    - *H4a: Dominance of SMEs in the IT market is associated with large-scale digitalization.*
    - *H4b: Dominance of large corporations in the IT market is associated with large-scale digitalization.*

Before concluding, however, it is also necessary to reflect upon the objective limitations of the proposed approach and outline additional avenues for further research apart from the hypotheses outlined above. First and foremost, since this typology is understood in terms of categorical variables (where inputs and outputs are more conceptual rather than causal attributes), additional hypotheses could be well formulated with a specific focus on the digitalization types.

Second, further empirical testing and, if necessary, potential empirical expansion of the developed typology is a must. As the empirical showcasing suggests, there are indeed cases of

countries that might well represent one or another specific type of digitalization. At the same time, making clear-cut differences between countries could be challenging. One can justifiably argue that the case of Turkmenistan, for example, is rather extreme and the quadrant of small-scale state-driven digitalization will suffer from the problem of limited empirical diversity (i.e., that not too many cases will fit in there).

Furthermore, despite its attempts to reflect the process-centric nature of digitalization by integration not just outputs, but also inputs, a justified criticism would be that this conceptualization is still too static and not robust enough. Therefore, an exploration of a new potential dimension of "*through-output*" between input and output might be considered in future research. This dimension could clarify potential ambiguities regarding the state-business relations in the area of digitalization in countries with state capitalist economic systems in place (e.g., Russia), where the government has both serious institutional and coordination capacities, but also might delegate many of its functions to private subcontractors.

One final criticism regarding the outputs of digitalization could be that this binary approach does not allow for any hybridity and does not allow us to assess borderline cases more accurately. Similarly, one could argue that in cases where there are significant amounts of confounding data on both the role of the state and businesses. Therefore, once the central approach to constructing this typology is empirically tested on a larger scale and the operationalization of individual dimensions is adjusted accordingly, one can most certainly expand the typology by introducing additional levels of measurement of both inputs and outputs as can be seen in Table 9 below. Having a category for combined/mixed inputs as well as medium-scale outputs, thus, will be crucial for large-N studies.

Table 8. Expanded typology of digitalization: a potential modification

Dimensions		Outputs		
		Large-scale outputs	**Medium-scale outputs**	**Small-scale outputs**
Inputs	**State-driven inputs**	Large-scale state-driven digitalization ("Leviathan type")	Medium-scale state-driven digitalization ("?")	Small-scale state-driven digitalization ("Flagging type")
	Combined / Mixed inputs	Large-scale mixed digitalization ("?")	Medium-scale mixed digitalization ("Hybrid type")	Small-scale mixed digitalization ("?")
	Business-driven inputs	Large-scale business-driven digitalization ("Corporate type")	Medium-scale business-driven digitalization ("?")	Small-scale business-driven digitalization ("Tinkering type")

Source: Own elaboration.

In this light, the most important immediate need is the furthering sharpening of the operationalization dimensions and individual indicators to balance theoretical coherence with practical applicability of the typology. Another immediate concern in future research would be to address the question of assigning certain weights to different operationalization dimensions and/or indicators (since currently not assigning weights automatically assumes equal weighting of indicators and operationalization dimensions). In the longer run, it could also be important to address the research questions, which have been largely left out of the paper due to its scope constraints. First, the question of broader society-level digitalization could be studied separately, especially if one considers individuals as actors relevant for digitalization.[17] It might

[17] Here, some parallel could be drawn with theoretical debates in international relations on whether individuals could be considered actors or not.

very well be that both business and state-driven digitalization have spillover effects into societal digitalization and that individuals have some role to play as consumers or drivers of innovations. However, this research stream would require some additional evidence pointing us in the right direction.

Nevertheless, this paper has produced a robust and hands-on conceptual framework, which will serve as a solid foundation for digitalization-related research projects in the future. The practical value of the developed typology is also reflected in its potential policy application (e.g., for cross-national comparative case studies; QCA; cluster analyses). This paper has also proposed a variety of hypotheses for future empirical testing related to the state-business relations in the context of digitalization (also from a normative perspective). The results of this project provide clear research avenues for both empirical testing as well as further conceptual and theoretical work in the field of political economy of digitalization.

Annex I. Methodological details of the systematic review

The systematic review was carried in five stages. This includes the formulation of search criteria; evaluation of the scientific quality of the found publications; extraction and analysis of the relevant information. The review considered a wide variety of academic sources on the topics of digitalization, digitization, and digital transformation, but it will exclude grey literature (such as e.g., white papers, media reports) to prevent additional contextual complications.

Regarding academic literature, the following criteria guided the research process:

- *Relevance*. The literature should provide insights that can be used to answer the research question.
- *Recognition*. Preference is given to academic publications with high citation rates (at least 30 citations and higher).
- *Timespan*. The review covers publications in a wide timeframe of the past 10 years (2012-2022) to assess the most recent developments in the field.
- *Availability*. Full-text version should be available in the following open access scientific databases – Google Scholar, JSTOR, and Elsevier.

The systematic review employed the following keywords and their combinations for the literature search in the open access databases: “digitalization”, “digitization”, “digital transformation”, “definition”, “concept”, “framework”, “review”, “conceptualization”, “term” among others.

The accumulated sources passed a quality check, which was done by using a list of criteria from Table 10 (Petticrew and Roberts 2008). Following the strategy proposed by Gast,

Schildkamp, and van der Veen (2017) each criterion will be evaluated on a 3-point scale: 0, 0.5, or 1 point. To be included in the review, articles must have a combined score of at least 5 for the 10 criteria (i.e., at least half of the maximum). Quality criteria will not be applied to policy documents and other grey literature as these sources rarely conform to the criteria below. Instead, if the grey literature is based on sound reasoning and provides insights on any of the research questions it will be analyzed.

Table 9. Quality assurance criteria of the systematic review

Criterion	**Specifics**
General	1. Is the research objective clear? 2. Is the research done using the chosen method capable of finding a clear answer to the research question?
Selection sample	3. Was enough data gathered to assure the validity of the conclusions? 4. Is the context of the research clear (country, participants)?
Method	5. Do the researchers state the research methods used? 6. Do the authors give an argument for the methods chosen?
Data analysis	7. Are the data analyzed in an adequate and precise way? 8. Are the results clearly presented? 9. Do the researchers report on reliability and validity of the research?
Conclusion	10. Is the question answered using empirical evidence from the research that was done?

Source: Own elaboration based on Gast, Schildkamp, and van der Veen 2017.

Finally, all the data that helps to answer the main questions of this project will be extracted from the sources that meet the above-mentioned criteria. This information will be compared and systematized and will create a base for the preparation of the typology. Based on the analysis of the extracted information, the systematic review will identify the main conceptual patterns in defining digitalization.

Annex II. Detailed results of the systematic review

Table 10. Definitions of digitalization in the academic literature

Reference	Definition	Category of journals	Conceptual clarity challenge(s)
Group 1.1. Digitalization as a process of developing and adopting digital technologies[18] in individual, organizational, and/or societal contexts (N=15)			
Brennen and Kreiss, 2016.	Digitalization, by contrast, refers to "the adoption or increase in use of digital or computer technology by an organization, industry, country, etc."	Communication / IT	Unclear term: "digital or computer technologies".
Gray and Rumpe, 2015.	The emerging trend of "digitalization" […] represents the integration of multiple technologies into all aspects of daily life that can be digitized.	Communication / IT	Unclear term: "multiple technologies".
Gobble, 2018.	Digitalization, on the other hand, refers to the use of digital technology, and probably digitized information, to create and harvest value in new ways.	Management / Business	Lack of specificity ("probably digitized", unspecific "new ways").
Urbach and Röglinger, 2019.	Digitalization reflects the adoption of digital technologies in business and society as well as the associated changes in the connectivity of individuals, organizations, and objects.	Communication / IT	Conflation between the concept and its impacts. Unclear term: "digital technologies".
Srai and Lorentz, 2019.	Digitalization is defined as the way many domains of social life are restructured around digital communication and media infrastructures. In simple terms, digitalization may be defined as the use of digital technologies.	Management / Business	Lack of specificity.

[18] Electronic tools, systems, devices, and resources that generate, store or process data.

Morley, Widdicks, and Hazas, 2018.	Digitalization is the growing application of ICT across the economy "encompassing a range of digital technologies, concepts and trends such as artificial intelligence, the "Internet of Things" (IoT) and the Fourth Industrial Revolution".	Economics	"Digital technologies" are defined through examples. Lack of theoretical concept.
Myovella, Karacuka, and Haucap, 2020.	[Digitalization is] the advent of Information and Communication Technologies (ICT) particularly internet and mobile phone technologies that create new products and processes, new market channels and organizational complexities, along with technological advancement. Technological change including those in ICT is argued to be one of the indispensable engines of prosperity amongst others, and in order for countries to benefit from other engines of growth they need to utilize ICT.	Communication / IT	Lack of parsimony. Unclear term: "ICT" and definition of it by examples.
Mammadli and Klivak, 2020.	Digitalization […] is the adoption of digital services by both public and private sectors.	Management / Business	Unclear "services".
Parida, 2018.	Digitalization is a fundamental disruptive force triggered by Fourth Industrial Revolution and Internet of Things, which has changed the way we approach and think about business processes and activities.In this increasingly digital age, relationships between organizations (i.e. companies, governmental agencies, and others) and customersare being reshaped and new business models are being invented.	Sociology	Lack of parsimony; Conflation between the concept and its impacts
Legner et al., 2017	The term digitalization has been coined to describe the manifold sociotechnical phenomena and processes of adopting and using these technologies in broader individual, organizational, and societal contexts.	Communication / IT	Conflation between the concept and its impacts.
Riedl et al., 2017	Digitalization is the process of introducing digital technologies, which essentially deal with changes caused by information technologies.	Management / Business	Circularity. Unclear distinction between "digital" and "information technologies"
Urbach and Röglinger, 2019.	Digitalization reflects the adoption of digital technologies in business and society as well as the associated changes in the connectivity of individuals, organizations, and objects	Communication / IT	Conflation between the concept and its impacts.

Isaksson, Harjunkoski, and Sand, 2018.	"Digitalization" stands for new possibilities provided by the use of more and new types of data, communication infrastructure and computing power.	Communication / IT	Unclear term: "mew possibilities".
Coyle, 2006.	Mass digitization is more than just a large-scale project. It is the conversion of materials on an industrial scale. That is, conversion of whole libraries without making a selection of individual materials. This is the opposite of the discrete digital collections that we see in online archives like the Library of Congress's Making of America, or the Online Archive of California. The goal of mass digitization is not to create collections but to digitize everything, or in this case, every book ever printed. To do this economically and with some speed, mass digitization is based on the efficient photographing of books, page-by-page, and subjecting those images to optical character recognition (OCR) software to produce searchable text.	Archival research	Lack of parsimony. Definition by examples.
Soltis, 2017.	Digitization [...] is, electronic capture of data, including images.	Natural sciences	Lack of specificity.
Group 1.2. Digitalization as the increased usage of digital technologies specifically at the company level for a competitive advantage (N=13)			
Isensee, Teuteberg, Griese, and Topi, 2020.	Digitalization is defined as "the transformation of business models as a result of fundamental changes to core internal processes, customer interfaces, products and services, as well as the use of information and communications technologies."	Economics	Unclear "transformation of business models"; Conflation between the concept and its causes.
Jovanović, Dlačić, and Okanović, 2018.	Digitalization is [an era of digital transformation] where digital technologies are used to change business models, create revenue, improve business and value-producing opportunities.	Economics	Conceptual stretching (digitalization as an era).
Bloomberg, 2018.	"Digitalization is the use of digital technologies to change a business model and provide new revenue and value producing opportunities".	Management / Business	Unclear term: "digital technologies".

Björkdahl, 2020.	Digitalization involves the increased use of digital technologies and their integration and cross-fertilization in the firm's products and inbound and outbound activities.	Management / Business	Unclear term: "digital technologies".
Rachinger et al., 2018.	Digitalization […] is defined as the exploitation of digital opportunities.	Management / Business	Unclear term: "digital opportunities".
Crittenden, Biel, and Lovely, 2019.	Industries and organizations are increasingly disrupted by new or unique applications of technology. [...] The ongoing digitalization of many business practices has meaningfully changed channel interactions, creating new ways of interacting between businesses and customers and disrupting marketing practice	Education	Conflation between the concept and its impacts. Lack of parsimony.
Muro, Liu, Whiton, and Kulkarni, 2017.	Digitalization […] is the process of employing digital technologies and information to transform business operations.	Economics	Unclear term: "digital opportunities". Conflation between the concept and its causes.
Antikainen, 2018.	Digitalization refers to new digital technologies that are currently transforming the industry.	Economics	Unclear term: "digital technologies".
Hagberg, Sundstrom, and Egels-Zandén, 2016.	"Digitalization" refers broadly to the integration of digital technologies into retailing.	Management / Business	Unclear term: "digital technologies".
Björkdahl, 2020.	Digitalization involves the increased use of digital technologies and their integration and cross-fertilization in the firm's products and inbound and outbound activities.	Management / Business	Conflation between the concept and its causes.
Balsmeier and Woerter, 2019	Digitalization is a general-purpose technology, i.e. it can be adopted across a wide range of industries, including the service sector.	Economics	Conceptual stretching (digitalization as a technology).

Waldfogel, 2015.	Digitization is defined as the social transformation triggered by the massive adoption of digital technologies to generate, process, share and transact information.	Economics	Conflation between the concept and its causes. Unclear term: "digital technologies".
Degryse, 2016.	[Digitalization includes] three recent developments: — internet and the development of high-speed networks; — Big Data, that is the merging by internet platforms of colossal masses of directly exploitable commercial, personal and geographic data; — the explosion of new forms of mobile device.	Economics	Definitions by examples; Lack of parsimony. Conflation between the concept and its causes.
Group 1.3. A technical process of converting information into digital formats (N=1).			
Parviainen et al., 2017.	The action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form.	Communication / IT	Unclear term: "digitizing".

Source: Own elaboration.

As can be seen Tables 10 and 11, there is some conceptual overlap between some of the existing definitions of digitization and digitalization. A particularly illustrative example is the overlap between Group 2.2 and Group 1.1. While many of the mapped definitions see digitization as merely a technical data conversion method, Group 2.2 also refers to it as a process of increased usage of digital technologies in different institutional contexts. This is one of the two main sources of conceptual confusion. There is also significant overlap between Group 2.1. and Group 1.3.

Table 11. Definitions of "digitization" in the academic literature

Reference	Definition	Category of journals	Conceptual clarity challenge(s)
Group 2.1. A technical approach of converting information from analog into digital formats (N=11).			
Brennen and Kreiss, 2016.	Scholars across disciplines use the term "digitization" to refer to the technical process of converting streams of analog information into digital bits of 1s and 0s with discrete and discontinuous values.	Communication / IT	Unclear terms: "discrete and discontinuous values"
Gobble, 2018.	Digitization is the straightforward process of converting analog information to digital—turning pages into bytes, for instance, by scanning a document or uploading a sound recording.	Communication / IT	Definition by examples.
Jovanović, Dlačić, and Okanović, 2018.	Digitization: where the analog items are converted into digital versions (i.e. electronic version of paper documents).	Economics	Conflation between the concept and its impacts.
Bloomberg, 2018.	Digitization essentially refers to taking analog information and encoding it into zeroes and ones so that computers can store, process, and transmit such information.	Management / Business	Conflation between the concept and its impacts.
Rachinger et al., 2018.	Digitization [is] the process of converting analogue data into digital data sets.	Economics	Unclear term: "digital data set".
Khan, Khan, and Aftab, 2015.	Digitization is the process of transforming analog material into binary electronic (digital) form, especially for storage and use in a computer‖. Digitization converts materials from analog formats that can be read by people to a digital format that can be read only by machines.	Economics	Lack of parsimony.

Nelson et al., 2012.	Digitization of label information includes capturing the text as characters, dividing the text into specific properties, and storing this information in a database. Digitization may also include capturing digital images and other media. References to media objects are added to the database records.	Natural sciences	Definitions by examples.
Waldfogel, 2017.	Digitization is [transforming] information into digital form.	Economics	Lack of concreteness.
Ritter and Pedersen, 2020.	Being digitized entails moving from analogue to digital data for streamlining existing processes such as building an operational backbone or introducing ERP-systems through a standardized process where the end-state is known.	Economics	Definitions by examples. Conflation between the concept and its impacts.
Kayickci, 2018.	Digitization (or digitalization) means basically capturing an analog signal and converting it into digital form for the purpose of generating a digital representation that can be electronically stored or processed	Management / Business	Conflation between the concept and its impacts.
Borghi and Stavroula, 2013.	Mass digitization is commonly conceived of as the conversion of copyright works in digital format on an industrial scale.	Management / Business	Industry-specific (i.e. "copyright works")
Group 2.2. A process of increased development and adoption of digital technologies in individual, organizational, and/or societal contexts (N=8).			
Sabbagh, et al., 2012.	Digitization – the mass adoption of connected digital technologies and applications by consumers, enterprises, and governments.	Communication / IT	Unclear terms: "digital technologies and applications".
Schmidt, et al., 2015.	Digitization is more than using digital technologies to transfer data and perform computations and tasks. Digitization embraces disruptive effects of digital technologies on economy and society. To capture these effects, two perspectives are introduced, the product and the value-creation perspective. In the product perspective, digitization enables the transition from material, static products to interactive and configurable services. In the value-creation perspective, digitization facilitates the transition from	Communication / IT	Lack of parsimony.

	centralized, isolated models of value creation, to bidirectional, co-creation oriented approaches of value creation		
Katz, 2012.	Digitization is defined as the social transformation triggered by the massive adoption of digital technologies to generate, process, share and transact information.	Economics	Conflation between the concept and its causes.
Kagermann, 2015.	Digitization – the continuing convergence of the real and the virtual worlds, [which] will be the main driver of innovation and change in all sectors of our economy.	Management / Business	Unclear term: "virtual world" Conflation between the concept and its causes.
Legner et al., 2017.	Digitization is the technical process of converting analog signals into a digital form, and ultimately into binary digits, and is the core idea brought forward by computer scientists since the inception of the first computers.	Management / Business	Lack of parsimony.
Rydning, Reinsel, and Gantz, 2018.	This process of digitization is often referred to as digital transformation, and it is profoundly changing the shape of business today, impacting companies in every industry and consumers around the world. Digital transformation is not about the evolution of devices (though they will evolve), it is about the integration of intelligent data into everything that we do.	Management / Business	Circularity and conceptual stretching.
Matt et al., 2019.	The digitization also pertains to formerly non-digital devices for households and lifestyle (e.g. smart fridges and smart keys) that has become more computerized or computer-supported.	Communication / IT	Unclear terms: "computerized" "computer-supported"
Royakers et al., 2018.	Digitization penetrates every aspect of our lives: the technology nestles itself in us (for example, through brain implants), between us (through social media like Facebook), knows more and more about us (via big data and techniques such as emotion recognition), and is continually learning to behave more like us (robots and software exhibit intelligent behaviour and can mimic emotions). Van Est (2014) referred to this as the intimate	Philosophy	Lack of parsimony; definition through examples. Conflation between the concept and its causes.

	technological revolution. The digitization of society pushes the boundaries of our abilities and offers all sorts of opportunities, but also challenges our moral boundaries.		

Source: Own elaboration based on the systematic review.

The second source of conceptual confusion is that, apart from digitalization and digitization, some authors also the use the concept of "digital transformation". This concept is also quite close to one of the understandings of digitalization (Group 1.2), which focuses on the increased usage of digital technologies specifically at the company level. As pointed out by Vial (2021) in his systematic review, unlike with digitalization and digitization, there are no divergent interpretation of the term itself. The updated version of Vial's systematic review of "digital transformation" can be seen in Table 12.

Table 12. Definitions of "digital transformation" in the academic literature (systematic review by Vial)

Reference	Definition	Category of journals	Conceptual clarity challenge(s)
Group 3.1. Digitalization as the increased usage of digital technologies at the company level for a competitive advantage (N=26).			
Bloomberg, 2018.	Digital transformation refers to the customer-driven strategic business transformation that requires cross-cutting organizational change as well as the implementation of digital technologies.	Management / Business	Conflation between the concept and its impacts. Circularity ("transformation").
Karagiannaki, Vergados, and Fouskas, 2017.	The use of technology to radically improve performance or reach of enterprises.	Communication / IT	Conflation between the concept and its impacts.

Liere-Netheler, Packmohr, and Vogelsang, 2018.	The use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models)	Communication / IT	Definitiion by example: “digital technologies” Conflation between the concept and its impacts.
Mass, Hess, and Benlian, 2015.	Digital transformation strategy is a blueprint that supports companies in governing the transformations that arise owing to the integration of digital technologies, as well as in their operations after a transformation.	Communication / IT	Unclear term: “digital technologies”. Circularity (“transformation”).
Piccinini, Hanelt, Gregory, and Kolbe, 2015.	Digital transformation involves leveraging digital technologies to enable major business improvements, such as enhancing customer experience or creating new business models.	Management / Business	Unclear term: “digital technologies”. Conflation between the concept and its impacts.
Bekkhus, 2016.	Use of digital technologies to radically improve the company’s performance.	Communication / IT	Unclear term: “digital technologies”. Conflation between the concept and its impacts.
Berghaus and Back, 2016.	Digital transformation encompasses both process digitization with a focus on efficiency, and digital innovation with a focus on enhancing existing physical products with digital capabilities.	Communication / IT	Unclear terms: “digitalization”, “digital capabilities”.
Demirkan, Spohrer, and Welser, 2016.	Digital transformation is the profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way.	Communication / IT	Unclear term: “digital technologies”; Circularity (“transformation”). Conflation between the concept and its impacts.

Haffke, Kalgovas, and Benlian, 2016.	Digital transformation encompasses the digitization of sales and communication channels, which provide novel ways to interact and engage with customers, and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Digital transformation also describes the triggering of tactical or strategic business moves by data-driven insights and the launch of digital business models that allow new ways to capture value.	Management / Business	Unclear term: "digitalization". Conflation between the concept and its impacts. Lack of parsimony.
Hess, Matt, Benlian, and Wiesböck, 2016.	Digital transformation is concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes. These changes can be observed in the rising demand for Internet-based media, which has led to changes of entire business models (for example in the music industry).	Management / Business	Unclear term: "digital technologies". Conflation between the concept and its impacts; Lack of parsimony.
Singh and Hess, 2017.	Use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major businessimprovements like enhancing customer experience, streamlining operations or creating new business models.	Management / Business	Unclear term: "digital technologies" defined using examples. Conflation between the concept and its impacts.
Nwankpa and Roumani, 2016.	Changes and transformations that are driven and built on a foundation of digital technologies. Within an enterprise, digital transformation is defined as an organizational shift to big data, analytics, cloud, mobile and social media platform. Whereas organizations are constantly transforming and evolving in response to changing business landscape, digital transformation are the changes built on the foundation of digital technologies, ushering unique changes in business operations, business processes and value creation.	Communication / IT	Unclear term: "digital technologies" defined using examples. Circularity ("transformation"). Lack of parsimony.

Andrione, 2017.	Digital transformation is not a software upgrade or a supply chain improvement project. It's a planned digital shock to what may be a reasonably functioning system.	Management / Business	Unclear term: "digital shock".
Chanias, 2017.	Extended use of advanced IT, such as analytics, mobile computing, social media, or smart embedded devices, and the improved use of traditional technologies, such as enterprise resource planning (ERP), to enable major business improvements.	Communication / IT	Unclear term: "advanced IT" defined using examples. Conflation between the concept and its impacts.
Clohessy, Acton, and Morgan, 2017.	The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or automation of processes	Communication / IT	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Hartly and Hess, 2017.	Distinguishes itself from previous IT-enabled business transformations in terms of velocity and its holistic nature.	Communication / IT	Circularity ("transformation"). Comparative definition (with "IT-enabled business transformations")
Heilig, Schwarze, and Voß, 2017.	Transformations in organizations that are driven by new enabling IT/IS solutions and trends.	Communication / IT	Circularity ("transformation").
Horlach. Drews, Schirmer, and Böhmann, 2017.	Digital transformation as encompassing the digitization of sales and communication channels and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Furthermore, digital transformation entails tactical and strategic business moves that are triggered by data-driven insights and the launch of digital business models that allow new ways of capturing value.	Communication / IT	Unclear term: "digitalization". Conflation between the concept and its impacts. Lack of parsimony.

Kane, Palmer, and Phillips, 2017.	The best understanding of digital transformation is adopting business processes and practices to help the organization compete effectively in an increasingly digital world.	Management / Business	Conflation between the concept and its impacts.
Legner et al., 2017.	Digital transformation describes the changes imposed by information technologies (IT) as a means to (partly) automatize tasks.	Communication / IT	Conflation between the concept and its impacts.
Li, Su, Zhang, and Mao, 2018.	Digital transformation highlights the impact of IT on organizational structure, routines, information flow, and organizational capabilities to accommodate and adapt to IT. In this sense, digital transformation emphasizes more the technological root of IT and the alignment between IT and businesses.	Communication / IT	Conflation between the concept and its impacts. Lack of parsimony.
Morakanyane, Grace, and O'Reilly, 2017.	An evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value.	Communication / IT	Unclear term: "digital capabilities". Conflation between the concept and its impacts.
Paavola, Hallikainen, and Elbanna, 2017.	The use of new digital technologies, in order to enable major business improvements in operations and markets such as enhancing customer experience, streamlining operations or creating new business models.	Communication / IT	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Piccinini, Gregory, and Kolbe, 2015.	Fundamental alterations in existing and the creation of new business models [...] in response to the diffusion of digital technologies such as cloud computing, mobile Internet, social media, and big data.	Economics	Unclear term: "digital technologies" defined using examples.
Jovanović, Dlačić, and Okanović, 2018.	Digital transformation [is a process] where digital technologies are used to change all business aspects.	Economics	Conflation between the concept and impacts; Lack of specificity.
Rachinger et al., 2018.	Digital transformation is then defined as the process that is used to restructure economies, institutions and society on a system level.	Economics	Lack of specificity.

Source: Based on Vial (2021) with slight adjustments (several more definitions integrated).

Annex III. Detailed data collection table for empirical showcasing

Table 13. Detailed data for individual empirical showcasing

Conceptual criteria	Operational dimension	Indicators	Illustrative cases (Countries)			
			Turkmenistan (data up to 2022) SSD	Mongolia (data up to 2022) SBD	Estonia (data up to 2022) LBD	Russia (data up to 2022) LSD
Inputs of digitalization	Resources	Tax burden (The Heritage Foundation 2022).	Very low (i.e., very positive, 92.6 out of 100)	Very low (i.e., very positive; 89.2 out of 100)	Very low (i.e., positive, 81.1 out of 100)	Very low (i.e., very positive, 93.1 out of 100)
		Business freedom (The Heritage Foundation 2022).	Low (37.5 out of 100)	High (66.5 out of 100)	Very high (86.9 out of 100)	Moderate (62.5 out of 100)
		Monopolies and their nature	Market dominated by state monopolies (Globe Newswire 2022).	Both types of monopolies, largely private (Communications Regulatory Commission of Mongolia 2022)	No evidence state or private monopolies	Government-affiliated or state monopolies (Carnegie Centre 2018).
		Market access	Very inaccessible (US ITA 2021a)	N/A (likely moderately accessible)	Highly accessible (US ITA 2021b)	Moderately accessible (US ITA 2021c)
		Structural power of businesses	N/A, possibly low or very low.	Moderate (UNESCAP 2022)	High (U.S. Department of State)	Low (Kesarchuk *forthcoming*)

	Coordination capacity	Variety of a capitalist system in a country	Clan-based state capitalism (Globe Newswire 2022).	Mixed / Social market economy (Plueckhahn, and Bumochir 2018)	Liberal market economy (EC 2022)	Oligarchic state capitalism (Aligica and Tarko 2013)
		Affiliation of business associations (own expert opinion)	State-controlled	Independent	Independent	State-affiliated
		Programs supporting digitalization and their nature	No evidence of either private or public funding schemes functioning systematically	Emerging public funding and support schemes as well as private investments schemes (Access Solutions 2019)	Mostly private support schemes (incl., private business incubators), public schemes include some EU and EEA funds	Both public and private fundings as well as support programs present
	Institutional capacity	Information control by the government (VDem 2022)	Filtering capacity is very high in theory (2.84 out of 3) and very high in practice (0.31 out of 4) Internet shutdown capacity is very high in theory (3.78 out of 4) and very high in practice (0.85 out of 4)	Filtering capacity is moderate in theory (2.1 out of 3), but very low in practice (3.61 out of 4) Internet shutdown capacity is very low in theory (1.63 out of 4) and very low in practice (3.96 out of 4)	Filtering capacity is very high in theory (2.39 out of 3) but very low in practice (3.87 out of 4) Internet shutdown capacity is very high in theory (3.66 out of 4) but very low in practice (3.95 out of 4)	Filtering capacity is very high (2.87 out of 3) but moderate in practice (2.19 out of 4) Internet shutdown capacity is very high in theory (3.11 out of 4) but low in practice (3.33 out of 4)
		Judicial effectiveness (The Heritage Foundation 2022)	Very low (8.3 out of 100)	Moderate (57.1 out of 100)	Very high (92.3 out of 100)	Low (34.7 out of 100)

		Presence and independence of a market regulator	Yes, state-dependent (Ministry of Communication)	Yes, independent (Communications Regulatory Commission)	Yes, independent (Estonian Technical Regulatory Authority)	Yes, state-dependent (Roskomnadzor)
		Established practices of self-regulation	N/A (likely low or very low)	Little to no evidence (although self-regulation is observed in related sectors – e.g., media), likely low or moderate	Some evidence (see e.g., Telia 2018), likely moderate	Little to no evidence (although some legal frameworks are in place), likely low
		Lobbying power of the businesses	Moderate (EurasiaNet 2019)	N/A (likely moderate)	Moderate (Šimral 2020)	(Rutland 2018)
Outputs of digitalization	Accessibility of digital technology and digital services Source: ITU 2017; Global DataLab 2022 unless specified in the cell.	Share of households with a computer	Moderate (43.8%)	Low (30.7%)	Very high (ca. above 90%)	High (ca. above 74%)
		Share of households with Internet access	Moderate (48.9%)	Low (36.2%)	Very high (ca. above 86%)	High (ca. above 75%)
		Share of households with fixed-broadband subscriptions	N/A, likely low or very low.	Very low (ca., lower than 10%)	Very high (ca. above 90%)	Low (ca. above 33%)
		Mobile cellular subscriptions per 100 inhabitants (World Bank 2022a)	Very high (1 out of 1)	Very high (ca. 1 out of 1)	Very high (1 out of 1)	Very high (1 out of 1)
	Uptake in the private sector	Digital competitiveness (IMD 2022)	N/A, low (not included in the ranking)	Very low (Position 62)	High (Position 25)	Moderate (Position 42)
		Number of fixed broadband subscriptions per 100	Very low (0.17)	Very low (9.37%)	High (31.33)	Moderate (23.23)

		inhabitants (World Bank 2022b)				
		Share of population using social media (Datareportal 2022)	Very low (5%)	High (ca. 65-85%; var. estimates)	Very high (80%)	High (72.7%)
	Uptake in the public sector Source: UN 2022.	Online public services	Very low (0.1765 out of 1)	Moderate (0.5294 out of 1)	Very high (0.99 out of 1)	Very high (0.82 out of 1)
		ICT connectivity	Low (0.3555 out of 1)	High (0.6135 out of 1)	Very high (0.92 out of 1)	High (0.7723 out of 1)
		Human capital	High (0.6783 out of 1)	High (0.8063 out of 1)	Very high (0.92 out of 1)	Very high (0.8833 out of 1)

Source: Own elaboration based on various indexes, other secondary evidence and/or expert assessments. Approximations or lack of cases indicated in all cases.

Table 14 summarizes the qualitative scores for individual countries across the dimensions, while the rest of the section goes into detail of discussing the cases of individual countries.

Table 14. Summary of qualitative assessments across operationalization dimensions

Conceptual criteria	Operational dimension	Illustrative cases (Countries)			
		Turkmenistan (data up to 2022) "Flagging type"	Mongolia (data up to 2022) "Tinkering type"	Estonia (data up to 2022) "Corporate type"	Russia (data up to 2022) "Leviathan type"
Inputs	Resources	High degree of control	Low degree of control	Very low degree of control	Moderate degree of control
	Coordination capacity	Very high	Low	Moderate	High
	Institutional capacity	Very high	Low	Low	Very high
Outputs	Accessibility of digital technology and digital services	Low	Low	Very high	High
	Uptake in the private sector	Very low	Moderate	Very high	High
	Uptake in the public sector	Low	High	Very high	Very high

Source: Own elaboration based on Annex III (aggregated qualitative scores across operationalization dimensions only).

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References

Access Solutions (2019). Mongolia in the Digital Age. Available at: https://artnet.unescap.org/sites/default/files/file-2019-11/Digital%20Readiness%20Assessment%20Final%20Draft%20%2009.09.pdf

Agénor, P. R. (2010). A theory of infrastructure-led development. Journal of Economic Dynamics and Control, 34(5), 932-950.

Aligica, P. D., & Tarko, V. (2012). State capitalism and the rent-seeking conjecture. Constitutional Political Economy, 23(4), 357-379.

Andriole, S. J. (2017). Five myths about digital transformation. MIT sloan management review, 58(3).

Antikainen, M., Uusitalo, T., & Kivikytö-Reponen, P. (2018). Digitalisation as an enabler of circular economy. *Procedia Cirp*, *73*, 45-49.

Baldwin, W., & Scott, J. (2013). Market structure and technological change. Taylor & Francis.

Balsmeier, Benjamin; Woerter, Martin (2019). Is this time different? How digitalization influences job creation and destruction. Research Policy, S0048733319300733–. doi:10.1016/j.respol.2019.03.010

Bannister, F., & Connolly, R. (2012). Defining e-governance. e-Service Journal: A Journal of Electronic Services in the Public and Private Sectors, 8(2), 3-25.

Bekkhus, R. (2016). Do KPIs used by CIOs decelerate digital business transformation? The case of ITIL.

Bennett, R. J. (1998). Business associations and their potential to contribute to economic development: reexploring an interface between the state and market. Environment and Planning A, 30(8), 1367-1387.

Berghaus, S., & Back, A. (2016). Stages in digital business transformation: results of an empirical maturity study. In MCIS (p. 22).

Björkdahl, J. (2020). Strategies for digitalization in manufacturing firms. *California Management Review*, *62*(4), 17-36.

Bloomberg, J. (2018). Digitization, digitalization, and digital transformation: confuse them at your peril. *Forbes. Retrieved on August*, *28*, 2019.

Borghi, M., & Stavroula, K. (2013). Copyright and mass digitization (pp. 1-196). Oxford University Press. Chicago

Brennen, J. S., & Kreiss, D. (2016). Digitalization. The international encyclopedia of communication theory and philosophy, 1-11.

Brennen, S., & Kreiss, D. (2014). Digitalization and digitization. Culture digitally, 8.

Cámara, N., & Tuesta, D. (2017). DiGiX: the digitization index. BBVA Bank, Economic Research Department.

Carnegie Centre (2018). Digital Monopolies: Dividing the Big Data Pie in Russia, Available at: https://carnegiemoscow.org/commentary/77466

Chen, C. L., Lin, Y. C., Chen, W. H., Chao, C. F., & Pandia, H. (2021). Role of government

to enhance digital transformation in small service business. Sustainability, 13(3), 1028.

Clohessy, T., Acton, T., & Morgan, L. (2017). The impact of cloud-based digital transformation on IT service providers: evidence from focus groups. International Journal of Cloud Applications and Computing (IJCAC), 7(4), 1-19.

Cohen, J., & Fontaine, R. (2020). Uniting the Techno-Democracies: How to Build Digital Cooperation. Foreign Aff., 99, 112.

Collier, D. (2008). Typologies: Forming concepts and creating categorical variables.

Collier, D., LaPorte, J., & Seawright, J. (2012). Putting typologies to work: Concept formation, measurement, and analytic rigor. Political Research Quarterly, 65(1), 217-232.

Collington, R. (2022). Disrupting the welfare state? Digitalisation and the retrenchment of public sector capacity. New Political Economy, 27(2), 312-328.

Communications Regulatory Commission of Mongolia (2022). Dominant and deserved monopoly entities. Available at: https://crc.gov.mn/en/k/T/11

Coyle, K. (2006). Mass digitization of books. *The Journal of Academic Librarianship*, *32*(6), 641-645.

Crittenden, W. F., Biel, I. K., & Lovely III, W. A. (2019). Embracing digitalization: Student learning and new technologies. Journal of Marketing Education, 41(1), 5-14.

DateReportal (2022). Individual Country Reports. Available at: https://datareportal.com/reports/

Degryse, C. (2016). Digitalisation of the economy and its impact on labour markets. *ETUI research paper-working paper*.

Demirkan, H., Spohrer, J. C., & Welser, J. J. (2016). Digital innovation and strategic transformation. It Professional, 18(6), 14-18.

Digitalization involves the increased use of digital technologies and their integration and cross-fertilization in the firm's products and inbound and outbound activities

Djankov, S. (2015). Russia's economy under Putin: From crony capitalism to state capitalism (No. PB15-18). Peterson Institute for International Economics.

Durkiewicz, J., & Janowski, T. (2018). Is digitalization improving governance quality? Correlating analog and digital benchmarks. In Proceedings of the 18th European Conference on Digital Government ECDG (pp. 48-56).

EC (2022). Digital Economy and Society Index, https://digital-strategy.ec.europa.eu/en/policies/desi

Elman, C. (2005). Explanatory typologies in qualitative studies of international politics. International organization, 59(2), 293-326.

Esteva, G. (2010). What is Development?. In Oxford Research Encyclopedia of International Studies.

Evans, P. B. (1989). Predatory, developmental, and other apparatuses: A comparative political economy perspective on the third world state. In Sociological forum (Vol. 4, No. 4,

pp. 561-587). Kluwer Academic Publishers-Plenum Publishers.

Evans, P., & Heller, P. (2015). Human development, state transformation, and the politics of the developmental state. In The Oxford handbook of transformations of the state.

EurasiaNet (2019). Туркменистан: сугубо личное дело. Available at: https://russian.eurasianet.org/туркменистан-сугубо-личное-дело

Feldstein, S. (2021). The Rise of Digital Repression: How Technology is Reshaping Power, Politics, and Resistance. Oxford University Press.

Frantz E., Kendall-Taylor A., Wright J. (2020). Digital Repression in Autocracies, VDem Institute, available at: https://www.v-dem.net/media/filer_public/18/d8/18d8fc9b-3ff3-44d6-a328-799dc0132043/digital-repression17mar.pdf

Fuchs, D., & Lederer, M. M. (2007). The power of business. Business and Politics, 9(3), 1-17.

Garcia-Muiña, F. E., González-Sánchez, R., Ferrari, A. M., & Settembre-Blundo, D. (2018). The paradigms of Industry 4.0 and circular economy as enabling drivers for the competitiveness of businesses and territories: The case of an Italian ceramic tiles manufacturing company. Social Sciences, 7(12), 255.

Gast, I., Schildkamp, K., & van der Veen, J. T. (2017). Team-based professional development interventions in higher education: A systematic review. Review of educational research, 87(4), 736-767.

GDL (2022). GDL Area Profiles. Available at: https://globaldatalab.org/profiles/region/TKMt/

Gil Nelson, D. P., Riccardi, G., & Mast, A. R. (2012). Five task clusters that enable efficient and effective digitization of biological collections. ZooKeys, (209), 19.

GlobeNewswire (2022). Turkmenistan - Telecoms, Mobile and Broadband - Statistics and Analyses. Available at: https://www.globenewswire.com/news-release/2022/03/18/2405844/0/en/Turkmenistan-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses.html

Gobble, M. M. (2018). Digitalization, digitization, and innovation. *Research-Technology Management*, *61*(4), 56-59.

Gray, J., & Rumpe, B. (2015). Models for digitalization. *Software & Systems Modeling*,*14*(4), 1319-1320.

Gunningham, N., & Rees, J. (1997). Industry self-regulation: an institutional perspective. Law & Policy, 19(4), 363-414.

Haagh, L. (2019). Public state ownership within varieties of capitalism: regulatory foundations for welfare and freedom. International Journal of Public Policy, 15(1-2), 153-186.

Habibi, F., & Zabardast, M. A. (2020). Digitalization, education and economic growth: A comparative analysis of Middle East and OECD countries. Technology in Society, 63, 101370.

Hagberg, J., Sundstrom, M., & Egels-Zandén, N. (2016). The digitalization of retailing: an exploratory framework. *International Journal of Retail & Distribution Management*.

Hall, P. A., & Soskice, D. (2001). An introduction to varieties of capitalism. op. cit, 21-27.

Hartl, E., & Hess, T. (2017). The role of cultural values for digital transformation: Insights from a Delphi study.

Haufler, V. (2013). A public role for the private sector: Industry self-regulation in a global economy. Carnegie Endowment.

Heilig, L., Schwarze, S., & Voß, S. (2017). An analysis of digital transformation in the history and future of modern ports.

Heller, N. (2017). Estonia, the digital republic. The New Yorker, 18.

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive*, *15*(2).

Horlach, B., Drews, P., Schirmer, I., & Böhmann, T. (2017). Increasing the agility of IT delivery: five types of bimodal IT organization.

Huskey, E. (2010). Elite recruitment and state-society relations in technocratic authoritarian regimes: The Russian case. Communist and Post-Communist Studies, 43(4), 363–372. doi:10.1016/j.postcomstud.2010.10.004

IMD (2022). World Digital Competitiveness Index. Available at: https://www.imd.org/centers/world-competitiveness-center/rankings/world-digital-competitiveness/

Isaksson, A. J., Harjunkoski, I., & Sand, G. (2018). The impact of digitalization on the future of control and operations. Computers & Chemical Engineering, 114, 122-129.

Isensee, C., Teuteberg, F., Griese, K. M., & Topi, C. (2020). The relationship between organizational culture, sustainability, and digitalization in SMEs: A systematic review. *Journal of Cleaner Production*, *275*, 122944.

ITU (2017). ICT Development Index 2017, https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2017/MISR2017_Volume1.pdf

ITU (2017). ICT Development Index 2017. Available at: https://www.itu.int/net4/ITU-D/idi/2017/index.html

Ivanova, M., & Putintseva, N. (2020). Approaches to evaluation of digital transformation of government: Comparative analysis of indicators in the central and eastern european countries. In Proceedings of the 2nd International Scientific Conference on Innovations in Digital Economy: SPBPU IDE-2020, pp. 1-8.

Jovanović, M., Dlačić, J., & Okanović, M. (2018). Digitalization and society's sustainable development–Measures and implications. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, *36*(2), 905-928.

Kagermann, H. (2015). Change through digitization—Value creation in the age of Industry 4.0. In *Management of permanent change* (pp. 23-45). Springer Gabler, Wiesbaden.

Kane, G. C., Palmer, D., & Phillips, A. N. (2017). Achieving digital maturity. MIT Sloan Management Review.

Karagiannaki, A., Vergados, G., & Fouskas, K. (2017). The impact of digital transformation in the financial services industry: Insights from an open innovation initiative in fintech

in Greece. In Mediterranean Conference on Information Systems (MCIS). Association For Information Systems.

Kattel, R., & Mergel, I. (2019). Estonia's digital transformation: Mission mystique and the hiding hand (pp. 143-160).

Katz, R. L., & Koutroumpis, P. (2012). Measuring socio-economic digitization: A paradigm shift. *Available at SSRN 2070035*.

Kayikci, Y. (2018). Sustainability impact of digitization in logistics. Procedia manufacturing, 21, 782-789.

Kesarchuk O. (forthcoming). The Power and Powerlessness of the Post-Soviet Business in a Comparative Perspective, 21st Annual ASN World Convention, Harriman Institute, Columbia University.

Khan, S., Khan, S., & Aftab, M. (2015). Digitization and its impact on economy. *International Journal of Digital Library Services*, *5*(2), 138-149.

Kotarba, M. (2017). Measuring digitalization–key metrics. Foundations of Management, 9(1), 123-138.

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., & Ahlemann, F. (2017). Digitalization: opportunity and challenge for the business and information systems engineering community. *Business & information systems engineering*, *59*(4), 301-308.

Li, L., Su, F., Zhang, W., & Mao, J. Y. (2018). Digital transformation by SME entrepreneurs: A capability perspective. *Information Systems Journal*, *28*(6), 1129-1157.

Liere-Netheler, K., Packmohr, S., & Vogelsang, K. (2018). Drivers of digital transformation in manufacturing. Hawaii International Conference on System Sciences, Waikoloa Beach, HI, pp. 3926–3935.

Lowry, A. (2020). Russia's Digital Economy Program: An Effective Strategy for Digital Transformation?. The Palgrave Handbook of Digital Russia Studies.

Mammadli, E., & Klivak, V. (2020). Measuring the effect of the Digitalization. *Available at SSRN 3524823*.

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & information systems engineering*, *57*(5), 339-343.

Matt, C., Trenz, M., Cheung, C. M., & Turel, O. (2019). The digitization of the individual: conceptual foundations and opportunities for research. Electronic markets, 29(3), 315-322.

Mazzucato, M. (2011). The entrepreneurial state. Soundings, 49(49), 131-142.

McKinsey (2015). Digital America: A Tale of the Haves and Have-Mores, 1-18.

Milakovich, M. E. (2012). Digital governance: New technologies for improving public service and participation. Routledge.

Morakanyane, R., Grace, A. A., & O'Reilly, P. (2017). Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature. Bled eConference, 21.

Morley, J., Widdicks, K., & Hazas, M. (2018). Digitalisation, energy and data demand: The impact of Internet traffic on overall and peak electricity consumption. *Energy Research & Social Science*, *38*, 128-137.

Mubarak, F., Suomi, R., & Kantola, S. P. (2020). Confirming the links between socio-economic variables and digitalization worldwide: the unsettled debate on digital divide. Journal of Information, Communication and Ethics in Society.

Muhamedov, R. (2021). Serdar Berdimuhamedov and Turkmenistan's Digital Transformation in The Diplomat. Available at: https://thediplomat.com/2021/07/serdar-berdimuhamedov-and-turkmenistans-digital-transformation/

Muro, M., Liu, S., Whiton, J., & Kulkarni, S. (2017). Digitalization and the American workforce.

Myovella, G., Karacuka, M., & Haucap, J. (2020). Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies. *Telecommunications Policy*, *44*(2), 101856.

Newmark, A. J. (2017). Lobbying regulation in the states revisited: What are we trying to measure, and how do we measure it?. Interest Groups & Advocacy, 6(3), 215-230.

Nwankpa, J. K., & Roumani, Y. (2016). IT capability and digital transformation: A firm performance perspective.

OCCRP (2022). One Family's 'Golden Age': President's Relative Controls Turkmenistan's Only Mobile Operator. Available at: https://www.occrp.org/en/investigations/one-familys-golden-age-presidents-relative-controls-turkmenistans-only-mobile-operator

Paavola, R., Hallikainen, P., & Elbanna, A. (2017, January). Role of middle managers in modular digital transformation: the case of Servu. In European Conference on Information Systems (pp. 887-903). Association for Information Systems.

Pagani, M., & Pardo, C. (2017). The impact of digital technology on relationships in a business network. Industrial Marketing Management, 67, 185-192.

Parida, V. (2018). Digitalization. In Addressing Societal Challenges (pp. 23–38). Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:ltu:diva-68008

Parker, D., & Kirkpatrick, C. (2012). Measuring regulatory performance. The economic impact of regulatory policy. OECD Expert Papers.

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. *International journal of information systems and project management*, *5*(1), 63-77.

Parviainen, P., Tihinen, M., Kääriäinen, J., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. International journal of information systems and project management, 5(1), 63-77.

Petticrew, M., & Roberts, H. (2008). Systematic reviews in the social sciences: A practical guide. John Wiley & Sons.

Piccinini, E., Hanelt, A., Gregory, R., & Kolbe, L. (2015). Transforming industrial business: the impact of digital transformation on automotive organizations.

Plueckhahn, R., & Bumochir, D. (2018). Capitalism in Mongolia–ideology, practice and ambiguity. Central Asian Survey, 37(3), 341-356.

Pollard, S. (2013). Typology of industrialization processes in the nineteenth century. Taylor & Francis.

Rachinger, M., Rauter, R., Müller, C., Vorraber, W., & Schirgi, E. (2018). Digitalization and its influence on business model innovation. Journal of Manufacturing Technology Management.

Reis, J., Amorim, M., Melão, N., Cohen, Y., & Rodrigues, M. (2019). Digitalization: A literature review and research agenda. In: *International Joint conference on Industrial Engineering and Operations Management* (pp. 443-456). Springer, Cham.

Riedl, R., Benlian, A., Hess, T., Stelzer, D., & Sikora, H. (2017). On the relationship between information management and digitalization. Business & Information Systems Engineering, 59(6), 475-482.

Ritter, T., & Pedersen, C. L. (2020). Digitization capability and the digitalization of business models in business-to-business firms: Past, present, and future. Industrial Marketing Management, 86, 180-190.

Royakkers, L., Timmer, J., Kool, L., & van Est, R. (2018). Societal and ethical issues of digitization. Ethics and Information Technology, 20(2), 127-142.

Rutland, P. (2018). Business and state in contemporary Russia. Routledge.

Rydning, D., Reinsel, J., & Gantz, J. (2018). The digitization of the world from edge to core. Framingham: International Data Corporation, 16.

Sabbagh, K., Friedrich, R., El-Darwiche, B., Singh, M., Ganediwalla, S. A. N. D. E. E. P., & Katz, R. A. U. L. (2012). Maximizing the impact of digitization. *The global information technology report*, *2012*, 121-133.

Sabbagh, K., Friedrich, R., El-Darwiche, B., Singh, M., Ganediwalla, S., & Katz, R. (2012). Maximizing the impact of digitization. *The global information technology report*, *2012*, 121- 133.

Sartori, G. (1970). Concept misformation in comparative politics. American political science review, 64(4), 1033-1053.

Schmidt, R., Zimmermann, A., Möhring, M., Nurcan, S., Keller, B., & Bär, F. (2015). Digitization–perspectives for conceptualization. In *European Conference on Service-Oriented and Cloud Computing* (pp. 263-275). Springer, Cham.

Shleifer, A. (2005). Understanding regulation. European Financial Management, 11(4), 439-451.

Shoemaker, P. J., Tankard Jr, J. W., & Lasorsa, D. L. (2003). How to build social science theories. Sage publications.

Singh, A., & Hess, T. (2017). How chief digital officers promote the digital transformation of their companies. MIS Quarterly Executive, 16(1).

Šimral, V. (2020). Two problems with lobbying regulations in EEA countries. Studies of Transition States and Societies, 12(1), 53-67.

Soltis, P. S. (2017). Digitization of herbaria enables novel research.

Srai, J. S., & Lorentz, H. (2019). Developing design principles for the digitalisation of purchasing and supply management. *Journal of Purchasing and Supply Management*, *25*(1), 78-98.

Startup Estonia (2022). Startup Ecosystem. Available at: https://startupestonia.ee/startup-ecosystem

Stewart, D. W., Shamdasani, P. N., & Rook, D. W. (2009). Group depth interviews: Focus

Telia (2018). Estonian Association of Information Technology and Telecommunications Initiates Best Practices Agreement for Reducing Cold Calling in Mobile Sector. Available at: https://www.telia.ee/en/uudised/estonian-association-information-technology-telecommunications-initiates-best-practices-agreement-reducing-cold-calling-mobile-sector

The Heritage Foundation (2022). 2022 Index of Economic Freedom. Available at: https://www.heritage.org/index/country/russia

The World Bank (2022a). Mobile cellular subscriptions (per 100 people). Available at: https://data.worldbank.org/indicator/IT.CEL.SETS.P2

The World Bank (2022b). Fixed broadband subscriptions. Available at: https://data.worldbank.org/indicator/IT.NET.BBND.P2

Trček, D. (2019). Driving digital transformation through e-government.

UN (2022). UN E-Government Knowledgebase: Country data. Available at: https://publicadministration.un.org/egovkb/en-us/data-center

UNESCAP (2022). A Climate Resilient ICT Sector in the Mongolia. Available at: https://www.unescap.org/sites/default/d8files/knowledge-products/A%20Climate%20Resilient%20ICT%20Sector%20in%20Mongolia.pdf

University of Bologna, 2022. BIT-ACT Publications. Available at: https://site.unibo.it/bit-act/en/publications

Urbach, N., & Röglinger, M. (2019). Introduction to digitalization cases: how organizations rethink their business for the digital age. In *Digitalization cases* (pp. 1-12). Springer, Cham.

US Department of State (2022). 2021 Investment Climate Statements: Estonia. Available at: https://www.state.gov/reports/2021-investment-climate-statements/estonia/

US ITA (2021a). Turmenistan - Market Challenges. Available at: https://www.trade.gov/country-commercial-guides/turkmenistan-market-challenges

US ITA (2021b). Estonia - Market Overview. Available at: https://www.trade.gov/country-commercial-guides/estonia-market-overview

US ITA (2021c). Russia - Market Overview. Available at: https://www.trade.gov/country-commercial-guides/russia-market-overview

Vasilev, V. L., Gapsalamov, A. R., Akhmetshin, E. M., Bochkareva, T. N., Yumashev, A. V., & Anisimova, T. I. (2020). Digitalization peculiarities of organizations: A case study. Entrepreneurship and Sustainability Issues, 7(4), 3173.

VDem (2022). Digital Society Index, https://www.v-dem.net/data_analysis/VariableGraph/

Vial, G. (2021). Understanding digital transformation: A review and a research agenda. Managing Digital Transformation, 13-66.

Warwick, K. (2013). Beyond industrial policy: Emerging issues and new trends, OECD.

Zhao, M., Liao, H. T., & Sun, S. P. (2020). An Education literature review on digitization, digitalization, datafication, and digital transformation. In 6th International Conference on Humanities and Social Science Research (ICHSSR 2020), pp. 302-306. Atlantis Press.