

State of Digitalization, 2023

State of Digital Maturity, 2018-2023 Evolution, Stages and Barriers

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Introduction

Despite the virtuous circle of digital innovations and accelerated investment, many enterprises, sector associations, consortia and development agencies, in the majority of countries, are struggling to advance their Digital Maturity, as a set of not-so-obvious limiting factors have been counteracting the main and well-established incentives. These barriers are common across industries and countries, with different intensities depending on the sector, country and size of the enterprise.

The objective of this article is to outline the main groups of disincentives and to present eight sets of initiatives to address them. These initiatives are defined, with specific examples and key learnings from digitally advanced enterprises and countries, in two separate articles, "Digital Advancement Initiatives- Knowledge Transfer and Skilling" and "Digital Advancement Initiatives- Strategic Platform Management and Ecosystem Participation".

Additionally, as digital technologies evolve at an unprecedented speed, their analysis, deployment decisions and investments, can be a baffling undertaking. For this reason, this article includes a brief study of the evolution of digital technologies, the stages of their applications, and the adoption rationale, to provide a broader analytical framework that may facilitate the formulation of digital advancement strategies and the prioritization of initiatives.

Part I: Digitalization Evolution and Stages

1. The Rise of a Virtuous Circle of Digital Innovation

Digitalization, understood as the improvement of enterprises' competitiveness, capabilities and processes enabled by the deployment of digital technologies, gradually emerged as a strategic priority in 2018.

Since then, the rapid development of cloud computing (CC) technologies that enable Digitalization has become increasingly important to enterprise management. As they offer an ever-expanding range of business applications and opportunities for performance improvement and cost-efficient access to competitive capabilities.

The combination of the following factors has generated a virtuous circle of accelerated innovation in cloud-computing-enabled technologies:

- **Sustained increase of computing power** at lower costs due to chip miniaturization, combined with greatly improved and cheaper digital infrastructure, (communications network, storage, connectivity, and cloud capacity), ready to support cost-efficient cloud-computing services.
- **The consolidation of industrial CC providers** (Amazon Web Services, Microsoft Azure, GoogleCloud, SAP, and OracleCloud), that offered IaaS (Infrastructure-as-a-Service) as an alternative to on-premises ICTs infrastructure, and CC enterprise software applications (SaaS, Software-as-a-Service).
- **The emergence of developer-driven platforms to create and commercialize new cloud-based software applications** (PaaS, Platform-as-a-Service), like OracleCloudPlatform and IBMCloud further accelerated innovation and expanded the range of cloud-based business applications.
- **The come-of-age of the Industrial Internet of Things (IIoT)**, which was ready to automatize more complex tasks by leveraging and integrating multiple technologies. IIoT was by then able to network sensors and actuators with virtually any device ranging from smartphones to GPSs, transponders, medical devices and jet engines.
- **Inflexion point on the development of Artificial Intelligence (AI)**, with the emergence of Deep Learning, that applied layers of neural networks to previous machine learning techniques. Deep Learning, led to the exponential growth of AI applications, such as natural language recognition, technology prototyping and machinery reliability and performance predictions. The high expectations and faster-than-expected advancements made AI one of the best-funded technologies.
- **The solid advance of Big Data** in the analysis of structured content and also in the management of the deluge of unstructured content originated from internet users' behaviour. By 2018, Big Data was ready to manage the coming deluge of data generated by sensors and actuators of IIoT-abled devices, and also

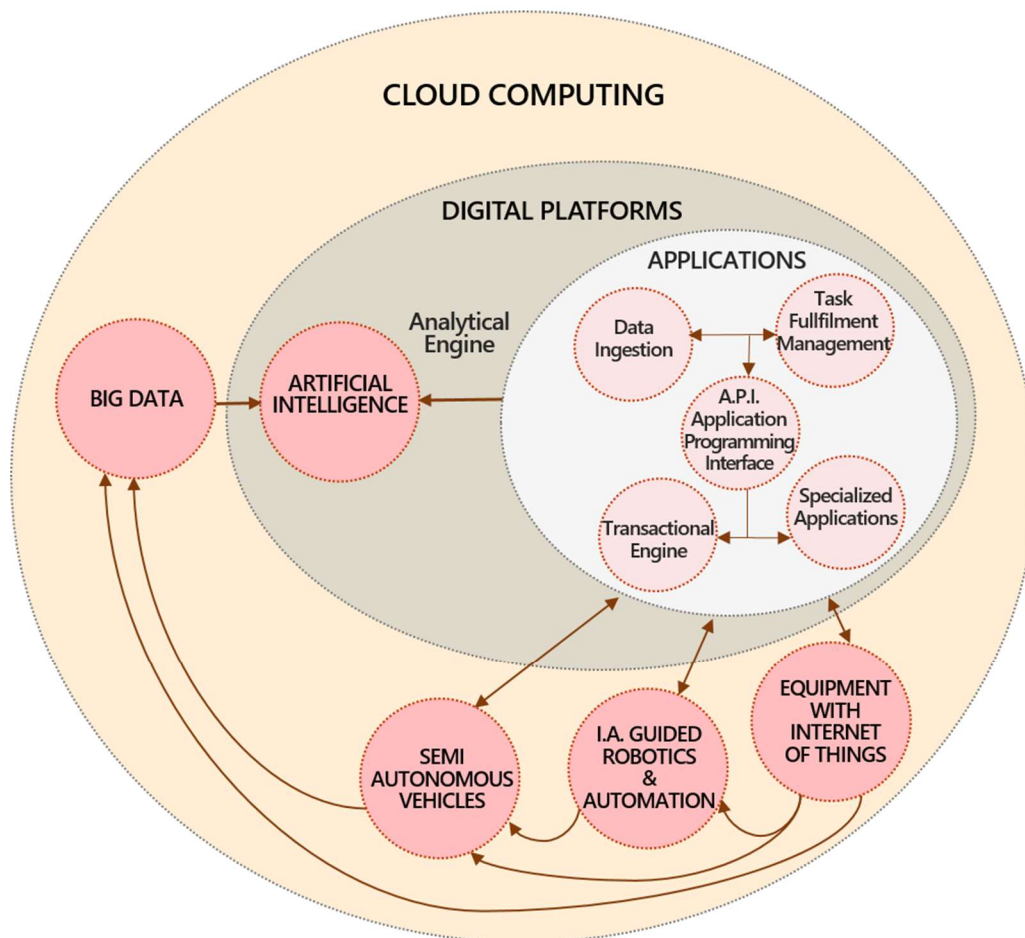
from the extensive use of smartphones. The capabilities of Big Data, in turn, facilitated AI development by providing the enormous amounts of data required for AI's deep learning.

- **At the core of this virtuous circle of accelerated innovation is Digital Technologies' ability to integrate and mutually leverage each other.**

Additionally, they integrate with them and other technologies, for example, Advanced Robotics results from Robotics powered by IIoT devices, that network and interact with their environment. In turn, the integration of AI with Advanced Robotics allows innovation in drones and autonomous vehicles.

The diagram below illustrates how CC, IIoT, Big Data and AI use and reinforce each other.

– Digital Technologies Mutual Integration and Leverage, Conceptual –



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2. Digitalization Emergence Stage: 2018-2020

Digitalization is concentrated in leading large corporations and in the most competitive countries.

The virtuous circle and acceleration of digital technologies' mutual integration and leverage, led the Digitalization advancement during 2018-2020. Investment in ICTs increased from 4% in 2018 to 18% in

2019 and 13% in 2020 and investment in global computing infrastructure doubled. Mainly due to complex investment and Digital Transformation efforts from large corporations.

The level of Digitalization was increasingly being determined by enterprise size.

In the case of Europe 80%, 58% and 42% of very large, large, and medium enterprises were investing or

planning to invest in digital technologies by 2020, while only 30% of small companies were taking steps towards Digitalization. (IDC, Statista, European Investment Bank).

Additionally, the most competitive countries engaged in national strategic digital development and workforce planning created specialized-leading public agencies, adjusted their academic and professional education systems, and evolved their managerial culture towards collaboration and risk-taking. Resulting in an increasing digital gap between these countries and the rest.

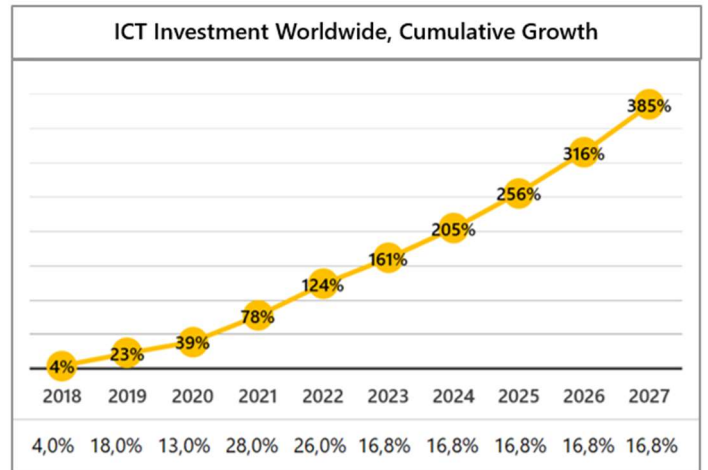
3. Digitalization Consolidation Stage: 2020-2022

The COVID-19 epidemic disruption delayed the most complex investment projects, the adoption of advanced digital technologies was put on hold, and complex Digital Transformations were reduced. On the other side, the lockdowns and disruptions in operations and logistics triggered an increase in Digitalization in countries, sectors, and firms that started the crisis with low Digitalization levels.

Many medium and small companies finally engaged in their Digitalization and many others further advanced their capabilities achieving a minimal generalized level, which helped them to adapt to lockdowns through remote work and online operations, making them more resilient and increasing their productivity.

Countries with low levels of basic Digitalization, experienced larger advances, as example, Greece, a European laggard reached 61% of workers using a computer connected to the internet, in comparison to above 85% of the most digitally advanced countries (International Monetary Fund, 2023). Most advanced countries noted the importance of Digitalization not only for longer-term productivity but also for the resilience of the economy to shocks.

Overall, Digitalization accelerated ICT investment grew from 13% in 2020% to 28% in 2021 and 26% in 2022. Enterprises focused their Digitalization efforts on their immediate needs of increasing resilience to disruptions, reaching and engaging customers on multiple digital channels, and increasing and applying better data and insights to support operations and planning.



Source: World Economic Forum, Statista and CETMO Analysis

4. Digitalization Biased Stage, 2023

In 2023 investment in Digitalization, despite recovering from the pandemic, reached 16.8% growth similar across regions (measured as ICT worldwide investment). This growth is supported by the digital jump-in of reluctant enterprises and administrations, that have become aware of the inevitability of the adoption of these technologies to maintain their competitiveness. Past reluctance and concerns have led to a sense of urgency and preoccupation regarding how to leverage digital technologies.

Digital Maturity is mainly determined by the enterprise's size, except in the most digitally advanced countries. Large corporations advance towards Digital Transformation, while most medium and small ones struggle to adjust their processes to the new digital technologies. If a large part of a given sector has low Digital Maturity, it acts as an anchor, decreasing the overall sector's competitiveness compared to those from more digitally advanced countries.

Digital Maturity is biased towards internal operations, and B2C interactions, while the leverage of digital technologies to facilitate B2B collaboration, exchange and transactions with buyers and suppliers and collaboration is far smaller. There are some differences among sectors:

ICT, finance, insurance and professional services are the sectors with the highest Digital Maturity and also the least biased towards internal operations.

Advanced manufacturing, wholesale trade, oil & gas, and utilities, are sectors with significant Digital Maturity but are very biased towards internal operations.

Transport & logistics, hospitality, basic manufacturing, health care, pharma, & chemicals, agriculture, mining and construction, have a low overall digital maturity and particularly low digital investments and capabilities to facilitate digital transactions and collaboration and in developing or participating in platform and ecosystem new business models.

Just as an illustrative example, in the transport sector, where even medium-sized companies advance in the use of cloud-based fleet management, predictive maintenance, warehousing and planning. The mere digitisation of the bill of lading transport documents (e-CMR) is just 1% (EU, 2023).

Sectors with complex and interdependent transactions, heavily regulated, with a low tolerance for failure, and repeated attempts of vertical integration, and either capital or labour-intensive, are less digitally advanced as a battery of disincentives explained later are particularly strong.

Part II: Digital Maturity Advancement Barriers

There are three main groups of barriers to further digital advancement: First, the limited access to digital knowledge, which includes: the shortage of digitally skilled personnel, the limited experience-sharing to accelerate the learning curve, and the few sources of information to identify reliable second-tier providers of digital solutions for those enterprises that cannot secure the services of leading providers.

The second group of barriers relates to Digitalization's unclear benefits.

Enterprises have significant digital know-how not leveraged, as the perceived effects on managers' and employees' professional careers, of participating in Digitalization projects are unclear. Additionally, enterprises' Digitalization investment returns are delayed until business processes are updated. This comes as a surprise and a deterrent, to those enterprises with limited resources.

The third battery of barriers limits the Digitalization of transactions and the use of data and is at the core of the current state of biased Digitalization towards internal operations. Shared data rights, outdated regulations and owner-biased platform governance models have greatly limited the generation of public data spaces and sector-specific data sets to help optimize operations, logistics, planning and investment.

Most importantly, this third battery has also limited the Digitalization of business transactions and the development of digital platforms and ecosystems that can facilitate transactions, reduce costs, provide efficient services, and trigger value-creation network economies.

The next table summarizes these three groups of disincentives, and introduces eight potential sets of initiatives to address these barriers:

– Digital Maturity Advancement Barriers, 2023 –

Digital Advancement Barriers	Digital Maturity Advancement Initiatives
<p>A Limited Access To Digital Knowledge</p> <p>A1 Low new technology acquisition cost, but scarce digital talent</p> <p>A2 Minimal sharing of knowledge & experiences</p> <p>A3 No sources to identify reliable local providers</p> <p>B Unclear Professional Career Effects</p> <p>C Shared Data Rights Delay Value Creation</p> <p>C1 Shared data rights inhibit Digitalization and the facilitation of business transactions</p> <p>C2 Common bilateral transactional models decrease access and usage of data</p> <p>C3 Low generation of Platform and Ecosystem Business Models that facilitate transactions</p>	<p>Increase Digital Skills and Digital Knowledge Sharing</p> <p>Develop digital upskilling and reskilling programs leveraging corporate, consortia and public best practices</p> <p>Participate in professional forums to exchange digital experiences</p> <p>Certifications and tools to identify reliable technology integrators</p> <p>Facilitate Transparency and Digital Career Information</p> <p>Professional digital skills demand and compensation portals</p> <p>Strategic Platform Management and Ecosystem Participation</p> <p>Leverage regulatory, governance and data-sharing innovations</p> <p>Support platforms that facilitate data usage of sector data spaces</p> <p>Realign platforms to support participation and value creation</p> <p>Develop platform management and ecosystem participation strategy</p>

Source: CETMO, 2023  CETMO

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A. Limited Access to Digital Knowledge

Research conducted by CETMO in 2021 and 2022 pointed out that for many enterprises in most countries, the incentive of low digital technology acquisition costs was offset by the scarcity of digital knowledge to make digital technologies' adoption decisions, efficiently deploy them, and undertake the changes in operational processes necessary to generate benefits.

There are three areas of limited digital knowledge accessible to many enterprises, in most countries:

- A.1. The well-known insufficient and high cost of digitally skilled personnel.
- A.2. Limited sharing of knowledge and experiences to accelerate the learning curve.
- A.3. Lack of sources to identify reliable second-tier local technical providers.

A.1. Low new technology acquisition cost, but scarce digital talent

The Digitally skilled personnel required is estimated to reach 23% of the global labour force by 2027 (World Economic Forum, 2023). This unprecedented demand results from the fast advancement of Digital technologies applications and capabilities and, also from the need for not only, technological skills but also managerial ones to facilitate the transformation of a wide range of business processes in planning, operations, logistics, inventory management, manufacturing, and sales, and even develop new go-to-market and business models.

A.2. Minimal sharing of knowledge and experiences

The importance of experience and knowledge sharing to accelerate innovation and competitiveness has been well-established since Michael Porter's 1998 cluster development model.

Digitally advanced countries strive to increase their collaborative business culture.

On the other hand, countries with little collaborative culture and sub-sectors with a history of vertical integration attempts, suffer from a chronic lack of knowledge sharing regarding Digitalization experiences, details of their implemented solutions, and common pitfalls. This lack of knowledge sharing flattens the learning curve and significantly slows down digital advancement.

A.3. Lack of sources to identify reliable local technical providers.

Many second-tier local technology integrators do not have the necessary experience and skills to provide well-adjusted enterprise platforms and other digital solutions to the medium and small size enterprises that they cater to. CETMO's research reveals that bad experiences in initial Digitalization efforts, and the scarcity of sources of information to identify reliable integrators have become a significant Digitalization barrier.

B. Unclear Professional Career Benefits and Delayed Business Case

CETMO's research unveiled that often enterprises have significant digital know-how not leveraged, and technologists, managers and technicians may not be applying all their digital knowledge and skills, due to the lack of career incentives to undertake potentially risky Digitalization initiatives. This reservation depends on the enterprise's, country and sector business culture, in particular the tolerance of failure and how risk-taking is rewarded.

As explained in other CETMO articles on Digital Competitiveness, one characteristic of leading enterprises and digitally advanced countries is that their business culture primes business agility, and stimulates and rewards innovation and risk-taking.

Additionally, there is a delayed enterprise business case: the bulk of benefits and new capabilities provided by digital technologies are generated when processes are significantly modified to leverage them, which results in a delayed positive business case, and reinforces the need for digitally skilled human capital.

C. Shared Data Rights and Outdated Regulations Delay Value Creation

C.1. Shared data rights inhibit Digitalization and the facilitation of business transactions

The Digitalization of business transactions has an enormous value-generation potential. Digital platforms and ecosystems can facilitate transactions and reduce their cost, also they can include partners that provide cost-efficient services, trigger value-creation network

economies, and allow new value-distributed business models.

At present, Digitalization is biased towards internal operations, and the optimization of enterprise platforms to facilitate business transactions with suppliers and B2B buyers is an underdeveloped area, in many sectors of most countries.

Dominant shared data rights regulations and platform governance models are platform-owner-biased and inhibit the Digitalization and facilitation of business transactions to the point of becoming a major barrier to the advancement of Digital Maturity at enterprise, sector and national levels.

Furthermore, in most cases, B2B buyers and sellers do not receive compensation for sharing their data when they transact with other enterprises' platforms. This explains enterprises' minimal transactions and reluctant participation with other enterprises' platforms.

This affects all countries to different degrees, depending on their policies.

As explained in the following article, regulations and governance are evolving, in particular in the EU. European Union Digitalization strategy and digital policy-making are increasingly relevant as they directly affect the country members' policies and regulations, and also become a point of reference for many other countries.

C.2. Common bilateral transactional models decrease access and usage of sector data

For most enterprises in many sectors, the enormous value-generation benefits of the Digitalization of transactions have not materialised as most enterprises' platforms use a basic bilateral transactional model, using their own platforms to fulfil their supply chain and customer needs with bilateral interfaces with Buyers and Suppliers platforms.

For many enterprises, the only two benefits from interacting with other enterprises' platforms, are regulatory compliance and business continuity. Without dominant value-sharing platforms and ecosystems, it is up to sellers and B2B buyers to decide which and how many platforms to interface with, ending up with many bilateral interfaces. As a result, transaction costs increase instead of being reduced

Additionally, the lack of developed platforms and ecosystems results in the scarcity of sector-specific data-

sets to help optimize operations, logistics, planning and investment.

C.3. Low generation of platform and ecosystem business models that facilitate transactions

Large leading enterprises manage strategically their proprietary platforms to increase competitiveness and generate value through digital transactions.

For most enterprises, there are two ways to facilitate enterprise transactions, lower their cost, and obtain other benefits, either evolve their bilateral digital transactional model to a multi-participant, transaction-facilitating platform, or they have to participate in other existing enterprise platforms, platform gateways and ecosystems.

In most sectors, no dominant platforms, not digital business ecosystems have emerged to facilitate business transactions. In order to gain competitiveness enterprises, consortia and digital development agencies should strategically support, develop, invest and participate in advanced platforms and ecosystems, and there is a significant body of Best Practices to leverage.

Closing

This article has outlined seven barriers that limit or even inhibit digital advancement.

Enterprises, consortia and development agencies in all industries and most countries face these same barriers, with different intensities depending on the sector, country, and size of the enterprise.

In the following articles, we present eight sets of initiatives, to address these disincentives, with specific examples, guiding principles and Best Practices from the growing corpus of experiences from leading enterprises and the most digitally advanced countries. All articles follow the order of the first illustration included in this article.

The following article "*Digital Advancement Initiatives-Knowledge Transfer and Skilling*" covers the first four sets of advancing initiatives:

1. Develop digital upskilling and reskilling programs leveraging corporate, consortia and public Best Practices
 - Update investment criteria for internal Digital Skilling programs

- Apply experience from leading corporate skilling programs
 - Redirect and leverage professional education systems
 - Develop skills to participate in multi-party collaborative efforts
2. Participation in professional forums to exchange digital experiences
 3. Certifications and tools to identify reliable technology integrators
 4. Professional digital skills demand and compensation portals

A third article, “Digital Advancement Initiative – Strategic Platform Management and Ecosystem Participation”, will cover the remaining sets of initiatives:

5. Leverage regulatory, governance and data-sharing innovations
6. Support platforms that facilitate data usage of sector data spaces
7. Realign Platforms to support participation and distributed value-creation
8. Develop Platform Management and Ecosystem Participation Strategy

This set of articles aims to provide a broader analytical framework, that may facilitate the formulation of digital advancement strategies and the evaluation of investments and digital initiatives.

They also provide an introduction to the large corpus of experiences and Best Practices, able to be adjusted and applied by any kind of enterprise, to digital advancement projects of any scale.

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