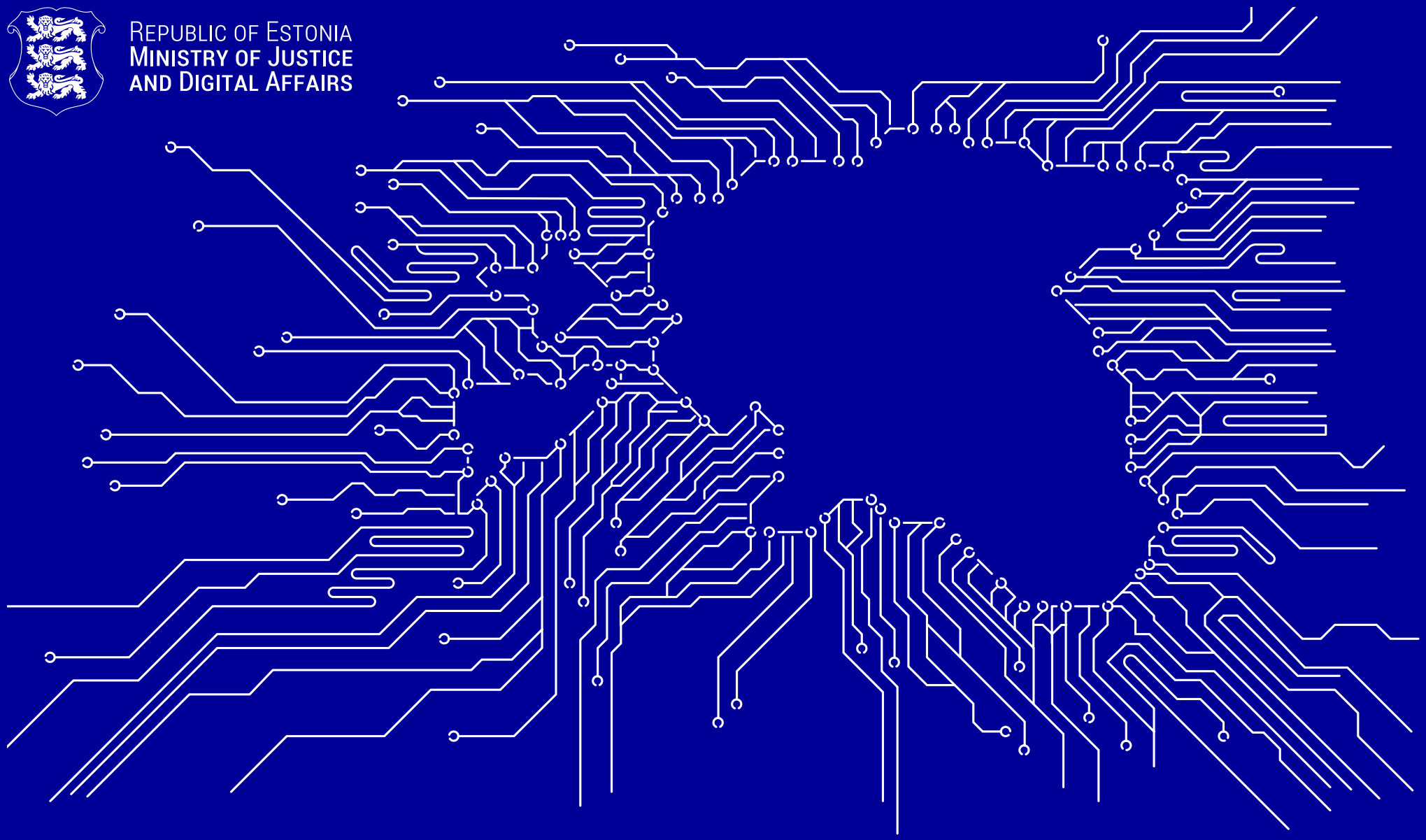

Republic of Estonia
Ministry of Justice and Digital Affairs

EUROPE'S DIGITAL DECADE STRATEGIC ROADMAP: ESTONIA

2025

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Introduction

The Digital Decade policy programme 2030 sets up an annual cooperation cycle to achieve the common objectives and targets. This governance framework is based on an annual cooperation mechanism involving the Commission and Member States.

The Estonian Digital Decade Strategic Roadmap is and updated version (previous 2023) based on Estonian Digital Agenda 2030 (the national strategy for Estonian digital transformation), the Education strategy 2021—2035 and the Estonian Research and Development, Innovation and Entrepreneurship Strategy 2021—2035.

1. Estonian national roadmap comprises of the following:
    a. Where applicable, the main planned, adopted and implemented policies, measures, and actions that contribute to achieving the general objectives and the digital targets of Europe's Digital Decade.
    b. Where available, national projected trajectories contributing to achieving the relevant digital targets set out in Article 4 of the Digital Decade Policy that are measurable at national level.
2. Where possible, this roadmap provides measures and estimates of the investments and resources needed to contribute to achieving the general objectives and the digital targets, as well as a general description of the sources of those investments, either private or public, including, the planned use of EU programmes and instruments.
3. The national roadmap includes Estonia's current intentions regarding multi-country projects to the extent these have been identified.

Analysis of the State of Play of Digital Transformation in Estonia

STATE OF PLAY

Estonia has been acknowledged as an advanced digital society, Estonia is a global leader in ensuring ease of business and a hassle-free life for its citizens. We are ready to go beyond digital with seamless technology integration, empowering people and businesses. Our regulations encourage an entrepreneurial spirit, making Estonia not just a launchpad but a growth accelerator and enabling it to pilot solutions in real-world conditions before wider adoption.

According to the European Union Digital Decade previous Country reports, Estonia is expected to make a positive contribution to the collective efforts to achieve the Europe's Digital Decade targets, namely for being at the forefront of the digitalisation of public services. However, further efforts are needed to ensure that the country's digital infrastructure is improved, especially the connectivity infrastructure, which is a critical enabler for all components of the Digital Decade policy programme.

The technological change around us is accelerating and offering new opportunities (artificial intelligence, 5/6G, new computing technologies (AI, quantum), bio-green-nano technologies, etc. The time of mere "digitization" is over for Estonia. Now the question is how to skilfully manage emerging technologies to bring about the broader societal changes that they enable.

A major challenge for organizations - both in the public and private sectors - is to keep up with the changes. This was shown by the crises - COVID and Russia's war in Ukraine. Understanding the situation and realizing the final goal are insufficient if the complexity of implementing the necessary changes exceeds the capacity of our companies and institutions. Therefore, a successful digital strategy must also offer a management model and understand how to simplify the complexity for the implementers.

The main goals of the Estonia are set in our long-term government strategy "Estonia 2035" and development plan "Digital Agenda 2030". They state continuous movement towards an intelligent, caring, cooperation-oriented and innovative society. Based on this vision, the Estonian people of the future will be supported by a personal state, where the use of public services is as convenient as possible and considers the needs of the person, and people also have comprehensive control and an overview of the activities and data that concern them. Estonian people and companies are helped by the public sector, which is based on knowledge and data-based management logic and is open, transparent, and efficient in its activities. Estonian companies are smart and innovative, among other things, data and solutions based on artificial intelligence are widely used in the provision and development of their services.

This vision is broad and comprehensive, but the reality of the implementation of the development plan has been more modest - today's development plan deals more narrowly only with the digital state, cyber security, and connectivity.

Several activities of today's development plan, especially the most horizontal ones, have not yet been successfully put into operation, and are lacking a trajectory on how to get there: (green transition, innovation, cross-disciplinary cooperation, digital skills). These are topics whose responsibility and activities are shared between several development plans and programs.

Considering digital skills, the situation of education in Estonia has been described in the context of the three strategic goals of the Education Strategy, through strengths and challenges highlighted in studies and analyses, vision documents, education strategy working groups and stakeholder consultations. We are guided by the principle that to achieve the future goals of education in Estonia, it is necessary to maintain and further develop its strengths and to address bottlenecks.

In the digitalisation of businesses, the rapid change of technology is changing business models and the nature of work. To stay competitive, existing solutions need to be constantly updated and new ones developed. For enterprises, these changes create new business opportunities; however, exploiting them requires the ability (resources, skills) to adopt new technologies, the willingness to continuously learn and adapt business models, the ability to cooperate internationally and to find one's place in changing global value chains. This, in turn, requires keeping up to date with the latest developments in science and technology, both in the field of research and in the education system. The use of data, including data management and cyber security, is becoming increasingly important, offering new business opportunities while also requiring increasingly thorough knowledge and skills.

CHALLENGES AND OBSTACLES

Based on the necessary changes described above, Estonia's aim is to bring together the internal and external developments that are taking place. To keep the pace, we need to set a clear vision for the Estonian digital society and set measures, activities and metrics how to move in this direction. What are the milestones from year to year and what investments will the implementation of these goals require.

THE MAIN CHALLENGES ESTONIA IS CURRENTLY FACING:

+ **Challenges in the Quality and Sustainability of Digital Services**

Estonia has made remarkable progress in digitizing public services, but significant challenges remain. Many digital services fall short of meeting user expectations and best practices, which limits their overall value and effectiveness. Additionally, the continuous updates and maintenance required to ensure the sustainability of these services are not always guaranteed. This puts the long-term viability of the system at risk. Furthermore, preparations for implementing major innovations have been insufficient, and the adoption of new solutions has been neither swift nor widespread. Without addressing these issues, Estonia risks losing its competitive edge in the global digital landscape.

+ **Rising Cybersecurity Risks and the Need to Strengthen Core Capabilities**

As one of the world's most digitized nations, Estonia faces increasing cybersecurity challenges. The risks associated with cyberattacks are growing alongside technological advancements, and these threats have become more complex and diverse. Estonia's cybersecurity framework still has gaps that need to be addressed to ensure robust and consistent protection. In a rapidly advancing global technology environment and amidst the politicization of cyberspace, it is crucial for Estonia to secure trustworthy supply chains and establish reliable partnerships. Strengthening the nation's core cybersecurity capabilities is essential to maintaining its reliance on digital solutions and infrastructure.

+ **Shortage of IT Skills and Specialists**

A shortage of skilled IT professionals is one of the most significant obstacles to Estonia's continued digital transformation. Although Estonia is recognized for its high level of general digital literacy, there is an ongoing lack of highly qualified specialists needed to drive advancements in the digital economy, improve public services, and enhance cybersecurity. This skills gap limits businesses' ability to innovate and risks creating structural unemployment as new technologies become more prevalent. To address these challenges, Estonia must focus on developing expertise in emerging technologies such as artificial intelligence, quantum computing, and robotics to maintain its position as a digital leader.

STRENGTHS AND ASSETS

Estonia has a vision and an action plan concerning the development of the Estonian economy, state, and society with the help of digital technology in the next decade. In Estonian context our digital success is based on different sectors and domains coming together as a joint effort. This success has not been led by one Ministry or agency, but all domains are responsible for digitalisation of its services.

OUR BIGGEST STRENGTHS AND ASSETS ARE:

+ Estonia has achieved remarkable progress as a digital state, setting a global example with its **innovative solutions and widespread adoption of digital services**. Nearly 90% of Estonians actively use digital services, making the country one of the leading users in the EU. Both individuals and businesses have embraced digital platforms for interacting with the government, with nearly all public services now available online. This achievement is grounded in Estonia's robust foundational platforms, such as the national digital identity and the X-Road system, which ensure secure and efficient development of services across various sectors.

+ Estonia has also established itself as a leader in cybersecurity, a critical area for any advanced digital society. **Citizens trust the security of their data and the resilience of digital services,** which are supported by state-of-the-art solutions. This trust has been vital in a global environment marked by increasing cyber threats and technological disruptions. Estonia's ability to safeguard its digital infrastructure and implement innovative security measures demonstrates its readiness to handle the challenges of a highly interconnected and digitalized world.

+ In addition to its public sector innovations, **Estonia has cultivated a vibrant IT sector and a thriving tech startup community**. The IT industry has been a key driver of economic growth, with exports from the sector growing significantly in recent years. Estonia's success in fostering a globally recognized tech ecosystem highlights its capacity to support innovation and attract talent. These strengths ensure that Estonia remains not only a digital leader but also a hub for technological advancement and international collaboration.

+ Estonia is an innovative country which values the creation and use of knowledge and where social life is organised by means of new human-centric and efficient technologies. **The governance set-up promotes social cohesion, the adoption of new solutions, innovation, and flexible governance.** Public services function in the background and are proactive, and the data space is protected. The organisation of governance and people's participation in it in Estonia is trendsetting and sets an example to other countries.

Policies, Measures and Actions to Achieve the Digital Targets

OBJECTIVE I – DIGITAL SKILLS

Achieving the goals of a digital society is hindered by a shortage of highly skilled digital specialists across sectors. New technologies demand advanced competencies to assess their potential and risks, but the labour market struggles with a lack of technical expertise and top-tier talent. This scarcity increases competition and slows digital transformation efforts. The public sector requires a systematic approach to enhance civil servants' digital skills. Managers' understanding of digital transformation also varies, with uneven capabilities to plan and execute necessary changes.

Vulnerable groups, such as those with outdated skills or limited digital literacy, face barriers to accessing services and participating in democracy. Digital skills development is fragmented across government sectors, lacking coordination to address gaps, improve basic literacy, and promote advanced skills through quality retraining and upskilling programs.

Estonia scores above the EU average in both basic and advanced digital skills. In 2023, based on DESI index results, 62.6% of individuals had at least basic digital skills, slightly above the EU average of 55.6%. According to the outcomes of PIAAC studies, Estonians rank highly in basic digital skills and problem-solving through technology. The in-country statistics demonstrate that Estonians are active users of digital services provided by both the public and private sectors. Unfortunately, this doesn't align with the DESI index results, which show that almost 35% of the population lacks basic skills to use digital services.

The PIAAC 2023 results[1] and the OECD 2024 report[2] indicate that despite high performance in digital skills, respondents from Estonia (similar to those from Japan, Finland, and Norway) tend to be more critical of their level of digital skills and feel the need for further upskilling. This self-criticism might explain why Estonian respondents are more pessimistic regarding their digital capability when answering the surveys that form the basis of the DESI index. This suggests a need to review the methodology of the DESI index to be more correlating to real situation of Estonia.

The percentage of employed ICT specialists is higher than the EU average. With 6.7% of ICT specialists in the workforce in 2023, Estonia was 2,4

[1] Räis, M.L. & Perend, M.-L. (2024). PIAAC 2023. Täiskasvanute oskused Eestis ja mujal maailmas. https://hm.ee/sites/default/files/documents/2025-01/PIAAC_CY2_Eesti_riiklik_raport.pdf

[2] OECD (2024). Do Adults Have the Skills They Need to Thrive in a Changing World? Survey of Adult Skills 2023. https://www.oecd.org/en/publications/do-adults-have-the-skills-they-need-to-thrive-in-a-changing-world_b263dc5d-en.html

percentage points above the EU average. Given the high percentage of ICT graduates in recent years (10.1% in 2021 which is more than the double the EU average of 4.2%), the percentage of ICT specialists is likely to increase over the next seven years. This would further contribute to the Digital Decade target of having at least 20 million (around 10%) employed ICT specialists in the workforce within the EU by 2030. The share of female ICT specialists in Estonia, at 24.5% is also well above the EU average of 18.9% and among the highest in the EU. The ICT sector is also vital to Estonia's economy, with exports growing 10% from 2022 to 2023 and comprising 12% of total exports. Software development accounted for 80% of ICT service exports.

KEY MEASURES

Estonia is currently implementing several measures that can help increase the level of digital skills to contribute to the collective efforts to meet the Digital Decade target of at least 80% of the population having at least basic digital skills.

+ In 2022, a programme was launched to empower public libraries to improve the digital skills of citizens living in their local area and enable them to use digital public services. The programme is supported by funding from the European Social Fund. As a first step, training is provided to librarians and municipality officials who will provide counselling services to local inhabitants with a low level of digital skills. Second, the Ministry of Education and Research launched an initiative to offer "in-service training courses" for adults. These courses are offered by vocational schools, universities, and other higher education institutions and are free of charge for the participants. Around a third of these courses focus on ICT skills. Third, training on digital skills is also funded by the Unemployment Insurance Fund. Around 10% of the total training budget is allocated to ICT training. To date, around 5 000 people have participated in these training courses.

+ Estonia has launched several programmes and initiatives to address the growing demand for ICT specialists and ICT graduates in the labour market, and to promote women's access to the field.

  + First, recently launched retraining and upskilling programmes are expected to train another 7 000 ICT specialists between 2021 and 2027. These initiatives include three pilot programmes aimed at creating alternative paths into the ICT sector for people without previous training or work experience.

  + Second, to reduce the gender imbalance in the ICT sector, the Estonian Ministry of Social Affairs has developed projects, supported by EU funding, to promote women 's access to the ICT sector and to reduce the current gender imbalance. This is in line with Digital Decade targets and objectives to reduce the digital divide and promote convergence between genders. The design and implementation of these projects builds on the findings of an 18-month research project on "Glass Walls and Ceilings in the Estonian ICT Sector".

  + Third, an e-services development training programme will be piloted and launched in 2023. This programme is aimed at equipping service owners with the right skill set to develop new services and to re-think existing offerings, applying design thinking methods and a user-centric and problem-oriented approach. Estonia's ambition to make

a significant contribution to the collective efforts to achieve the 2030 Digital Decade targets for ICT specialists is also underlined by the fact that Tallinn University of Technology (TalTech) is a leading partner in the international consortium DigitalBusiness which aims to create a commercially sustainable 100% online European master's study programme.

+ Enterprises increasingly provide ICT training and thereby contribute to improving the digital skills of their employees. The percentage of enterprises providing ICT training is with 19% still below the EU average of 22%. However, the gap between Estonia and the EU average is decreasing, from 8 percentage points in 2017 to 3 percentage points in 2022. This shows the positive impact of the measures taken by Estonia. The development between 2020 and 2022 was very similar to the EU average (which saw an increase of around 10%).

+ Learning options are responsive to the development needs of society and the labour market. Rapidly changing societies and evolving labour markets, including new fields and professions and new forms of work, require the upgrading of existing skills. This implies that individuals must be prepared for career transitions and for continuous learning — retraining and further training throughout their lives — and that the education systems are able to respond quickly to changing skills needs. By providing skills, the education system creates the preconditions for entrepreneurship and innovation, for economic growth that considers the specific characteristics of Estonia, and for a balanced and cohesive society. An ageing population will create new challenges for the labour market and the social sector, changing the way work is done and the expectations of future employees. Demand for technology-related skills will continue to grow until 2035. In a society based on new technologies, education plays an increasing role in the cultural and ecological survival of society. General and future competences, and at least a few in-depth competences in specific fields (the 'T-shaped skills model'), help people to adapt in the labour market. Flexible and practical upskilling opportunities and work-based learning are becoming increasingly important in education.

OBJECTIVE II – DIGITAL INFRASTRUCTURES

Estonia has a competitive telecommunications market, particularly in mobile services, with some of Europe's lowest prices and a 90.29% usage rate among residents aged 16–74 (DESI 2024). The country's 5G network rollout is advanced, covering 87% of its territory.

Estonia outpaces the EU average in FTTP availability, reaching 77% of households compared to the EU's 64% (DESI 2024), and surpasses neighbours Latvia (62%) and Finland (61%). However, rural areas face challenges due to low population density, requiring state support for network expansion.

Fixed broadband subscriptions of at least 100 Mbps have grown significantly, reaching 35.5% of households (DESI 2024), but remain below the EU average of 65.9%. A shift from 50 Mbps to 100 Mbps packages is evident.

Further efforts are needed to contribute to the Digital Decade target of having full coverage of all populated areas by 2030. Overall, 5G coverage in Estonia has reached 43% of populated areas, which is significantly below the EU average of 81%. Regarding 5G coverage on the 3.4-3.8 spectrum band, which is necessary for advanced applications that need large spectrum bandwidth, Estonia has only achieved 15%. This is again significantly below the 41% in the EU overall. Recent improvements in 5G spectrum assignment will improve the 5G coverage over the coming years.

This sub-objective is directly related to the implementation of one of the axes of the "Digital Agenda 2030". It sets a vision that services should be convenient and available all over Estonia, which is why relevant (telecommunications) connections are needed. The digital power of the economy, in turn, depends on the development of connectivity. The better the connections, the more digital solutions, products, and services can serve as vehicles for development in various sectors and across Estonia. The quality and availability of connections also determines whether conditions are favourable for the creation of future solutions in Estonia and whether people from other countries come here with the same aspirations.

KEY MEASURES

Estonia has taken several measures to improve its connectivity infrastructure to contribute to the collective efforts to achieve the Digital Decade targets in this area.

+ The first large scale support measure for access networks came to conclusion. Between 2018-2023 in total 40 016 addresses were covered with VHCN, nearly 12 000 of those in 2023.

+ The second round of applications of the support measure financed from the Recovery and Resilience Facility was carried out, with 14 MEUR allocated to cover 5 900 addresses with VHCN. In total more than 11 000 addresses will be covered with VHCN by the end of 2025.

+ A new first time pilot measure to support local initiative village networks was launched in 2023. With a total budget of 800 000 euros five local initiative groups received aid to cover 100 addresses with VHCN.

+ To boost the country's resilience, Estonia is introducing national roaming. This will ensure basic connectivity for people in times of crises or network failures or collapses, include data connection, SMS, and voice calling. Negotiations are ongoing with ministries, and operators and the initiative will be incorporated into the national legal framework.

+ Estonia is monitoring the development of data centers to report on the progress of edge nodes. Currently, we have three operational sites in Tallinn, Suurupi, and Hüüru. There are also activities in the private sector; however, since the demand is market-driven, we do not implement additional national initiatives to increase these numbers.

Estonia has no developments to report in semiconductors. Estonia contributes to the collective efforts in high-performance computing mainly through the Estonian Scientific Computing Infrastructure (ETAIS) project. The project is run by a consortium of the University of Tartu, Tallinn University of Technology, the National Institute of Chemical Physics and Biophysics, and The Education and Youth Board (HARNO). ETAIS aims to increase the competitiveness of Estonia's computing and data-intensive research disciplines by providing access to a new and modern scientific computing infrastructure.

Estonia is also part of the EuroQCI initiative to build a pan-European quantum infrastructure and a partner in the Nordic-Estonian Quantum Computing e-Infrastructure Quest (NordIQuEst). The purpose of this project (which runs from April 2022 until May 2025) is to create a Nordic ecosystem that combines high-performance computing and quantum computing.

High-performance computing (HPC) and data management are essential for Estonia's digital society, supporting research, innovation, and strategic technological development. Estonia prioritizes HPC infrastructure through efficient investments like the ETAIS consortium, enabling cutting-edge academic and industrial applications. Since 2022, Estonia has access to the LUMI supercomputer, which provides significant computational resources, including 28.9 million CPU hours, 1.7 million GPU hours, and extensive storage capacity. By 2023, approximately 40% of Estonia's allocated LUMI resources were utilized, with full utilization expected from 2024 onward.

GOALS FOR UPCOMING YEARS:

+ The state will invest in the development of HPC capacity and academic networks with the following objectives:
    + Enhance the societal and economic impact of research, development, and innovation by supporting progress with modern data infrastructure.
    + Increase awareness and skills related to HPC services among both public and private sector stakeholders.
    + Bring services closer to end users, making HPC usage more accessible and straightforward.
    + Expand the number of HPC service users in both the public and private sectors.
    + Ensure efficient development of HPC capabilities by combining international resources with Estonia's local infrastructure.
    + These efforts aim to strengthen Estonia's position as a leader in digital innovation and high-performance computing.

Challenges include the growing demand for high-quality HPC services driven by AI development and the need for resources in both the public and private sectors. Priorities for the next three years include increasing HPC accessibility, improving user training, and advancing computational capacity to support Estonia's scientific, economic, and technological goals.

OBJECTIVE III – DIGITALISATION OF BUSINESSES

While Estonia is a leader in public sector digitalization, the level of digital adoption among businesses is more modest. Estonia's businesses, while small and agile, leverage digital tools effectively for targeted processes such as financial management and accounting. Many industry-specific software solutions are available, and a range of digitalization services is offered by both public and private sectors to support companies in their modernization efforts.

However, the focus remains largely on isolated solutions rather than comprehensive digital strategies that enable the uptake of new technologies, i.e. AI and data analytics to be deployed in ways that deliver economic impact. To maximize the benefits of Estonia's advanced digital infrastructure, businesses need to expand their use of digital technologies across all operations, enhancing overall competitiveness in both domestic and international markets. As stated in the Digital Decade Country report 2024 ith 55.9% of its SMEs having at least basic level of digital intensity, Estonia performs lower than the EU average of 57.7%. The annual growth rate for this indicator is 1.7%, which is lower than the EU average of 2.6%. However, Estonia is one of the EU's front runners in the use of e-Invoices (58,7% against the EU average of 38%).

DIGITAL SOLUTIONS ACROSS ALL AREAS OF LIFE

In the current situation, where Digital Decade targets are divided between various Estonian development plans, the Estonian "R&D, innovation and Business Development Plan 2021 - 2035" sets goals to reach the objectives above.

With the support of R&D, innovation and entrepreneurship, digital solutions are created, delivered, and used in every area of life. Data economy is used to create new business opportunities, secure cyberspace is ensured.

Using Information and Communication Technology (ICT) horizontally through other sectors was selected as a growth area during RDI strategy 2014-2020 preparation. The development of the ICT sector continues to be important, as it provides a major local (e-governance) and global (export of smart solutions and e-services, cyber security, application of artificial intelligence, etc.) contribution to the functioning of society and the economy.

IN RECENT YEARS, R&D HAS MAINLY FOCUSED ON:

+ Artificial intelligence and machine learning - innovative solutions for creating automated systems, including healthcare (e.g., ICT-based solutions for e-health and personalised medicine) and e-government solutions.

+ Data science and big data — solutions for user-centred e-Governance, including the Internet of Things, robotics, industrial automation, healthcare, etc.

+ Robot-human interaction and the Internet of Things in industry, including the digitalisation of industry and optimisation of processes.

+ Reliability of software, including measures of software correctness, safety,

resource usage analysis, validation of analytical results and methods and tools for independent verification of certificates (e.g., for e-government and public services).

+ The Internet of Smart Things, including both devices and technical solutions, as well as changes in processes (e.g., production processes) and in people's daily behaviour (e.g. health data).

+ Security and reliability of hardware and systems, cyber defence — solving security problems related to cyber threats (e.g., in the fields of energy, communications, finance, transport, and security).

+ Digital transition and lifelong learning by addressing not only the information technology dimension but also the social, cultural and values dimensions in the development and use of digital solutions for lifelong learning; the assessment and development of digital maturity of organisations and the adoption of digital innovations in education and entrepreneurship.

The development plan is linked with underlying strategic guidance from the "Estonia 2035" strategy, in particular the business environment, the cultural space and the living environment, security and safety, public administration.

BUSINESS ENVIRONMENT: Estonia's business environment is conducive to the entrepreneurial spirit and to the emergence and growth of knowledge-intensive enterprises, the creation and export of higher value-added products and services, and investments in all regions of Estonia. According to the State of European Tech 2023 report Estonia has the highest number of funded startups per capita, and the most billion-dollar companies per capita. Global Entrepreneurship monitoring report 2023 shows that Estonian companies are rather satisfied with physical and services infrastructure giving it 7 points on 10-point scale. Estonia also has one of the highest shares of 18-64 population (individuals involved in any stage of entrepreneurial activity excluded) who are latent entrepreneurs and who intend to start a business within three years (GEM2023). In 2023 Estonia exported total 30 billion euros worth of goods and services.

DIGITALISATION OF BUSINESSES

1) Activities of strand 1 of the Business Environment "Developing a competitive and smart business and consumption environment" 1.4. raise awareness among entrepreneurs about the so-called twin transitions (digital and green transitions for a sustainable and digital economy) and business transfer, and provide support services to foster technological innovation, the use of the best available technologies, the rise in management quality and generations exchange, p. 19.

(2) Activities of strand 2 of the Enterprise Environment "Increasing the capacity to create higher added value and export" 2.1. support the use of the best available technologies in industrial enterprises and encourage the adoption of business models based on modern technologies, allowing, inter alia, the diagnosis and audit of bottlenecks and the involvement of experts and top specialists from abroad with international experience, p. 20.

3) Activities of the knowledge transfer strand 1 "Increasing the R&D&I intensity and knowledge transfer capacities of enterprises" 1.9. encourage the automation of enterprises through the development of a digitalisation roadmap and the financing of investments therein, including support for

digitalisation and the use of AI and robotics-related technologies to make companies' processes and supply chains more efficient and to increase the added value of products and services, p. 16. 4) Knowledge transfer 1. Under the strand, four areas of smart specialisation have been selected, which the state is prioritising by directing additional resources there. One of the priority areas of development is "Digital solutions in every area of life", p. 13.

INNOVATIVE COMPANIES/SCALE-UPS (UNICORNS)

The "R&D, Innovation and Business Development Plan 2021 - 2035" aims to meet Digital Decade targets by focusing on innovative companies and scale-ups, notably unicorns. The plan includes various activities implemented through a knowledge transfer program in R&D and entrepreneurship. Key actions involve enhancing R&D&I intensity and knowledge transfer capabilities among companies and fostering science and technology-intensive start-ups. To develop the start-up ecosystem and improve capital access, several initiatives are underway. These include support conditions for boosting start-up entrepreneurship through Startup Estonia, which focuses on ecosystem development, talent, and capital via accelerators. Investments from the Baltic Innovation Fund (BIF), EstFund, and AS SmartCap in start-ups and venture capital funds are critical for developing the local capital market and enhancing capital availability. Support is also extended for deep tech start-up projects, the Creative Destruction Lab-Eesti (CDL-Eesti) business accelerator, the NATO DIANA business accelerator, Applied Research Programme Grants (RUP), and Applied Research Centre Services (RUK).

The Estonian business ecosystem includes many innovative and growing start-ups and scale-ups that are driving the country's growth and modernisation. There are currently 10[3] unicorns born in Estonia or founded by Estonians.

KEY MEASURES

Several measures are taken to increase the percentage of enterprises using big data, AI, and technology more broadly.

+ AI development programme has been created focusing on industrial companies and start-ups in the areas of green, health, and energy. The 'Digitalisation Roadmap' programme is intended to provide funding for SMEs for dedicated three-year action plans and services to improve their digitisation. Estonian enterprises can also apply for support for automation and the deployment of digital technologies and robots under a programme using RRF resources. The latest addition (March 2023) is a programme providing support to SMEs for cyber security measures, based on methodology developed by Estonia's Information System Authority (responsible for applying information security standards in the public sector).

+ The Estonian Digital Innovation Hub 'AI and Robotics Estonia' (AIRE) also focuses on improving the AI capabilities of Estonian companies and developing their digital maturity. It is part of the network of European

[1] The full list of Estonian unicorns — Invest in Estonia

Digital Innovation Hubs (EDIH). The EDIHs are one-stop shops supporting companies and the public administration to respond to digital challenges and to become more competitive. The EDIH network is co-financed by the European Commission and by the relevant Member States of the EU, in this case Estonia. AIRE in Estonia focuses mainly on the manufacturing sector (90% of the hub's work), but some resources are allocated to the health and tourism sectors. AIRE has been fully operational since 1 July 2022, after a 12-month pre-launch testing and pilot phase.

+ The Government offers various grants and support measures to accelerate the digitalization of businesses. The **Digital Roadmap Grant** helps companies create strategic plans for digital transformation, while the **Digital Revolution Support** focuses on automating and integrating advanced digital technologies and robotics in industries such as manufacturing, mining, and logistics. Additionally, **Real-Time Economy (RTE) Development Grants** support large-scale pilots and software development, enabling businesses to create innovative, real-time digital solutions tailored to their needs. Specific measures, such as the **eCMR Development Support**, promote the creation of electronic consignment notes for logistics, enhancing efficiency and compliance. These programs collectively empower businesses to adopt cutting-edge technologies and drive Estonia's digital economy forward.

OBJECTIVE IV – DIGITALISATION OF PUBLIC SERVICES

Estonia is at the forefront of the digitalisation of public services and is expected to make a very strong contribution to the collective efforts to achieve the Digital Decade targets for the digitalisation of public services.

The country can serve as an example to other Member States. Estonia has shared its experience and best practices with other countries, including Ukraine as a candidate country, as part of the Estonian e-Governance Academy, a foundation-based international development cooperation programme. Further advancements in digital public services remain one of the priorities under Estonia's national Digital Agenda 2030.

Estonian citizen and businesses can access a wide range of public services online: With a score of 94, Estonia is one of the very advanced Member States in terms of the proportion of administrative steps that people can carry out online for their major life events (the EU average score is 77). Estonia's score of 99 is significantly above the EU average score of 84. This indicator broadly reflects the share of public services needed to start and run a business that are available online for domestic and foreign users. Estonia's score for data that is pre-filled in online forms for public services is 88, which is also significantly above the EU average of 68.

Internet users in Estonia make good use of the user-friendly services provided: 93% of internet users in Estonia used the internet to interact with public authorities in the last twelve months. This is significantly above the EU average of 74%. Online public services in Estonia are generally considered to be particularly transparent and designed with user involvement. Users have a high degree of control over how they manage their personal data. With a score of 87, Estonia is significantly above the EU average score of 65. In terms of user support Estonia is also one of the highest-ranking countries. The score of 98 indicates excellent online support, help features, and feedback mechanisms. The EU average score is 84. User support was at a level well above the EU average when it was first measured in 2021 (with a score of 93 compared with an EU average of 82).

Estonia is committed to further improving and developing its online public services, as one of the three priorities set out in the national Digital Agenda 2030. The focus is currently on linking services to life events and developing features that automatically suggest further steps that are typically linked to other services or a particular life event (e.g., marriage may lead to changing the surname which triggers the need to update several documents). Another priority is providing the user interface and allowing for a seamless interaction with public services, irrespective of when and where, or from which device, the services are being accessed. With a score of 97, the 'mobile friendliness' of online public services in Estonia is already above the EU average of 93, and Estonia is committed to improving it further. To further strengthen e-governance, Estonia created a centre of excellence for data governance and open data. This centre improves the quality of the data collected and held by the Estonian public authorities, increasing its usability for decision-making and its availability as open data to other stakeholders.

Estonia actively contributes to European Union initiatives such as the Single Digital Gateway (SDG)/Once-Only Technical System (OOTS) and the European Digital Identity (EUDI) Wallet. Leveraging our strong digital governance expertise, we support the development of seamless cross-border digital services and interoperability between EU member states. Through

the SDG and OOTS, Estonia promotes the “once-only principle,” reducing administrative burdens by enabling the secure exchange of data between public administrations. Similarly, we are involved in the EUDI Wallet initiative, helping to create a secure, user-friendly digital identity solution that empowers citizens and businesses across the EU to access services and verify their identity digitally by the end of 2027.

Estonia is at the forefront of providing access to electronic health records. 97,5% of Estonians have access to their electronic health records, which is significantly above the EU average of 79,1%. This is a significant contribution to the collective efforts to reach the Digital Decade target of 100% access. Citizens have full access to all their electronic health data (including medical images in digital format) through a national online access service (using eID authentication). A mobile application is not available but the browser version is responsive to mobile devices. The data is updated after each healthcare encounter. Real-time remote assistance is available in case of problems accessing the data. The service is offered to the whole population and supplied with relevant health data from the entire care sector, including both public and private providers.

Accessibility can be improved. The electronic access service in Estonia is not compliant with the Web Content Accessibility Guidelines v2.1 (WCAG), as required by the European Commission’s Web Accessibility Directive. Estonia reported that monitoring at national level shows that digital health records are largely accessible, but older people and people with disabilities may experience some difficulties. These difficulties are expected to be addressed when a new health portal will be rolled out.

Most of the Estonian population has access to an eID scheme notified under the eIDAS Regulation which provides access to a wide range of digital public services. Currently, Estonia has six eID means notified under the Estonian eID scheme. The ID card, the RP card, the Digi-ID, the e-Residency, the Digi-ID, the Mobiil-ID, and the Diplomatic identity card have all been notified at a ‘high’ level of assurance. Estonia therefore makes a significant contribution to the collective efforts within the EU to achieve this target. Estonia has not reported any specific actions taken at national level to further increase the percentage of citizens with access to an eID scheme.

Budget Allocated or Planned

ESTONIA'S DIGITAL AGENDA 2030

The estimated cost includes the total assessment of the costs MEUR (without VAT) that are required for ensuring sufficient funding for the achievement of the objectives of the Digital Agenda via the digital society programme:

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total: 2021–2030
Cost (million €)	68	111	135	120	120	125	131	135	138	139	**1224**

The detailed programme with allocated budget can be found at: Digiühiskonna Programm 2024-2027

EDUCATION STRATEGY 2021–2035

The forecast shows the expected cost in millions of euros. The forecast is based on the population projection of Statistics Estonia and the long-term economic forecast of the Ministry of Finance. Baseline and Strategic Goal 1: Costs of providing formal education, including operating costs, subsidies and investments; means to maintain teachers' salaries at the 2020 reference level; continued restructuring of the school network in line with the principles of spatial quality. Strategic Goal 2: Costs to increase adaptability and flexibility in education (learners with special educational needs, learners from migrant backgrounds); development of teaching resources and curricula and teacher training costs; increasing teachers' salaries to 120% of the national average by 2025 and maintaining this level until the end of the period. Strategic Goal 3 includes investment in the activities of Action Trajectory 3, i.e. vocational systems, OSKA, adult learning, apprenticeships, work-based learning, etc.

Year	DESCRIPTION OF COSTS			Total (EUR millions)
	Baseline and Strategic Goal	Strategic Goal 2	Strategic Goal 3	
2021	882	65	29	976
2022	976	87	60	1122
2023	1011	153	58	1222
2024	1045	220	64	1330
2025	1099	291	68	1457
2026	1153	331	71	1556
2027	1206	371	72	1649
2028	1221	410	70	1701
2029	1264	445	62	1771
2030	1280	481	45	1807
2031	1342	529	46	1917
2032	1407	580	46	2033
2033	1474	633	47	2153
2034	1544	688	47	2280
2035	1618	747	48	2412

The detailed programme with allocated budget can be found at: Haridus- ja noorteprogramm 2024-2027

ESTONIAN RESEARCH AND DEVELOPMENT, INNOVATION AND ENTREPRENEURSHIP STRATEGY 2021—2035

Research funding will reach 1% of GDP by 2021 and will be maintained at least at the same level thereafter, subject to public finance policy possibilities. The 1% of GDP projected in the Strategy's budget forecast does not mean that the level of research funding could not rise above that level.

RDIE Strategy	Funding 2021–2035 (million EUR)
Research System Programme (MoER)	2,828
Knowledge Transfer Programme (MoER+MoEAC)	3,361, incl. MoER 2024 + MoEAC 1,337
Business Environment Programme (MoEAC)	1,708
Total funding for RDIE Strategy	7,897

** In addition to the funding scheme of the RDIE Strategy, sectoral R&D activities are funded by other ministries under their own strategies. The sectoral R&D spending of other ministries is not included in the funding scenarios of the RDIE Strategy.*

The assumption is that the nominal funding of the research system will be maintained even during an economic downturn.

The detailed programme with allocated budget can be found at: Ettevõtluskeskkonna programm 2024-2027

ESTONIAN NATIONAL TRAJECTORIES AND TARGET VALUES TO CONTRIBUTE TO THE EU'S DIGITAL TARGETS

Based on the current strategy, Estonia's the goal for the next decade is to increase Estonia's digital power: digital government guarantees the best experience, high-speed Internet is available to all those who request it in Estonia and our cyberspace is safe and reliable. The goal is measured based on the development of four metrics as follows:

Satisfaction of private persons with public digital services + satisfaction of entrepreneurs with public digital services + availability of highspeed Internet + resilience and trustworthiness of cyberspace /4=X

Initial situation of the development plan in 2021 was (69% + 47% + 58% + 96%)/4 = 67,5). Objective for 2030 is (90% + 90% + 100% + 96%)/4 = 94

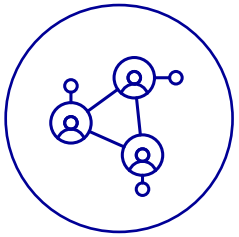
THE DIGITAL DECADE COVERS AND MEASURES FOUR DIRECTIONS:

Skills

ICT Specialists: 20 million + gender convergence
Basic Digital Skills: min 80% of population

Digital transformation of businesses

Tech up-take: 75% of EU companies using Cloud, AI, or Big Data
Innovators: grow scale-ups & finance to double EU Unicorns
Late adopters: more than 90% of SMEs reach at least a basic level of digital



Secure and sustainable digital infrastructures

Connectivity: Gigabit for everyone
Cutting edge Semiconductors: double EU share in global production
Data – Edge & Cloud: 10,000 climate-neutral highly secure edge nodes
Computing: first computer with quantum

Digitalisation of public services

Key Public Services: 100% online
e-Health: 100% of citizens have access to medical records online
Digital Identity: 100% of citizens have access to digital ID

DIGITAL DECADE TARGETS AND ESTONIAN TRAJECTORIES*

Digital Decade Target	Baseline 2023 (DESI 2024) Estonia	2024	2025	2026	2027	2028	2029	Target 2030, Estonia	EU Target
1.a. Basic digital skills, % of 16 to 74-year-olds	62,6%	65%	67%	69%	71%	73%	75%	80%	80%
1.b. ICT experts, % of population	6,7%	7%	7,5%	8%	8,5%	9%	9,5%	10%	10%
2.a. Gigabit, %	76,9%	77%	78,5%	80%	81,5%	90%	95%	100%	100%
Fibre to the Premises (FTTP) coverage	76,9%	77%	78,5%	80%	81,5%	90%	95%	100%	
2.b. 5G, %	87,5%	90%	95%	96%	97%	98%	99%	100%	100%
2.c. Edge Nodes	3	-	-	-	-	-	-	-	10 000
2.d. Quantum Computer	-	-	-	-	-	-	-	-	2
3.a.i. Cloud computing services, % of enterprises	52,6%	55%	58%	60%	68%	70%	72%	75%	75%
3.a.ii. Big data, % of enterprises	25,6%	30%	35%	45%	60%	65%	70%	75%	75%
3.a.iii. Artificial intelligence (AI), % of enterprises	5,2%	14%	20%	26%	38%	50%	62%	75%	75%
3.b. Digital intensity among SMEs, %	55,9%	60%	65%	70%	75%	80%	85%	90%	90%
3.c. Unicorns	2	-	-	-	1	-	2	5	500
4.a. Digital public services %, citizens	95,8%	99%	100%	100%	100%	100%	100%	100%	100%
4.a. Digital public services %, enterprises	98,8%	100%	100%	100%	100%	100%	100%	100%	100%
4.b. Access to electronic health record, %	97,5%	99%	100%	100%	100%	100%	100%	100%	100%
4.c. Electronic identification, %		80%	85%	90%	90%			100%	

*Estonia is not setting milestones for all the targets because it is not justified to set national targets for all of the EU targets.

OVERALL IMPACT AND CONCLUSION

To achieve the 2030 vision for a digital society, it is necessary that in other policy areas the local development plan is complemented in several ways. According to the organisation of the preparation of Estonian development plans, this is not an automatic obligation to other areas, but an order and expectation of the digital society vision drawn up within the framework of this development plan regarding the content and direction of other policies. They provide the basis for presenting views on the implementation and renewal of development plans and for coordinating activities between institutions.

Achieving the 2030 targets for the digital society will require:

The availability of sufficient and high-level ICT specialists, including the availability of cyber specialists, is critically important. By 2030, the number of ICT specialists in the economy needs to at least double, and the proportion of cyber specialists among them will have to increase to realise future goals to the extent necessary. To do this, the relevant study opportunities must be constantly expanded and the quality of study at all levels constantly improved — this requires, above all, decisive steps in the volume and quality of teaching capabilities, including ensuring the succession of teaching staff. Since the domestic education system alone is not enough to realise opportunities, it is necessary to create an easy opportunity for talents to come to Estonia — to make it a convenient and attractive destination for them.

To bring the wider digital transformation of the economy and public administration to the next level of digital maturity, it is important to initiate large-scale retraining and upskilling of digital skills. This will enable professionals from different fields to acquire the necessary digital expertise to launch and manage or support digital transformation in their organisations. The development of (professional) digital skills must also be a natural part of all levels of education. These steps will also facilitate workers' adaptation to changes in the economy.

The need to address the wider digital literacy of the population will continue. There is less and less need to "bring people online". Instead, it must be ensured that they have up-to-date skills to handle digital solutions usefully and safely. By 2030, all Estonian adults should be regular Internet users. This will provide an opportunity to ensure that they have sufficient capacity, including a basic level of relevant awareness, to be able to make ever better use of the services following the leaps in development of the digital state.

In the field of research and development, it is necessary to invest in the growth of research and development capabilities related to the development of the digital society. Then you will find players to create smart solutions and at the same time have the knowledge and solutions to try and implement quickly in the country and in the economy. The key is to ensure sufficient ICT funding for the Technical Regulatory Authority. The best possible services need a good Estonian language technology base so that both domestic and global service providers can make their services as convenient as possible for the members of the Estonian digital society.

This means increasing investment in basic language technology solutions.

Enterprise policy must focus on two objectives at once: (1) supporting the digital transformation of more traditional sectors (e.g., industry) with

the necessary levers — from raising awareness and skills to supporting investment; 2) continuous development of a technology-based business environment. Excellent conditions must be created and ensured in Estonia, that companies develop smart products and services, that companies that create new smart solutions are born and grown, and that corresponding foreign players come to Estonia.

The development of the business environment also plays an important role in this, so that doing business in Estonia would be the easiest in the whole world. The development of so-called real-time economic organisation and solutions will play an important role as the next leap in development.

To ensure both the development of the business environment and, more broadly, the creation and deployment of innovative solutions, in a rapidly changing world, law-making must be flexible and able to respond quickly to opportunities. At the same time, law-making must continue to protect fundamental human rights and ensure ethical use of data.

If public services in a country are increasingly invisible, i.e., more proactive, and automatic, the interaction between people and the state and people's understanding of the functioning of the state may decrease. To avoid this, the quality of information services and the openness of governance must be improved. In other words, people must be increasingly actively involved in public decision-making and debate. This can be done, among other things, by making smart use of digital solutions, from supporting the functioning of communities to increasing opportunities for participation at national level.

Through business diplomacy and export support activities, it is necessary to continue working for Estonia to be known in the world as an ambitious and smart digital society and country. This opens doors for companies to bring IT solutions into the world, which makes them a stronger partner in creating future solutions in Estonia as well. On the other hand, Estonia's reputation depends on whether talents and world players consider Estonia as their possible next location.

Achieving the sustainability of the health and care system highlighted in the vision through digital solutions will only be possible if the health and well-being development plans focus on a comprehensive and meaningful digital transformation strategy, the development of content areas is well integrated, and the implementation is also effectively managed. This is demonstrated by the experience so far in managing the public health development plan and the lack of implementation of the e-health strategy.

EU Level Cooperation – Estonian Participation in Multi-Country Projects and Joint Commitments

Estonia is collaborating with other Member States in setting up two **European Digital Infrastructure Consortia (EDICs)** in digital public services. The Networked Local Digital Twins Towards CitiVerse is intended to help build carbon neutral, resilient, inclusive, sustainable, and more beautiful cities that are closer to people. The Genome EDIC aims to provide an infrastructure supporting genome-based medicine, research and innovation, and a better healthcare system for personalised medicine. Estonia is also considering the possibility of setting up the Copyright Infrastructure EDIC to define and promote the rules governing data management practices in creative industries. Estonia's national digital strategy already encourages the public sector to use innovation procurement as a strategic tool to accelerate the uptake of innovative digital solutions in public services. The review of Estonia's Digital Agenda 2030 will implement the recommendation of a national roadmap setting out ambitious initiatives in the digital sector, which will help to reinforce the country's investments and contribute significantly to the target on digitalisation of public services and the Digital Decade objective on innovation.

Overview 1) a. — multi-country projects included in the list of areas of activity for MCP in the Annex of the Decision, to which Estonia is committing or plans to commit in the future:

Name of the MCP	Short description of the MCP
Networked Local Digital Twins Towards CitiVerse EDIC	The digital twin for cities EDIC will help to build carbon neutral, resilient, inclusive, and sustainable cities more beautiful and closer to citizens. It will gather existing infrastructure solutions developed by individual Member States or in the context of the 'Digital Programme for cities and local communities', such as the EU Toolbox for Local Digital Twins. This EDIC will provide a long-term sustainable place for such solutions as well as improve data use, bring standardisation efforts for digital twins together and ensure interoperability between the digital twins from the start. It will lay down a foundation for the EU CITIVERSE and pursue joint activities together (e.g., joint public procurement or shaping the supply market). This EDIC has been pre-notified in June 2023 by EE, DE, SI, ES, CZ (as members). **The proposed seat for this EDIC is Estonia.**
Genome EDIC	The 1+MG multi-country project will improve the cooperation of MS in the achievements of the general objectives of the Digital decade through the formation of a European common data infrastructure and provision of services for data reuse in research and development for better healthcare. The aim is to provide an infrastructure supporting genome-based medicine, research and innovation and a better healthcare system for personalised medicine. This EDIC has been pre-notified in June 2023 by LU, FI, EE (as members) and support is still being collected from the Member States who had expressed their interest. The proposed seat for this EDIC is Luxembourg.
Alliance for Language Technologies (ALT-EDIC) – *Observer*	In a market dominated by international stakeholders, and where EU's data is not yet used to its full potential, the ALT-EDIC will establish a European-wide infrastructure and technology centre in the field of natural language processing. It will develop Large Language and Foundation Models optimising the uptake of European language technologies including through generative AI. The ALT-EDIC will address the shortage of training data in European languages and contribute to digital sovereignty, promotion of EU's values and linguistic diversity. The ALT-EDIC EDIC has been pre-notified in June 2023 by FR, LV, IE, SI, PL, HU, PT, ES, LT, EL, NL (as members), EE, AT, BE, BG, MT, RO (as observers). The proposed seat for this EDIC is France.


finland
sweden
estonia
russia
latvia
lithuania
belarus
poland

Stakeholders Involvement

The initial Digital Decade Strategic Roadmap of Estonia is mainly based on the Estonian Digital Agenda 2030, which was adopted in 2021. Additionally, it was based on Education strategy and Estonian Research and Development, Innovation and Entrepreneurship Strategy.

In 2023, a review was initiated to assess the need for changes to the Digital Agenda, involving partners and experts from the public sector, private sector, and civil society. To identify necessary modifications to both the Digital Agenda and the Digital Decade Strategic Roadmap, expert interviews, thematic workshops, and written surveys were conducted. In addition to preparing for the update of the Digital Agenda, sector-specific white papers were developed for the period 2023—2024 on topics such as personalized government, data and AI, identity management, cybersecurity, and more. These were created in collaboration with relevant stakeholders from each field.

Key stakeholders have been involved in various levels of collaboration and networking forums, where the development plan updates were discussed collectively and thematically. A survey was conducted among partners to gather input on sectoral developments, their impacts, and recommendations on how to address these topics at the strategic level. Additionally, four thematic workshops were held on personalized government, digital skills, regional digital capacity, and telecommunications & entrepreneurship.

Materials are found here (in Estonian): Arengukava uuendamine 2024 | Justiits- ja Digiministeerium

To approve the Digital Decade Strategic Roadmap, it was included to the process of updating Digital Agenda 2030. The draft was presented to the Digital Agenda Steering Committee, made available for public consultation, and circulated for approval among all ministries and relevant institutions.

Going forward, updates to the Digital Decade Strategic Roadmap will be managed by the Digital Agenda Steering Committee, which includes representatives from ministries, sectoral institutions, and partner organizations.

EUROPE'S DIGITAL DECADE
STRATEGIC ROADMAP: ESTONIA