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STAKEHOLDER ANALYSIS

18.4.2022

DIHUB

DIGITAL INNOVATION HUB FOR CLOUD BASED SERVICES

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1. Introduction

1.1. Objectives of Creating a Cloud-Based Innovation Ecosystem

The core objectives of creating a cloud-based innovation ecosystem are

- analyzing why cloud-based services are needed
- defining cloud computing and services, terms and roles in that specific field
- describing the stakeholders in the existing holistic cloud-based innovation ecosystem and their roles in the ecosystem at the European and national level
- raising awareness of vocational education and training providers in secondary and higher education and of informal training organisations (especially ICT program facilitators and teachers/coaches) about the ecosystem for promoting cloud-based innovations of small and medium-sized enterprises (SMEs)
- raising awareness of SMEs about the possibility to utilize and recruit talented workforce and to operate in cloud-based service development

Clearly, there are many benefits from using cloud services. Building a cloud-based ICT environment brings along with it business benefits for companies. While everyone has the same opportunities to adopt new technologies and services, each company has its own, unique set of products, services, and technologies with which they operate. This set of technologies and services is different for every company.

Combining several different cloud-based technologies and service models form a unique entity, which can create *a competitive advantage* for a company and thus for the whole society. By making the right choices, SME's (Small and Medium Sized Enterprises) can improve their competitive position.

The cloud-based innovation ecosystem benefits all parties.

- SMEs can operate more easily in the complex innovation ecosystem and find out faster about feasible solutions and options to foster their operations in their processes and service development.
- It improves the abilities, expertise, and the utilization of ecosystem resources of higher and secondary level VET providers by linking their educational and training services to promoting innovations (from micro-innovations to more advanced ones) in SMEs.
- It helps all stakeholders to gain understanding about the possibilities of and resources to promote cloud-based innovations, either for startups or mature SMEs.
- It increases the stakeholder's awareness about the complex stakeholder environment, thus making fruitful collaboration attractive.
- It makes networking and partnership possible.
- It stimulates the creation of co-operative projects and thematic networks.

1.2. Advantages of Cloud computing

Cloud computing has many advantages compared to the non-cloud ICT operation models. These advantages are illustrated in the following chart:

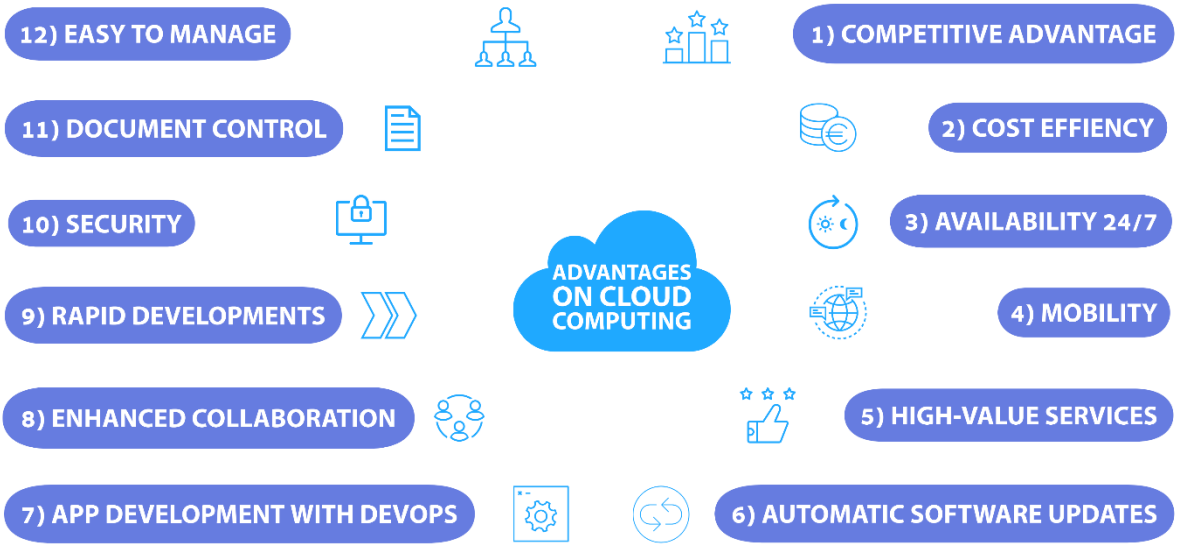

Diagram 1. Advantages of cloud computing

1. **A quick way to take the cloud-based services into use and gain competitive advantage**

One key benefit of cloud services is the rapid deployment of services. A self-service portal has been built for cloud services, where services can be ordered. Once the order is placed, the services will be available automatically without delay. Instead of having to build every service from scratch, a company gets access to new services rapidly. This creates immediate competitive advantage for SMEs.

2. **Less costs based on the flexibility of use**

There are no sizeable hardware costs of in cloud computing. The cost depends on the service you use. Cloud services enable the sizing of services according to the normal load. When the normal capacity is not enough, more capacity can be acquired when needed. When the need no longer exists, capacity can be released.

3. **Availability 24/7**

Most cloud operators are reliable in their hosting services. Maintaining the uptime is very close to 100 %.

4. ***Functioning all over the globe***

Cloud computing makes it possible to work anywhere on the globe. Only an internet connection is required.

5. **Being able to take advantage of high added value services**

As the customer does not have to worry about maintaining the ICT infrastructure, they can focus on using the services that provide more added value. Big cloud players like AWS, Azure, or Google are constantly releasing new services. Staying up to date requires constant monitoring of their range of services.

6. **Automated updates on software**

Cloud server suppliers regularly update the software while taking care of the security issues as well. There is no need to waste time on these issues because cloud-based services enable SMEs to concentrate on their core business.

7. **Accelerate application development with DevOps**

DevOps is a continuous development operating model in which agile software development meets customer-oriented ways of working. DevOps shortens system development process times and enables a tight but high-quality software release cycle in relation to business objectives. Once the application developers (Development or Dev) and

infrastructure operations (Operations or Ops) have been made to work seamlessly together, a DevOps team is formed. The cloud enables code-based infrastructure and allows different teams to publish new versions of applications almost automatically. This allows new versions of applications and thus fixes and features to be released faster than before.

8. Enhanced collaboration

Cloud applications enhance collaboration by allowing diverse groups of stakeholders and people to meet virtually, and exchange and share information through a cloud.

9. Facilitate the introduction of new technologies

Many new technologies have their origins in the public cloud. While many technologies can also be built into your own data center, construction is much slower than in a public cloud, where you can purchase a highly productized service that allows for the rapid adoption of new technology. Here are just a few examples of technologies that are changing the way you build applications and IT infrastructure: micro-services, container technology, docker, kubernetes, serverless architecture, data lake, analytics, machine learning, artificial intelligence etc.

10. Security

If something happens to your computer, you can easily download the missing data from the stored cloud system. Sensitive data is secured in the cloud.

11. Control of documents

There is no need to use e-mail as a document sharing system because the cloud offers a way to store and share documents.

12. Easy management

A cloud-based system architecture is fast and easy to maintain. Even a micro-sized enterprise can build the IT infrastructure of a large enterprise. The competitive advantage that cloud services can offer is greater for small businesses than for large ones because small businesses do not have the weight of an old IT environment and an outdated IT organization.

2. Cloud Computing and Services: Terms and Roles

The National Institute of Standards and Technology (NIST) defines cloud computing as follows: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction" [1]

ISO/IEC 17789 provides a Cloud Computing Reference 1 architecture including the cloud service categories below:

- **Software as a Service (SaaS)**
- **Platform as a Service (PaaS)**
- **Infrastructure as a Service (IaaS)**

Cloud computing takes place in a *complicated ecosystem* of stakeholders with differing requirements and expectations. On general terms, it can be seen as describing anything that delivers hosted services over the Internet 1 An *ecosystem* describes the structure of the industry, the roles of operators and relations between operators. The ecosystems of cloud businesses are formed around the large ICT companies, key technologies of data mining and platform services [2]

2.1. Network service providers (NSPs) viewpoint

Network service providers add value to the economy by providing network services. Cloud service providers (CSPs) add value to the economy by providing cloud services. Businesses and consumers need to connect to cloud services, which is where NSPs come in. CSPs provide the services businesses and consumers connect to.

2.2. Cloud Service providers (CSPs) viewpoint KOHTA 2.3. PUUTTUU KOKONAAN

Cloud Services are ICT services for the customer organization where cloud-computing technologies are used. The organization's own IT unit can produce these services, or the production can be outsourced. The share of outsourced services has increased rapidly in recent years. Typically, cloud services are divided into application rental, platform services, and IT infrastructure services.

IT Infrastructure-as-a-Service (IaaS) includes providing computing, storage and data network capacity needed to run and use platform services and applications. IaaS services are nowadays virtualized physical data center resources that are provided either publicly to several customer organizations or, to a small extent, to a single organization. Publicly provided services are commonly referred to *as the public cloud* and the services provided within the organization are called *the private cloud*. A private cloud can be operated by an organization's own IT unit or an outsourced service provider.

Within IaaS service, the concept of *hybrid cloud* is simultaneously brought into the picture. A hybrid cloud refers to a mixed computing, storage, and service environment made up of on-premises infrastructure, private cloud services and a public cloud. The primary benefit of a hybrid cloud is agility. The need to adapt and change direction quickly is a core requirement of a digital business. An enterprise might gain from (or need to) combine public clouds, private clouds, and on-premises resources to gain the agility it needs for a competitive advantage. [3]

Platform-as-a-Service (PaaS) refers to functionalities that the application providers or internal IT unit develop, deploy and manage using cloud computing technologies. The platforms cover a range of programming interfaces, development environments, infrastructure software (e.g. operating systems, middleware and databases) and information systems for provisioning, monitoring and invoicing of services. Well-known cloud platforms are for instance Microsoft Azure, Amazon Web Services, ,Google Cloud, IBM Cloud and Oracle Cloud Infrastructure.

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[1] Caithness, N., Drescher, M., Wallom, D. Can functional characteristics usefully define the cloud computing landscape and is the current reference model correct?, 2017, Journal of Cloud Computing: Advances, Systems and Applications, Springer Open, Retriewed 4th May 2021, time 13:00.

[2] Suomalainen pilvimaisema, Liikenne- ja viestintäministeriön Julkaisuja 14/2013, The Ministry of Transport and Communications of Finland, Retriewed 4th May 2021, time12:00.

[3] What is Hybrid Cloud? NetApp. https://www.netapp.com/hybrid-cloud/what-is-hybrid-cloud/

Software-as-a-Service (SaaS) refers to the ability to provide an end-to-end standardized cloud computing application for end users. [4] [5] Many of the features of cloud computing are especially utilized in customer architecture, self-service, and application usage over a data network. SaaS services include, for example, general email services, social media services, and horizontal business applications from customer relationship management to financial management. In recent years, services have been created with special features. Examples of these are Caas and Faas services as well as BPPaas.

Containers-as-a-Service (CaaS) is a cloud service that helps manage and deploy apps using container-based abstraction. CaaS can be deployed on-premises or in the cloud. The provider offers the framework, or the orchestration platform, on which the containers are deployed and managed, and it is through this orchestration that key IT functions are automated. CaaS is especially useful for developers building containerized apps that are more secure as well as scalable. Users can buy only the resources they want (scheduling capabilities, load balancing, etc.), saving money and increasing efficiency.[6]

Function as a service (FaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage application functionalities without the complexity of building and maintaining an infrastructure. Building an application following this model is one way of achieving *a serverless* architecture, and it is typically used when building microservices applications. Cases of using FaaS are associated with "on-demand" functionality that makes it possible to power down the supporting infrastructure. Hence charges are not incurred when the infrastructure is not in use. [7]

Business Process as a Service BPPaaS includes an integrated business process of linking applications together. When the processes are programmed, they support business directly.

A concept called Xaas (anything as a service) exits. It is a general term that refers to the delivery of anything as a service. It recognizes the vast number of products, tools, and technologies that vendors deliver to users as a service over a network.

2.4. Customer viewpoint

A business customer utilizes cloud services as part of their business. Usually, they use a public cloud for application rental, computing as well as storage. Business customers can also form their own private cloud, which is more secure than a public one. 2

A consumer customer uses cloud-based applications such as search engines, e-mails and social media services. They also consume content from the cloud. 2

2.5. Channels viewpoint

Retailers assemble and sell cloud services. They provide a marketplace for service providers and customers. The dealership agreement guarantees a commission for the retailers. 2

Aggregators bring together all the information technology related infrastructure services, platform services and selected SaaS services best suited for the needs of the customer. They provide service integration, data harmonization and data security. The integration work can be provided as a project, or the aggregator can offer the entity to the customer as a service. 2

Intermediators assemble and transmit cloud services such as the capacity of many public clouds. They provide value adding services such as identity and access management, pricing and invoicing. The operating model is similar to IaaS services in terms of service agreement and capacity invoicing. 2

[4] Mell, P. and Grance, T. (2011). The NIST Definition of Cloud Computing
[5] Marston, S. et al. (2011). Cloud computing - The business perspective. Decision Support Systems, 51, pp.176-189
[6] What is CaaS? 2020. Red Hat. https://www.redhat.com/en/topics/cloud-computing/what-is-caas
[7] https://en.wikipedia.org/wiki/Function_as_a_service

2.6. Value added service providers viewpoint

Consultants help customers in making decisions about cloud services and help to build them. The consultancy is performed as a project 2.

Business Process outsourcing providers produce information technology services as well as services related to the manual part of the customer's process. For example, the service provider can audit invoices on behalf of the customer in addition to providing a SaaS service. 2

Content providers utilize cloud services but appear as their own service to the final customer. The customer typically pays for the service monthly or by transaction. The content provider offers the customer audiovisual as well as information-based content. Usually, the content provider maintains the network for distributing content. 2

2.7. Enabler's viewpoint

Terminal suppliers manufacture and deliver terminal equipment and software, which utilize cloud services, to the customer. The cost for the customer is the acquisition price of the equipment2

Data providers collect, process and provide data through a service interface to cloud services (mainly SaaS services). The data can be, for example, weather data, location data or customer information**.** 2

Component providers are the vendors of the necessary hardware and software for the provision of cloud services. Hardware manufacturers produce server hardware and their components to the IaaS provider. Software companies develop software for virtualization, platform services, integration, and monitoring to produce cloud services. The cost to the customer consists of the purchase price of the equipment or the software license and the annual maintenance fee. 2

The i**ntegrator/subcontractor** delivers services for the construction of a private cloud, building a hybrid cloud solution as well as combining existing and new SaaS applications to support the business process. The integrator can also deliver other subcontracting related to software or IT infrastructure. The services of the integrator are typically project-based and invoiced based on time and materials. 2

Network operators build and produce network capacity. Their ongoing service allows cloud services to be utilized over the network. The service fee is charged as a fixed monthly price or according to capacity utilization2

Standardization assists in facilitating technical cooperation between cloud services, specialization of actors and adoption of cloud services2

Regulation enables and guides the development, provision and delivery of cloud services. Within cloud services, the regulation affects e.g. the use and development of information networks, data protection in situations where the physical location of the data may be uncertain, processing private and confidential information, copyright and settlement issues when changes occur in the software business, misconduct, and logistical issues. 2

Table 1 The roles of cloud ecosystem actors and examples of operators in Finnish environment [Modified and updated from the publication of Ministry of Transport and Communications. 2]

ROLE	EXAMPLES
CUSTOMERS **Business customers** **Consumer customers**	
CHANNELS **Dealer** **Aggregator** **Intermediator**	Elisa, Salesforce (AppExchange), Zoho.com, GetApp.com NordCloud Graviant, cloudservicefinder.com
VALUE ADDED SERVICE PROVIDERS **Consultants** **Business Process** **Outsourcing providers** **Content providers**	NordCloud, Deloitte Qvantel, IBM, CGI Spotify, Netflix
CLOUD SERVICE PROVIDERS **SaaS providers** **PaaS providers** **IaaS providers**	Basware, Dream Broker, Loyalistic, Cuutio, Software, Sympa, Salesforce, Hubspot, Netsuite Tieto Oyj, Microsoft Oy, CGI, Amazon, Google UpCloud, Nebula, CSC – IT Center for Science Ltd, Ixonos Oyj, Elisa, Cybercom, F-Secure, Amazon, Rackspace, Dropbox
ENABLERS **Network service providers (NSP)** **Terminal suppliers** **Data providers** **Component providers** **Integrator/Subcontractor** **Standardization**	Telia, Elisa, DNA, Finnet Nokia, Apple, Samsung National Land Survey of Finland, Finnish Meteorological Institute, Google, AdWords Intel, Cisco, IBM, Oracle, EMC, Red Hat, Rightscale, Apache, OpenStack, Vaadin, Techila Tieto Oyj, Ixonos, CGI FinnCloud, Trusted Cloud (Germany), G-Cloud (UK)
REGULATION	EU and national regulation bodies

3. The Cloud-based DIHUB Innovation Ecosystem

The cloud computing terms and roles described above form a core ecosystem for cloud actors. To gain a wider perspective to innovation development in SMEs, we must include additional actors in the picture. If business processes are to be developed and if cloud-based services are to be taken into use in SMEs, educational institutions and business support organisations need to facilitate innovation development by contributing services. Policymakers need to pave the way and support the next steps in fostering a digital transition in Europe and at the national level.

3.1. Stakeholders in Europe

The European Commission launches the policy programs that foster digitalization in Europe. Policy programs are implemented through different kinds of activities and European institutions. Since 2014, the Commission has taken several steps to facilitate the development of a data-agile economy. These steps include:

- the Regulation on the free flow of non-personal data
- the Cybersecurity Act
- the Open Data Directive
- the General Data Protection Regulation

In 2018, the Commission presented an AI strategy for the first time and agreed on a coordinated plan what plan? strategy plan? with the member states. The High-Level Expert Group on Artificial Intelligence presented their Ethics Guidelines on trustworthy AI in April 2019.

One of the European Commission priorities for 2019-2024 consists of a Europe Fit for the Digital Age program. The Commission is determined to make this decade Europe's “Digital Decade”. Europe must now strengthen its digital sovereignty and set standards, rather than following those of others – with a clear focus on data, technology, and infrastructure. The core foci are the following **Error! Bookmark not defined.**:

- Artificial Intelligence
- European Data Strategy
- European Industrial Strategy
- High Performing Computing
- Digital Markets Act
- Digital Services Act
- Cyber Security
- Digital Skills
- Connectivity
- European Digital Identity

On 19th July 2021, the European Commission kick-started two new Industrial Alliances: the Alliance for Processors and Semiconductor technologies, and the European Alliance for Industrial Data, Edge and Cloud. The two new alliances will advance the next generation of microchips and industrial cloud/edge computing technologies and provide the EU with the capabilities needed to strengthen its critical digital infrastructures, products, and services. The alliances will bring together businesses, Member State representatives, and academia, users, as well as research and technology organisations. [8]

From the DIHUB-projects point of view, the Digital Service Act is very important. The Digital Services Act contains rules for online intermediary services, which millions of Europeans use every day. The obligations of different online players match their role, size, and impact in the online ecosystem. These online players include the producers of the services below:

- Intermediary services offering network infrastructure: Internet access providers, domain name registrars
- Hosting services such as cloud and webhosting services

[8] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3733

- Online platforms bringing together sellers and consumers such as online marketplaces, app stores, collaborative economy platforms and social media platforms. Very large online platforms pose particular risks of the dissemination of illegal content and societal harms. Specific rules are proposed for platforms reaching more than 10% of the 450 million consumers in Europe.

All online intermediaries offering their services in the single market, whether they are established in the EU or outside, will have to comply with the new rules. Micro and small companies will have obligations proportionate to their ability and size, but the rules will ensure that they remain accountable. [9]

Policy programs are implemented through different kinds of activities and European institutions.
In this project, the following European institutions and initiatives have a significant role.

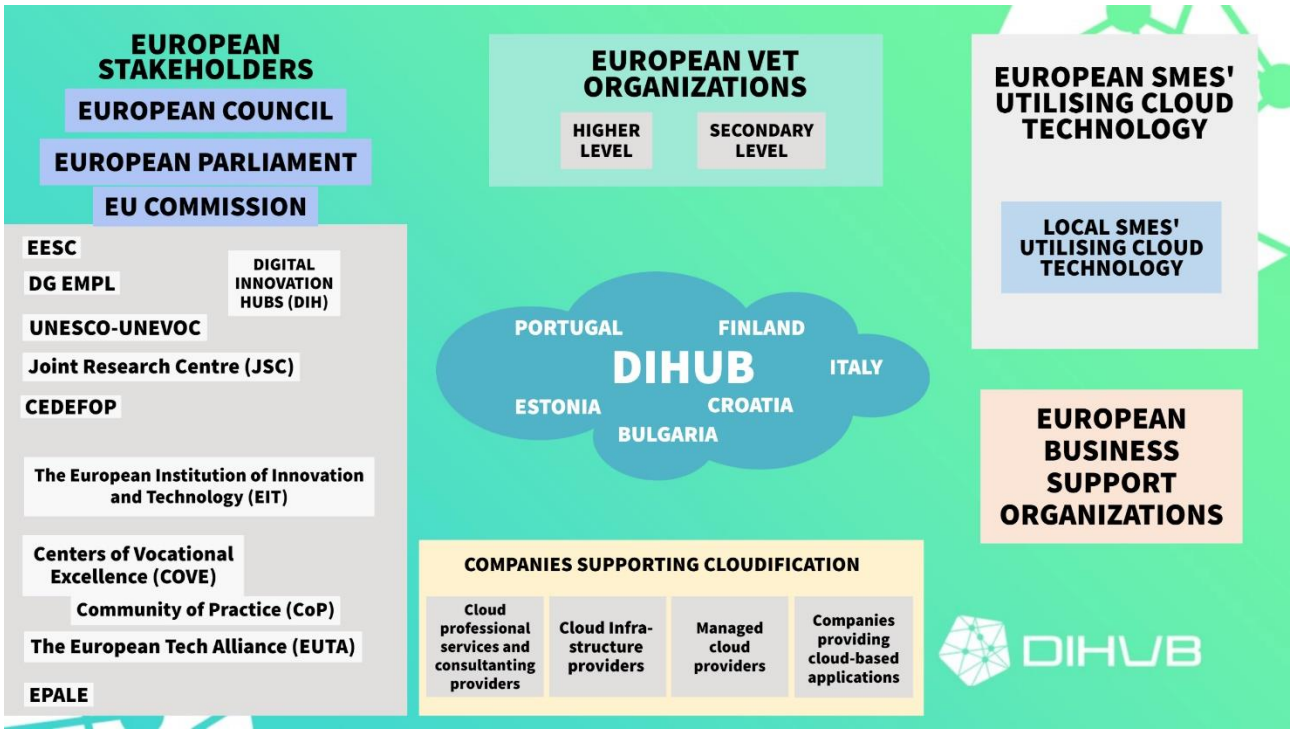


Diagram 2. Stakeholders of the Cloud-Based DIHUB Innovation Ecosystem in Europe

3.1.1. European Economic and Social Committee (EESC)

The European Parliament, the Council and the Commission will be assisted by an Economic and Social Committee, which acts in an advisory capacity." The EESC issues between 160 and 190 opinions and information reports per year and it also organizes several annual initiatives and events. The members include employers, trade unionists, and representatives of social, occupational, economic, and cultural organisations. The EESC is appointed for renewable 5-year term by the Council based on a proposal by Member States.[10]

The EESC has also set up three specialist observatories of which one is for the digital transition and the single market (SMO).

[9] The Digital Services Act: ensuring a safe and accountable online environment. European Commission. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-services-act-ensuring-safe-and-accountable-online-environment_en
[10] https://www.eesc.europa.eu/en/about

3.1.2. DG EMPL

The Commission's Directorate-General for Employment, Social Affairs and Inclusion (DG EMPL) is responsible for EU policy on employment, social affairs, skills, labour mobility and the related EU funding programmes (including Erasmus+/COVE).

3.1.3. UNESCO-UNEVOC

As UNESCO's designated center for technical and vocational education and training (TVET), UNESCO-UNEVOC supports UNESCO member states in their efforts to strengthen and upgrade their TVET systems. TVET is focused on the acquisition of knowledge and skills for the world of work, and helps youth and adults develop the skills needed for employment, decent work and entrepreneurship while supporting inclusive and sustainable economic growth. [11]

3.1.4. Joint Research Centre (JSC)

The Joint Research Centre (JRC) is the European Commission's science and knowledge service which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy. [12]

3.1.5. European Training Foundation (ETF)

The European Training Foundation is the EU agency supporting countries surrounding the European Union to reform their education, training, and labor market systems. [13]

3.1.6. The European Centre for the Development of Vocational Training (CEDEFOP)

Cedefop is one of the EU's decentralized agencies. Founded in 1975 and based in Greece since 1995, Cedefop supports development of European vocational education and training (VET) policies and contributes to their implementation. The agency helps the European Commission, EU Member States, and the social partners to develop the European VET policies. [14]

3.1.7. The European Institution of Innovation and Technology (EIT)

The European Institute of Innovation and Technology (EIT) is an independent EU body strengthening Europe's ability to innovate. The EIT is an integral part of Horizon Europe, the EU's Framework Programme for Research and Innovation. [15]

3.1.8. Centres of Vocational Excellence Initiative (COVE)

Centres of Vocational Excellence (CoVEs) bring together a wide range of local partners, such as providers of vocational education and training, employers, research centers, development agencies, and employment services (among others), to develop "skills ecosystems" that contribute to regional, economic, and social development, innovation, and smart specialization strategies.

They aim to provide high quality vocational skills, support entrepreneurial activities, diffuse innovations, and act as knowledge and innovation hubs for companies (particularly SMEs), while working together with centers in other countries through international collaborative platforms.

The Platforms for Centres of Vocational Excellence initiative introduces a European dimension to vocational excellence by supporting the development of Centres of Vocational Excellence, operating at two levels:

[11] https://unevoc.unesco.org/home/
[12] https://ec.europa.eu/jrc/en
[13] https://www.etf.europa.eu/en/about
[14] https://www.cedefop.europa.eu/en/about-cedefop
[15] https://eit.europa.eu/who-we-are/eit-glance

- **National:** linking Centres of Vocational Excellence closely to local innovation ecosystems, and connecting them at the European level
- **International:** establishing major hubs through Platforms of Centres of Vocational Excellence for vocational training, by bringing together centers that share a common interest in specific sectors or trades, or by innovative approaches to tackle specific societal challenges
-

Centres of Vocational Excellence are intended to be world-class reference points for training in specific areas for both initial training of young people as well as for continuing up-skilling and re-skilling of adults, by offering flexibly and at the right time training in skills needed by companies. They operate locally, being closely embedded in the local innovation ecosystems. CoVEs act as catalysts for local business investment and ensure the supply of high-quality, skilled workers. They also support entrepreneurial initiatives of their students (incubators), and act as knowledge and innovation hubs for companies (in particular SMEs). VET excellence ensures the high quality skills and competences of their students that lead to quality employment and career-long opportunities, which meet the needs of an innovative, inclusive, and sustainable economy. [16]

The DIHUB-project is one of the first financed COVE-projects.

3.1.9. Communities of Practice (CoP)

A community of practice (CoP) is a group of COVE project leaders who "share a concern or a passion for something they do and learn how to do it better as they interact regularly. [17] In this COVE context, the members of the CoP share the same interest in promoting Vocational Excellence.

3.1.10. EfVET

The principal aim of EfVET is to provide a transnational framework to support all co-operative actions aimed at enhancing and improving technical and vocational education and training.; in particular:

- facilitating networking and partnership
- stimulating the creation of co-operative projects and thematic networks
- enabling widescale promotion and dissemination of innovative measures and transnational projects
- providing technical support and advice to its members and help them access E.C. programmes
- acting as an agent for collaborative projects with TVET (technical and vocational education and training) organisations in outside Europe
- representing the views of its members' issues in the European public forum and provide a platform for the European Commission and others to consult

EfVET's role as an organisation is to promote, stimulate, foster and encourage these processes and to disseminate the good practices generated/produced by the members. https://www.efvet.org

3.1.11. EPALE

EPALE is a European, multilingual, open membership community of adult learning professionals, including adult educators and trainers, guidance and support staff, researchers and academics, and policymakers.
The Erasmus+ programme funds EPALE. It is part of the European Union's strategy to promote more and better learning opportunities for all adults.

EPALE does this by supporting and strengthening the adult learning professions. It enables members to connect with and learn from colleagues across Europe, through its blog posts, forums, the Partner Search tool, complemented with physical gatherings. https://epale.ec.europa.eu/en

[16] https://ec.europa.eu/social/main.jsp?catId=1501
[17] https://en.wikipedia.org/wiki/Community_of_practice

3.1.12. The European Tech Alliance (EUTA)

The European Tech Alliance (EUTA) brings together and gives voice to the most exciting homegrown European tech companies across business models, member states, and sectors.

Their objective is to create a better future for Europe through technology and based on shared EU values: they aim to contribute to our local economies and build a sustainable, greener, innovative, and inclusive Europe for future generations.

EUTA's track record of success highlights the recent growth and potential of the EU's digital economy. With the right legal framework and policies that enable innovation and fair competition for all players, Europe can continue to prosper and produce more global, European digital champions in the future. https://eutechalliance.eu/aboutus/

3.2. Digital Innovation Hubs (DIH)

The European Commission launched the first industry-related initiative called the Digital Single Market package on 19 April 2016. Building on and complementing the various national initiatives for digitizing industry, the Commission will act to trigger further investments in the digitization of industry and to support the creation of better framework conditions for the digital industrial revolution. One of the most important pillars of the Digitising European Industry initiative is the development of the **Digital Innovation Hubs (DIH)** network**.**

One-stop-shops that help companies to become more competitive in their business/production processes, products or services by using digital technologies are based on technological infrastructure (Competence Centres - CC) and provide access to the latest knowledge, expertise, and technology to support their customers with piloting, testing, and experimenting with digital innovations. DIHs also provide business and financial support to implement these innovations, if needed, across the value chain. Because proximity is considered crucial, DIHs act as a first regional point of contact, a doorway, and strengthen the innovation ecosystem.

A DIH is a regional multi-partner collaboration (including organizations like RTOs, universities, industry associations, chambers of commerce, incubator/accelerators, regional development agencies and even governments) which can also have strong linkages with service providers outside of their region for supporting companies with access to their services. [18] Detailed snapshots of the European DIH landscape at national level can be found at the following address: https://s3platform.jrc.ec.europa.eu/dihs-per-country#inline-nav-1

[18] https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs

3.3. Finnish Digitalization Policy and Key Stakeholders

Government level

The Government Programme has the following objective: Finland will be recognized as a front runner that develops and introduces new solutions enabled by digitalization and technological advances, doing so across administrative and sectorial boundaries. The aim is to increase the technological and digitalization capabilities of the public sector and to promote cooperation between the public and private sectors.

The goals of the Programme for the Promotion of Digitalisation to be achieved by 2023 are the following:

- high-quality digital public services will be available to citizens and businesses in accordance with, the requirements of the Act on the Provision of Digital Services, as a minimum;
- business operators will use in-person services and services based on printed materials to a considerably lesser extent, and a number of digital-only business services will be available;
- digital user support will be available throughout the country and will also be developed to serve business operators
- The Finnish government's own digitalization set up can been seen in more detail at: https://joinup.ec.europa.eu/sites/default/files/inline-files/Digital_Government_Factsheets_Finland_2019.pdf

Alongside the National Programme for the Promotion of Digitalisation, the Government's other means for achieving the digitalization goals are[19]:

- National AI programme AuroraAI
- Service and premises network renewal
- Digital Identity Development Project

The Ministry of Transport and Communications [20] aims to

- increase the availability of information and open data and generate new business operations
- promote the utilization of automation and robotics
- ensure that services and networks are safe for the users
- The key duties of the Ministry are:
    - to improve access to data
    - to provide opportunities for data-based businesses by means of regulation
    - to draft legislation concerning data resources and the use of information and
    - to address matters related to privacy protection and the security and confidentiality of transport and communications services.

The Regional level

Regional Councils are responsible for the overall development of the region. They coordinate the development through regional strategies. The Helsinki-Uusimaa Regional Programme gives guidelines for regional development. [21] There is a special strategy created for running the Smart Uusimaa programme. The strategy is a significant instrument for creating sustainable growth based on innovation in the region. The Helsinki Smart Region is an ongoing process facilitated by the Helsinki-Uusimaa Regional Council, which specializes in technology, wellbeing, cleantech, and digitalization. Different players from the entire Helsinki region - businesses, cities, the public sector, research, education centers, start-ups, and citizens - create smart innovations and possibilities to test them together. It also includes the actions to be taken for creating smart digital transformation. [22]

[19] https://vm.fi/en/programme-for-the-promotion-of-digitalisation

[20] https://www.lvm.fi/en/information-en

[21] https://www.uudenmaanliitto.fi/en/development_and_planning/regional_programming/helsinki-uusimaa_regional_programme_2.0

[22] https://www.uudenmaanliitto.fi/en/development_and_planning/regional_programming/smart_specialisation_in_helsinki-uusimaa_region

In the Helsinki-Uusimaa regional level, the aim is also to double the regional innovative potential and to create international partnerships and to establish different forms of EU cooperation.22 The DIHUB-project aims fit perfectly into these regional strategies by bringing together in a practical way the stakeholders at the European, national and local level for creating innovative cloud based solutions for the SMEs.

Municipalities have their own digitalization strategies based on the national and regional strategies. There were in total 309 municipalities in Finland in 2021. In the DIHUB-project, the core municipalities are Helsinki, Espoo, Vantaa, and Kauniainen, as well as the 22 other municipalities in the region.

Business actors

The core stakeholders in the DIHUB-project are obviously business actors. Business actors can be divided into main two groups based on cloud service issues. The first customer group consists of SMEs utilizing cloud-based services. The second customer group is made up of companies offering the cloud technology services, which are either assistance and expertise or applications.

The latter group consists of the following types of service providers:

- cloud infrastructure providers
- professional cloud services and consultants
- managed cloud providers
- companies providing cloud based applications

The actors mentioned above are described in more detail in the second chapter *Cloud Computing and Services; Terms and Roles.* In the DIHUB-project, the final customer/target group are the SMEs utilizing the cloud-based services. All business actors have a role in the practical grass-roots level of the DIHUB-services.

SMEs are the core customers of the DIHUB process. According to a questionnaire conducted by the Helsinki Region Chamber of Commerce in 2020, companies in Helsinki are very interested in using artificial intelligence in their business activities. Despite the major interest, the actual usage of artificial intelligence is still quite low. Over half of the 44 respondents reported that they are not using AI as part of their businesses.

Business support organizations include governmental and non-governmental organizations, which directly or indirectly help and support the commercial or industrial organizations engaged in the production and distribution of commercial products and services. Public bodies have different kind of business supporting units on the operational level. There are several business supporting units at the national level, such as Business Finland and the Finnish Patent and Registration Office. Most services are in the fields of advising, registration, and finance.

Business Finland; Growth Engines and Ecosystems

Business Finland uses the name Growth Engine to describe cooperation networks − ecosystems − aimed at new businesses. Growth Engines are implemented through an enterprise-driven partnership model between companies, research organizations, and public actors, which strive to find solutions to global market disruption and create new growth sectors in Finland. For example, in Competitive bidding on Growth Engines Business Finland has selected Unikie as one of the first winners. The purpose of the subordinated loan is to support the development of a self-driving vehicles ecosystem in Finland.

In addition to public bodies, there are numerous non-governmental institutions operating in and completing the advisory and financial knowhow of SMEs. The following are in a key role:

- The Finland Chambers of Commerce, https://kauppakamari.fi/en/
- Helsinki Region Chamber of Commerce, https://helsinki.chamber.fi/en/
- Federation of Finnish Enterprises, https://www.yrittajat.fi/en

There are different associations and foundations specializing in different fields. These include:

- Technology Industries of Finland (employers perspective) https://teknologiateollisuus.fi/en
- Tietoala ry, Association of IT sector Employees

https://tietoala.fi/in-english/
- TIVIA, The Finnish Information Processing Association https://tivia.fi/in-english/

A list of the other ICT sector associations can be found in the Wikipedia category (encompassing two sets articles) "Information technology organisations based in Finland" [23]

The term **Business hub** is a general one for ecosystems promoting business. Business hubs can be divided into sub hubs, which can be called Start Up –hubs, Technology hubs, Innovation hubs, etc. Such hubs are formed by people with businesses in their various stages and various types of organizations in one (physical or virtual) location, interacting as a system to create and scale new businesses. The organizations can be further divided into categories such as universities, funding organizations, support organizations (like incubators, accelerators, co-working spaces etc.), research organizations, service provider organizations (like legal, financial services etc.) and large corporations. Different organizations typically focus on specific parts of the ecosystem, e.g. startups at their specific developmental stage(s).

At least the following hubs exist in the Helsinki Region:
- Kiuas – the hub (startup hub), https://thehub.io/startups/kiuas
- Helsinki Business Hub, https://www.helsinkibusinesshub.fi/
- XES Helsinki (startup hub), https://www.xeshelsinki.com/
- Metropolia –phenomenon based innovation hub, https://www.metropolia.fi/en/rdi/innovation-hubs
- LaureaES, https://thehub.io/startups/laurea-entrepreneurship-society
- Mixed Reality Hub (Helsinki University), https://www2.helsinki.fi/en/researchgroups/mixed-reality-hub

Educational institutions

In the DIHUB-project context, an EQF (European Qualification Framework) scale ranging between EQF4 and EQF7 has been applied to secondary and tertiary education represented in this project. Informal learning provided by companies as market-based actors should also be considered providers of education and training in cloud-based technologies and services.

An overview of the VET providers in Europe is has been compiled by CEDEFOP. This overview, VET in Europe, is the most comprehensive information resource on vocational education and training (VET) systems in Europe. Refernet, Cedefop's European network, provides descriptions of national VET systems in the European Union, Norway and Iceland based on a common template designed by Cedefop. [24]

There are numerous VET providers in Europe. In Finland, the number of VET providers is 123 (in 2020, Statistics Finland). Of these, around 50 have ICT-programs where cloud-based topics are taught. More detailed statistics on secondary level VET providers in Finland can be found on the following web-pages:
https://vipunen.fi/en-gb/vocational-education-and-training

An overview of European higher education can be found on the EU commission Web pages:
https://ec.europa.eu/education/study-in-europe/planning-studies/european-higher-education_en

In Finland, there are 13 universities and 22 universities of applied science. All higher education institutions have ICT programs or ICT related service development programs where cloud-based services are part of the curriculum. Please find detailed information here: https://minedu.fi/en/heis-and-science-agencies

DIHUB Finland

DIHUB Finland is well connected to local peers all focused on the digital community. DIHUB Finland can be described as a vivid and emerging Finish support system looking for opportunities to disseminate DIHUB services among stakeholders.
Stakeholder collaboration is a continuous process. The content and processes are illustrated in more detail in the DIHUB model. Stakeholders of the cloud-based DIHUB innovation ecosystem in Finland are illustrated in diagram 3.

[23] https://en.wikipedia.org/wiki/Category:Information_technology_organisations_based_in_Finland
[24] https://www.cedefop.europa.eu/en/events-and-projects/projects/vet-europe

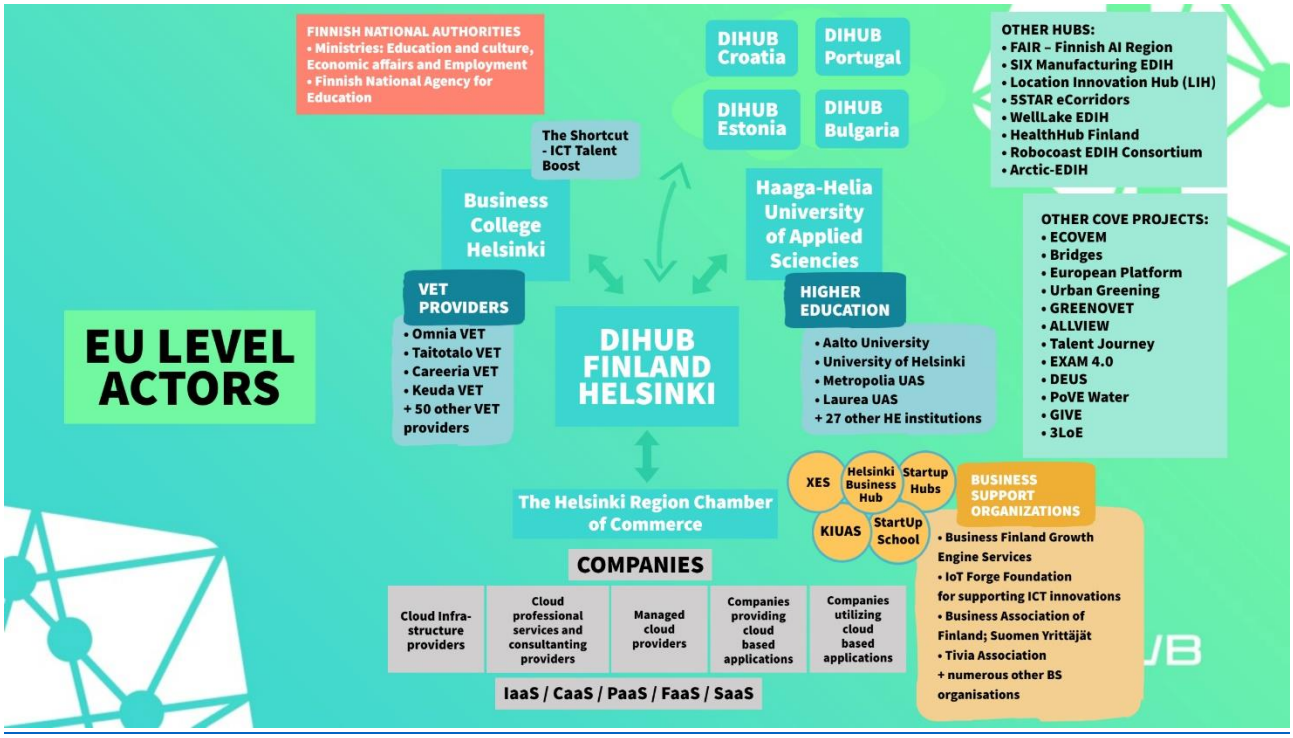


Diagram 3. Stakeholders of the cloud-based DIHUB innovation ecosystem in Finland

3.4. Bulgarian Digitalization Policy and Key Stakeholders

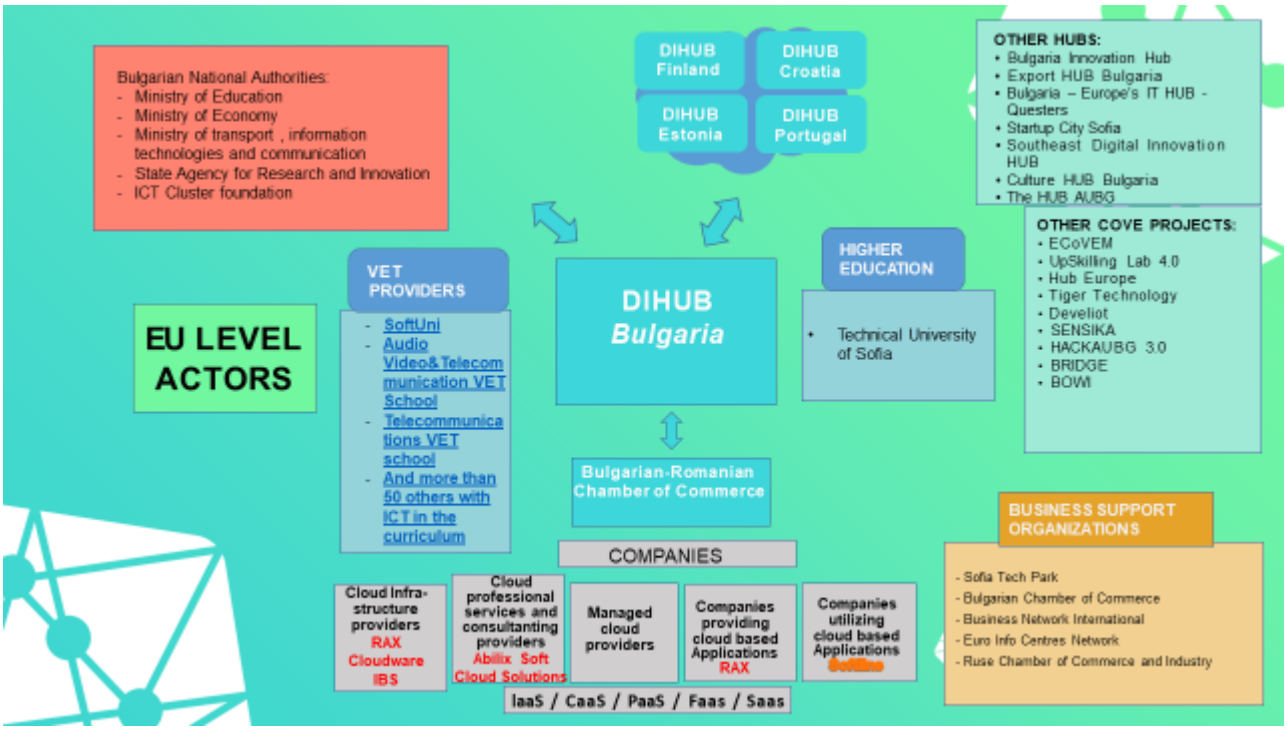


Diagram 4. Stakeholders of Cloud Based DIHUB Innovation Ecosystem in Bulgaria

Government level

According to the European Progress Report on Digital technologies, Bulgaria ranks 28th out of the 28 Member States in The European Commission's Digital Invasion Index in Economy and Society (DESI) for 2019. The share of people with at least basic skills in digital technology amounts to about 29% of the Bulgarian population, while in the EU, the average is 57%. Only 11% of people have skills above the basic level, which is less than one third of the EU average. Bulgaria is also well below the average level in the implementation of digital technologies. The goals of the NATIONAL PROGRAM DIGITAL BULGARIA 2025 may look significantly more modest than in other EU countries.

- The new regulatory framework in electronic communications is a key prerequisite for ensuring sustainable development of the electronic sector messages (DONE)
- Creating favorable conditions for the deployment of high-speed 5G by providing an appropriate radio frequency resource and pilot bands (almost DONE)
- Overcoming regional disparities by stimulating investments in ICT infrastructures and
    - supporting for ICT research and innovation technologies (most relevant to our project):
    - modernizing the existing ICT infrastructure and developing a new ICT infrastructure for research, development, and innovation by supporting key projects in the National Roadmap for Science infrastructure;
    - modernizing existing Centers of Excellence and Centers of Competence and Regional Research Centers in the field of ICT and the creation of new centers;
    - supporting the development of ICT clusters and utilizing their potential for innovation and regional smart specialization;
    - encouraging entrepreneurial activity and strengthening the production and management capacity of ICT enterprises sector and especially SMEs;
- Digitization of the Bulgarian industrial sectors and related services and the development of a data-based economy;
- Modernization of schools and higher education in the field of information and communication technologies
- Accelerated development of e-government

Regional level

Bulgaria is divided into 28 districts/regions. Sofia, the capital city, is in a separate region, which is characterized by high population density, concentration of technological and human resources, including the one in the ICT sector. Despite their small territory, the regions in Bulgaria have significant differences in practical cloud solutions. This determines their regional policies. In some regions, there are concentrations of heavy low-tech industry, in other regions, the emphasis is on agriculture, and in yet other regions, the emphasis is on tourism. Bulgaria's geographical position, at an external EU border, also leads to different a prioritization of the goals described above. As can be seen in the presentation of the business segment of the ecosystem, 3/4 of the existing hubs are in Sofia, and there are very few in other major cities - Plovdiv, Burgas and Varna, and their main emphasis is in solving regional problems, and not in national or European problems.

Business actors

Most Bulgarian organizations and business entities are facing a wide range of challenges related to processes such as globalization. There are difficulties related to the enhanced competitive environment, and there are also challenges in coping with local and global economic crises. The natural evolution of information technology increases the need for Bulgarian organizations and businesses to take permanent actions in the reindustrialization of the IT sector to keep their competitive advantages. Currently, usually only large companies in Bulgaria, which have the necessary financial resources, can invest in infrastructure and staff to integrate modern ICT solutions into their e-business system. These types of services are used by most small and medium sized companies mainly for e-mail and information storage.

SMEs are the core customers of the DIHUB process in Bulgaria. A survey conducted in 2020 by the Bulgarian Financial Supervision Commission (FSC) concerning entities in three areas – insurance, investments, and insurance – shows that companies are utilizing AI and cloud services in their activity. The companies that use cloud services operate mainly in the field of finance and accounting.

Business support organizations

Business support organizations in Bulgaria have a key role in supporting commercial and/or industrial companies. [25]

The Bulgarian Chamber of Commerce and Industry (established in 1895) is an independent, non-governmental organization for the assistance, promotion, representation, and protection of the business interests of its members. The Bulgarian Chamber of Commerce and Industry contributes to the development of international economic cooperation and assists the European and international integration of the Republic of Bulgaria.

The Ruse Chamber of Commerce and Industry (RCCI) is an independent, public volunteer (non-profit) founded to support, promote, represent, and protect the economic interests of its members and to promote economic relations within Europe and internationally.[26]

The Bulgarian Industrial Association, which encompasses the Union of the Bulgarian Business (BIA) is a non-governmental organization, established in 1980. BIA was recognized as a representative organization of employers on a national level by decision no. 669 on 11 August 2016. [27]

The aim of the **Enterprise Europe Network** is to assist Bulgarian business and research organizations to increase their competitiveness and access to European and global markets by providing integrated services for business cooperation and innovation. [28]

There are eight **Euro Info Centres** in Bulgaria: six of them are located in the Chambers of Commerce and Industry (Sofia, Plovdiv, Stara Zagora, Vratsa, Yambol, Dobrich) and two in Regional Development Agencies and Business Centres (in Ruse and Sandanski).

There are different field specific associations and foundations in Bulgaria. They include the following:

- The Bulgarian Association of Information Technologies (BAIT), http://www.bait.bg/about-bait
- Sofia Tech Park, https://sofiatech.bg/petascale-supercomputer/
- The Bulgarian Association of Software Companies (BASSCOM), https://basscom.org/
- The Professional Association of Robotics and Automation (PARA), https://www.para.expert/para-members/
- Business Network International, https://www.bni.com/
- ICT Cluster, www.ictcluster.bg

In the last 5 years, the Bulgarian IT ecosystem is progressing at a rapid pace. However, it still remains relatively unknown in the global technology scene. The Bulgarian digital and innovation ecosystem continues to grow, and especially Sofia is becoming one of the best places to build a startup with various local tech resources available, followed by Varna, Plovdiv and Burgas. At least the following **Business Hubs** exist in Bulgaria:

- Bulgaria Innovation Hub (BIH), https://www.bghub.io
- PrEXCELerator Bulgaria, https://businesshubs.eu/
- Telerik Academy, https://www.telerikacademy.com/about
- MOVE.BG (platform for value creators and a think-and-do tank for innovative solutions). https://move.bg
- Eleven, https://www.11.me
- StartItSmart, https://www.startitsmart.com/bg/
- SEPA Cyber Technologies, https://sepa-cyber.com/
- LAUNCHub Ventures, https://launchub.com/about
- Wollow Coworking Space, https://beehive.bg/
- DigiTech, https://industry4bg.com/

[25] Bulgarian Chaber of Commerce and Industry (BCCI), https://www.bcci.bg/general-bcci-en.html
[26] The Ruse Chamber of Commerce and Industry (RCCI), https://www.rcci.bg/about

[27] Bulgarian Industrial Association - Union Of Bulgarian Business, www.bia-bg.com

[28] Enterprise Europe Network, https://www.een.bg

Educational institutions

Bulgaria has strong youth education traditions. The share of people with an upper secondary and post-secondary degree is higher than the average share in the EU. The share with low or no qualification is below EU average. Participation in VET is slightly higher than in general education. Family influence and personal interests are the drivers for choosing VET. Demographic changes have affected the VET population. A declining school population has led to school network optimization, targeting greater efficiency while safeguarding quality. Many small VET schools have been merged with larger providers. But even after this optimization, there are 373 VET providers in Bulgaria according to statistics. In more than 60 of the VET providers, there are providers in which the curriculum is directly related to the acquisition of ICT knowledge, but cloud technology is not a part of any of the curricula.

As of 15 September 2019, there are 50 accredited educational institutions in the country - universities, academies, colleges, etc. Practically all of them have different levels and forms of ICT courses, and obviously in the institutions with a technical orientation, the courses are more intensive and in-depth. However, only one institution offers a course on cloud technology. This course is a one semester master level offered during second semester of the academic year 2020-2021. [29]Many curricula have access to cloud technologies, but teachers have yet to be trained first, and then new curricula need to be created.

3.5. Croatian Digitalization Policy and Key Stakeholders

An innovation ecosystem refers to a loosely interconnected network of companies and other entities that co-evolve capabilities around a shared set of technologies, knowledge, or skills, and work cooperatively and competitively to develop new products and services[30]

It is now widely recognized that achieving and sustaining any development outcome depends on the ability of multiple and interconnected actors – EDU institutions, government, and the private sector, but also individual entrepreneurs and others – to work together effectively. Each set of interconnected actors whose collective actions produce a particular development outcome is a local system (or "innovation hub"). Improving that development outcome therefore requires an ecosystems approach, which was recognized as part of the DIHUB project – which is focused on cloud technologies. Although innovation is a means for improving how development goals are achieved rather than an outcome in itself, the same principles apply. For innovative ideas to be efficiently generated, developed, tested, and ultimately scaled for development impact in cloud, they also require the coordinated, collaborative action and resources of the actors noted above – collectively referred to as the "innovation ecosystem".

Innovation ecosystems can operate at multiple levels (e.g. regional, national) and within multiple industry sectors. Because of this breadth, it can be difficult to draw meaningful boundaries around who is or is not part of an innovation ecosystem. It is therefore helpful to focus first on the need and the problem that the innovation is seeking to address with cloud technologies and only then consider the specific actors, digital tools, resources and contextual factors that the cloud service will need to engage, utilize, or influence to be impactful.

When adopting an ecosystem approach, the Croatian HUB, which is a part of the DIHUB project recognizes that[31]:

#1 A cloud innovation ecosystem is made up of different actors, relationships and resources who all play a role in taking a great idea to transformative impact at scale.
#2 The effectiveness of each part within the cloud innovation ecosystem is moderated by other parts of the system (e.g. entrepreneurs depend on being able to access financing).
#3 A change to one part of the innovation ecosystem leads to changes in other parts of the innovation ecosystem (e.g. an increase in internet connectivity will accelerate the design and testing of cloud services).

[29] https://www.tu-sofia.bg/university/163
[30] James F. Moore, Predators and prey: a new ecology of competition, Harv. Bus. Rev., 71 (3) (1993), pp. 75-86
[31] International Development Innovation Alliance (IDIA)

The Croatian DIHUB node already functions well and requires little technical support. However, in order to grow and to collaborate with other Hubs, it has to address challenges like fragility, inequity, conflict, weak institutions, or economic stagnation. Because ecosystems are dynamic, traditionally strong ecosystems must collaborate intensively and must be ready to respond to external factors. As part of growth, it is important to identify and find ways to support needs of Hub nodes about to adopt new technologies, as they are the poles around which strong and sustainable DIHUB services can emerge.

The Algebra University College and Croatian Employers' Association are at the heart of the Croatian DIHUB node. Being the largest private educational group in Croatia and serving 15.000 individuals annually with various educational programs focused on digital technologies, the Algebra University College fits perfectly with The Croatian Employers' Association legacy as a voluntary, non- profit and independent employer association that represents, promotes and advocates for the interests of its members. With 29 branch associations of CEA which advocate for specific economic interests of different sectors, the DIHUB is able to address challenges, threats and opportunities among industry partners. Third parties, which complete triple helix approach, include the following government institutions (among others): the Ministry of Science and Education, the Ministry of Labour, Pension System, Family and Social Policy, as well as the Agency for Science and Higher Education, and the Croatian Chamber of Economy. National government institutions follow relevant European guidelines on digital and lifelong learning policies for development.

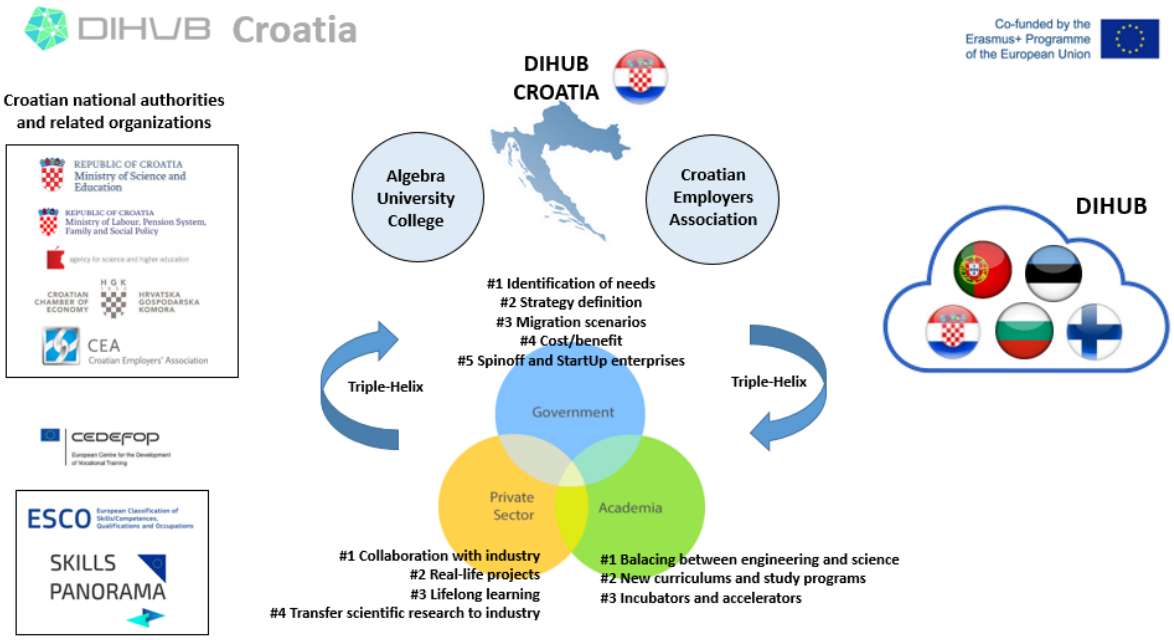


Figure 5a. Stakeholders of Cloud Based DIHUB Innovation Ecosystem in Croatia

The triple helix approach supports identification of needs, strategy definition, migration scenarios, cost/benefit analysis and spinoff and startup enterprise management as key points for government involvement. It is followed by collaboration with industry, real-life projects, lifelong learning and transfer scientific research to industry actions from private sector. Finally, EDU institutions provide a sandbox and balance between engineering and science, adjust new curriculums and study programs and provide incubator and accelerator support.

DIHUB Croatia is also well connected among local peers all focused on digital community. We can describe Croatian support system as a vivid and emerging system, which looks for opportunities to disseminate DIHUB services along stakeholders.

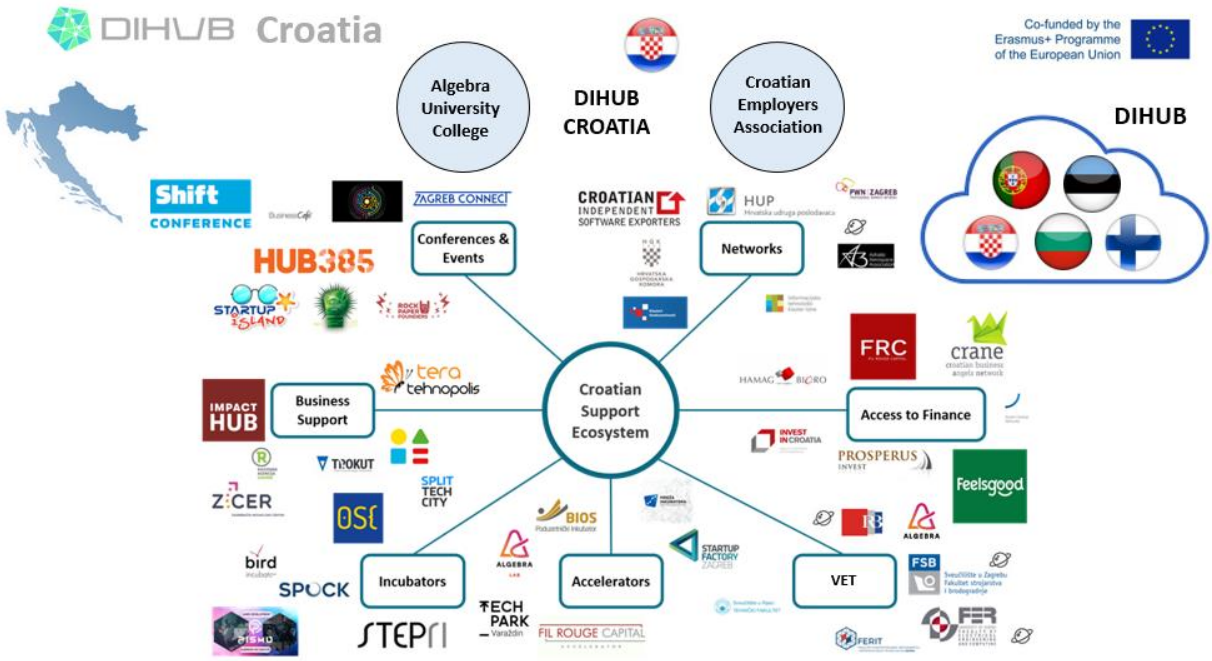
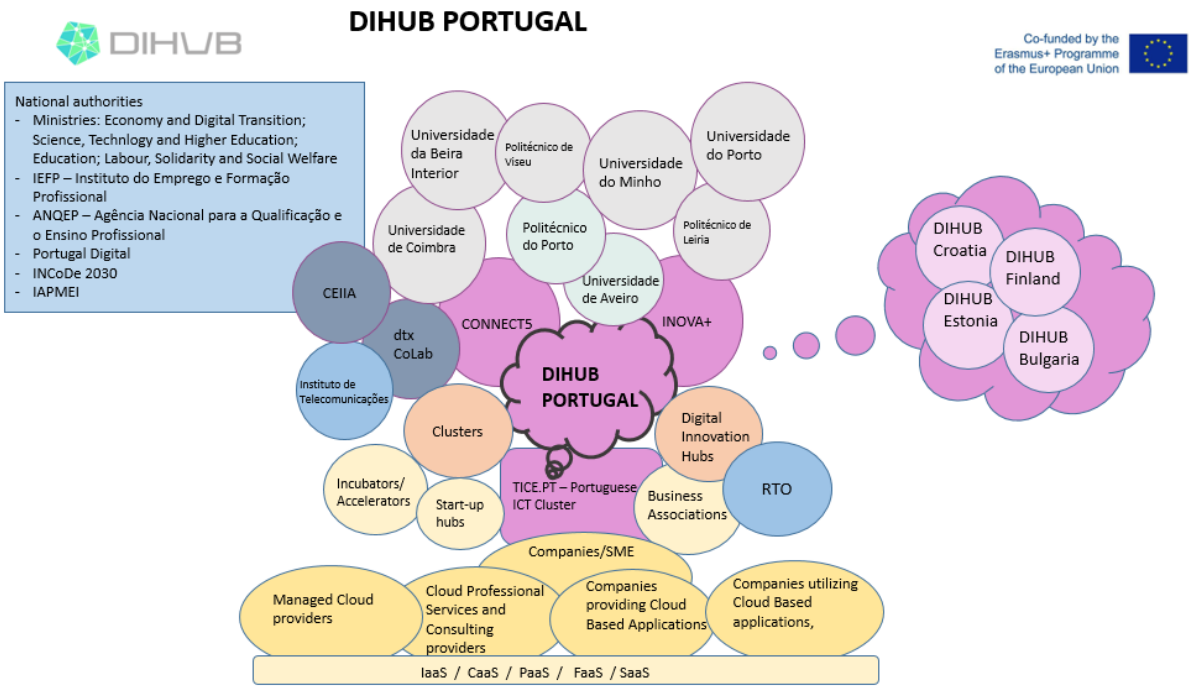


Figure 5b. Stakeholders of the Cloud Based DIHUB Innovation Ecosystem in Croatia

3.6. Portuguese Digitalization Policy and Key Stakeholders



The Portuguese DIHUB Innovation Ecosystem was established around the core of the Portuguese National ICT Cluster – TICE.PT, one of DIHUB partners. As an ICT-based cluster organization, within its members there are several different stakeholders, including Academia, Research and Technology Organizations, VET providers, Business Associations, Professional Associations, Chambers of Commerce, Large Corporates, SME, and Start-ups. There are also long-term

agreements with national and regional authorities aiming to foster innovation through collaboration, develop advanced skills, develop international business and to promote entrepreneurship. Internationally, TICE.PT is also connected with European peers through Strategic Clusters Partnerships like Smart City Tech (dedicated to Smart Cities technologies), Silicon Europe Alliance (in the field of microelectronics) and DIA (Digital Industry Alliance). It also operates, under an agreement between GAIA-X AISBL and the Portuguese Government, the Portuguese GAIA-X hub. GAIA-X is a European initiative (supported by the European Commission) which develops a decentralized next generation data infrastructure (an open, transparent, and secure digital ecosystem, where data and services can be made available, collated, and shared in an environment of trust).

Government level

Portugal has a relevant track record concerning digital transition. From 1984 to 1994, a large program was designed and deployed in over 140 elementary and secondary schools all over the country to foster ICT adoption in schools. Over 2000 users were trained among teachers, students, researchers, and others. In 1997, the Portuguese Science and Technology Ministry developed the "Green Book for Information Society", which was the first digital transition roadmap for the country. It deployed several relevant infrastructures and capacity-building schools, universities, cities, and companies. In 1999, a one-stop-shop concept was established and applied to public services over a unified ICT services infrastructure. A unified ID card for Citizens was deployed in 2007 and it nowadays supports multiple digital public services. Moreover, in 2006, an ambitious public services simplification reform was deployed (Simplex).

Following this tradition, in 2020, the Portuguese Government published the Digital Transition Action Plan (managed by the Portugal Digital Mission Structure - https://portugaldigital.gov.pt) and overhauled INCoDE 2030, a strategic plan for digital skills and competences designed within the scope of the Digital Jobs and Skills Coalition. These two plans aim to foster digital technologies adoption, and include capacity-building, the digital transformation of businesses, Public Services digitalization and, overall, digital transition catalysis. Until March 2022, Digital Transition was managed by a dedicated Secretary of State under the Ministry of Economy. Nowadays, the Public Reform and the political coordination of Digitalization is done by a Secretary of State under direct coordination of the Prime Minister. TiCE.PT has been recognized by the Government since 2009 as the Cluster Organization for ICT and integrates several working groups in topics related to digital transition and digital skills, namely the National Coalition for Jobs and Skills, INCoDE 2030, and the ICT sectorial board of the National Qualification and Vocational Training Agency. TICE.PT has a close relationship with IAPMEI, the Portuguese Support Agency for SMEs, ANI – the National Innovation Agency and AICEP – the Foreign Trade and Investment Agency.

Regional level

Portugal is organized into five different regions in the mainland and two autonomous regions encompassing the two archipelagos (Azores and Madeira). DIHUB activities have been mainly in two regions (Norte and Centro) where the Portuguese partners are located, despite the national coverage of both partners. Furthermore, due to TICE.PT and INOVA+ cooperation arrangements, several municipalities outside the Norte and Centro regions are also included, for example, Aveiro, Águeda, Viseu, Castelo Branco, and Porto.

Business actors

Business Actors engaged are mainly TICE.PT members or partners. TICE.PT members include some Telcos and Cloud-service providers like Altice, NOS, IP Telecom, VISABEIRA and Sooma.

Business support organisations

TICE.PT includes AIDA – Chamber of Commerce, ANETIE – the National Association of ICT and Electronics Association, ANJE – National Young Entrepreneurs Association -, APDSI – the Portuguese Association for Information Society Development, Porto Digital, API – Portuguese Media Association, INOVA-RIA – Aveiro Region Innovation Network and NERLEI – Leiria Region Business Association. These business support organizations are well connected to ICT companies, and also to several other sectors through the Chamber of Commerce and the National Young Entrepreneurs Association.

Moreover, TICE.PT actively cooperates with all the other Portuguese Clusters through the PortugalClusters - https://portugalclusters.pt/) consortium.

Business hubs

Under this category, there is cooperation with the previously mentioned business associations, one of them a European Enterprise Network node, incubators (like Instituto Pedro Nunes and PCI – Aveiro Creative Science Park), accelerators (Porto Innovation Hub and Start-up Portugal). Established links also exist with competence centers like CEIIA and dtx Colab.
Moreover, TICE.PT also participates in three different Digital Innovation Hubs: one which is a leader in data and connectivity (CONNECT5 – https://connect5.pt), the Centro Region DIHUB - https://www.ptcentrodih.pt – which consists of four clusters cooperating together and is transversal to all sectors and geographically located in the Centro Region, and the C-HUB – Cybersecurity DIH.

Educational Institutions

TICE.PT has a good number of Universities and Polytechnic within its members, including the University of Aveiro and the Polytechnic of Porto with whom it has performed local pilots. It also includes AEVA which runs a Professional School in Aveiro.

3.7. Estonian Digitalization Policy and Key Stakeholders

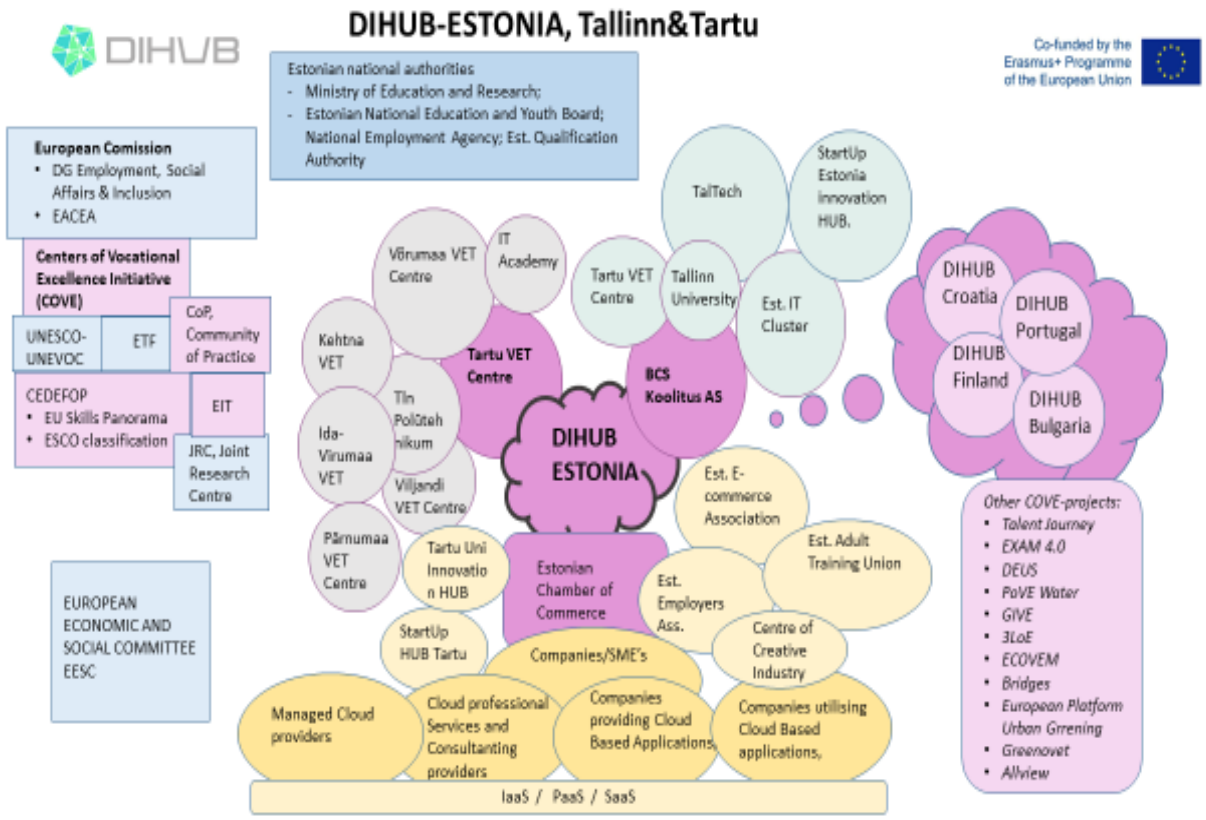


Figure 6a. Stakeholders of Cloud Based DIHUB Innovation Ecosystem in Estonia

Information and communication technology (ICT) has become one of the main tools for raising the competitiveness of every economic sector and walk of life. Therefore, the possibilities of ICT and challenges stemming from technology must be taken into consideration in preparing any national strategy as well as in developing services and products. In light of the above, such a strategy should not deal with the uptake of ICT in different walks of life and policy areas such as implementation of ICT in healthcare or private enterprise. Instead, the point of departure and general objective

should be the development of a mature and secure environment for the widespread use and development of smart ICT solutions. The overarching aim for Estonia is to use ICT to support economic competitiveness and to improve people's well-being and effectiveness of public governance. Innovative solutions and their implementation plans are introduced in the National Digital Agenda 2020 Development plan.

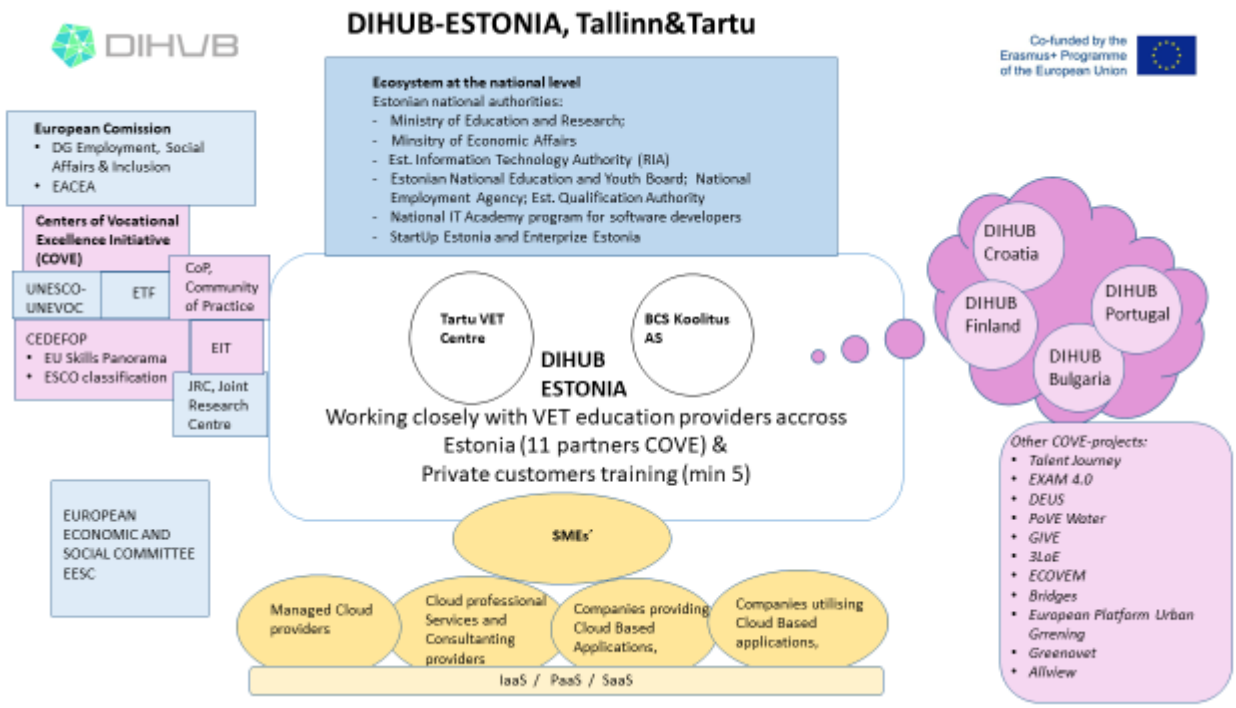


Figure 6b. Stakeholders of Cloud Based DIHUB Innovation Ecosystem in Estonia

The Estonian national Cloud Ecosystem is led by the Information System Authority (RIA), that coordinates the development and administration of information systems, ensuring the interoperability of the state's information system with other systems, organizes activities related to information security, and handles security incidents in Estonian computer networks. The Information System Authority is under the administration of the Ministry of Economic Affairs and Communications. The RIA itself provides Estonian citizens and companies with national online services in all business and private fields, or they are at least provided under its supervision. All Estonian national cloud services and digital solutions are listed at:
https://e-estonia.com/solutions/

Estonians are high achievers from an early age. IT skills are taught extensively in primary school, and students rank in the top 10 globally in science, mathematics and reading at the secondary school level. The majority of the workforce is multilingual. Estonia recently ranked first in Europe for entrepreneurial employee activity and competitiveness. The nation's digital mind-set makes its workforce highly adaptable. In the Industrial sector, 68% of the population excel in engineering and electronics, while in IT, Estonians are recognized leaders in software development, high-tech systems, and cyber security. Design, engineering, and digital expertise are increasingly integrated, making Estonia a pioneer in the fields of IOT, Blockchain and telecommunications.

The National program of Digital Agenda 2020 includes more detailed sub-objectives.

- Development of the information society and increasing cyber security.
- By 2025, The Estonian 5G activity plan is developed and implemented to stimulate the establishment and uptake of next-generation wireless communication networks in Estonia. Since 2020, the quality of the public e-services and the user experience, as well as the "invisible" and proactive event services are being developed to make public services as simple and efficient as possible for users. People must be able to get things done in one interaction, so that the government does not need to intervene. The aim is to enable

the of the public sector to use data analytics and research, and to upgrade its relevant awareness and skills.

- The adoption of artificial intelligence applications in the public sector began in 2020: an action plan was developed and started out with the implementation of pilot projects. During this experiment, a so called "kratt" will be carried out.
- As data volumes increasing and the widespread cross-use of data is also increasing, people must have control over the use of their data. Technological and organizational and legal conditions will be created so that people will know and be able to specify who uses the data in the hands of the state, when it is used, and for what purposes, so that among other things, they can allow their data to be used more easily (e.g. for research and developing new services).
- The IT Academia initiative will be expanded in order to ensure that there is an adequate supply of ICT specialists. (This means including and broadening in-depth ICT studies at general educational schools.) Higher ICT skills must also be aquired in traditional sectors of the Estonian economy.
- The national cyber security capacities and readiness of the state must be strengthened and private enterprises' ability to cope with cyber incidents must also be strengthened. They must be carefully monitored by the authorities: the cyber security baseline standard will be updated to next level by 2024, the state's competencies in the field will be consolidated, allowing more resources for the development of the cyber awareness of citizens, steps will be taken for early detection of data security needs in service development and IT development (the so-called security-by-design and privacy-by-design principles).
- Innovation in the field of e-governance and cyber security will be accelerated: more projects will be piloted, and new ways of involving private companies in product development will be sought for; re-using data and existing solutions will be developed, and greater support will be given to research and development (especially in the field of cyber security, among other activities).
- e-Residency - a government-issued digital identity and status that provides access to Estonia's advanced digital society, allowing secure online authentication to start and manage Estonian companies independently of location. The e-Residency program will be expanded.

Educational initiatives and national cloud technology software development strategies are consolidated under the Estonian IT Academy Program, which is a co-operational initiative between the Estonian state, universities, vocational schools and information and communication technology (ICT) companies to improve the quality of ICT education, develop research in the field, and to ensure the necessary human resources for the local labor market. The national program is guided by the vocational qualification system, providing the participating schools and students with a minimum of EQF level 4 professional qualification – junior IT system specialists and software developers.

The IT Academy Program is centrally coordinated and financially supported by the Estonian Education and Youth Board, under the supervision of the Ministry of Education and Science. Since 2019, the IT Academy has been piloted at the vocational education level to attract more students to continue their studies in higher VET or in a higher educational level. The Pilot program has also taken into account the need for software development curricula updates - both on a qualitative and on a methodological level. Innovative content delivery modes, apprenticeship and mentoring are supported by maintaining close contact with companies and other relevant stakeholders, such as labor authorities, national ICT Foundations, Chambers of Commerce and local start-up communities.

With a highly qualified workforce and strengths in engineering, electronics, and IT, Estonia is at the cutting edge of R&D and production of, and service for mechatronic solutions with embedded software. Estonia boasts a full digital ecosystem, world class cyber-security, and soon-to-be 5G infrastructure. Homegrown successes like Fortumo, Guardtime and Skeleton Technologies mix with global giants like Microsoft, CGI and Fujitsu, to create a dynamic environment ideal for investment and innovation.

There are 17 COVE institutions in Estonia to provide IT education on various EQF levels (4-6) - VET schools and 5 higher education providers. There are also 7 private education providers delivering boot-camp style upskilling and re-skilling programs to adult learners in close cooperation with ICT companies and IoT developers in particular (co called Smart City projects; EdTech companies, micromobility and green energy solutions developers).

To sum up: through the Estonian national ecosystem, the Estonian state provides its citizens with:

- Significant, export-oriented engineering and electronics sectors.
- World class education in math and IT

- World class IT skills, from software to control systems and cyber security.
- A full collaborative ecosystem for R&D, prototyping and production.
- Mechatronics solutions that attract global clients, awards, and funding.

As a result of its two-decade commitment to IT, Estonia is the world's most advanced digital society and recognised leader in digital skills, infrastructure, and legislation.

Estonia has unique capabilities in the research, development, and application of software, high-tech systems, digital identity technologies, and telecommunications. Estonian companies lead the world in blockchain, connected networks, and cleantech, and are at the cutting edge of IOT, big data, automation and real-time computing.

There are multiple regional Innovation HUBs and local ecosystems, which support SMEs and start-up communities. Regional ecosystems mainly include NGOs and public or private foundations, providing the SMEs with entrepreneurial study programs, incubation services and mentoring. On a national level, startup activities are fostered by a public foundation - Start-up Estonia. Local innovation and start-up incubators/HUBs exist in every town. There are also thematic incubators driven by universities and entrepreneurial HUBs initiated by public-private partnership. More information can be found at: https://startupestonia.ee/

The core stakeholders and beneficiaries of the DIHUB-project in Estonia are mainly business actors, representing SMEs, but also education providers – centers of vocational excellence and continuous education. As in Finland, Estonian SMEs can also be divided into two categories - cloud service providers and service utilizers and handlers. In the recent two to three years, the Estonian public sector has taken the lead in moving their data and service provision into a cloud and SMEs have followed their footsteps. Unfortunately, the smaller the company is, the more difficult this digitalization process for the company is.

While building our local DIHUB project activities and services to companies, we have tried to use the same tactics as the Estonian public authorities and have encouraged SMEs to start utilizing cloud services. Participation in the DIHUB pilot program has often meant taking a first step in moving towards cloud technologies implementation - especially for micro-sized companies.

SMEs are very interested in using artificial intelligence for business growth and innovation. A number of start-up minded companies are working closely with technical universities and their R&D departments to build such AI-driven services. Unfortunately - since the DIHUB in Estonia is mainly implemented in lower VET institutions, the HUB's capability to introduce AI solutions development is rather low and needs some improvement.

Business support organizations in Estonia are governmental and non-governmental organizations, which directly or indirectly help and support the commercial or industrial organizations engaged in the production and distribution of commercial products and services. Public bodies have different kind of business supporting units at the operational level. Activities are centrally coordinated by Startup Estonia – a public foundation, initiated by the Ministry of Economic Affairs. Besides innovation HUBs and the Estonian Patent and Registration Office, the Enterprise Estonia (EAS) is the largest business growth and export support unit that SMEs can turn to for guidance and funding.

4. DIHUB stakeholder mapping, collaboration, co-creation, and community building

4.1. Different layers

The five partner countries stakeholder mappings described above differ a lot in their detailed stakeholder composition. However, the core stakeholder groups can easily be divided into specific layers. These layers can be summed up in as illustrated in the diagram below:

Diagram 8. Layers of Stakeholder groups

For the DIHUB-project, all these stakeholder groups are needed to launch and run the DIHUB services. The initial policy initiative and funding for creating DIHUB services comes from European Union, and it is fostered by numerous EU-level instances promoting VET. National policy makers complete the local service environments with their policy actions and measures.

The biggest cloud service providers operate globally, but they have local services as well. There are also numerous local cloud service actors with different kinds of service roles in cloud technology. These roles are described in more detail in chapter 2.

Business support organisations promote SMEs in different fields of industry in their development and growth. SMEs use rapidly developing cloud technology to digitalize their processes and services to be able to compete in the market.

The VET provider's challenge is to maintain and continuously update the learning environment in cloud technology to respond to the needs of SMEs. By offering high quality education and training combined with work-based learning (WBL), they supply new talents to the labour market. DIHUB services give access to the learning environment to every learner whether the learner is in formal or informal training. Thus, the staff of SMEs or anyone interested in cloud technology can utilize the services. To be successful in creating a high-quality learning environment in cloud technology

and business promotion, VET providers need to work in a very close collaboration with other stakeholder groups, especially with SMEs.

The DIHUB community was launched with the help of strong stakeholder collaboration. That is why it is crucial to be conscious of the European wide, national, and local stakeholder set up to build an ever-developing learning environment in cloud technology and business. The collaboration with stakeholders must be systematic and inspiring. The impact of DIHUB-services to stakeholders has to be measured and evaluated. This makes it possible to satisfy the needs of customers by continuously developing processes in the short and long run. There is need for systemic impact analysis of the DIHUB services in the years to come.

4.2. Collaboration and co-creation

The DIHUB community relies on collaboration starting with the five local nodes in the hub. Collaboration and co-creation is vital for enlarging the DIHUB-community by adding to the number of nodes in different parts of Europe and even globally. Collaboration increases the competencies in cloud technology and business. It offers a chance to develop competencies further and to create new innovations in utilizing cloud technology in any field of industry.

Building the DIHUB community is the duty of every member of the community. For fostering collaboration, co-creation, and innovations, the following are crucial for mature stakeholder collaboration (findings from the YIBinS –project, and Erasmus+ Sports):

- Share your knowledge
- Be open minded
- Listen actively and show real interest
- Act proactively
- Be present and empathic
- Be prompt
- Support and give space to others
- Listen to your target groups, do not make presumptions
- Honor different opinions
- Manage diversity

5. Some Future Views of Cloud Ecosystems

The global covid-19 pandemic has made cloud computing more significant than ever before. Cloud services have become a necessity as many people work from home most of the time. Organizations have had to adjust their operations to a cloud-based world. According to a Forbes article[32], the spending on cloud technology increased by 37% during the first three months of 2020. This is only the beginning since cloud industry has been estimated to continue growing in years to come.

Forbes magazine has listed the five biggest cloud trends in 2021 and the first one is the multi-cloud approach. There will be more collaboration between big providers such as Amazon, Microsoft, and Google. This will be beneficial in many ways as barriers between the providers are broken down. Another prediction is that cloud computing will be even more efficient and fast in the future. Also, cloud gaming will be more popular as many providers have started to offer game services. 32

In the future, people do not have to choose between private and public clouds, because it can be found quite challenging. Hybrid and multi-cloud services are becoming more popular, and people can pick and choose the best suited elements of different services. The fifth and final trend is that people will be working more on virtual cloud desktops. This cost-efficient way of organizing a work environment is already offered by Amazon and Microsoft. 32

[32] Marr, B. 2021. The 5 Biggest Cloud Computing trends in 2021. Forbes. https://www.forbes.com/sites/bernardmarr/2020/11/02/the-5-biggest-cloud-computing-trends-in-2021/?sh=1bafa1ff12d9

Smart cities can be considered interesting Internet of Things (IoT) applications. The role of the IoT & cloud ecosystem in the development of smart cities will obviously be remarkable in the future. [33]

The manufacturing industry is facing tough competition, and many companies are looking for a new approach to boost their business activities in a collaborative business ecosystem. Cloud computing enables manufacturing resources and capabilities between different companies to be shared to support business and physical production. One future possibility may be a cloud-manufacturing ecosystem.[34]

Cloudification will most probably increase strongly and keep industry in Europe doing well. More designers and actors who understand the possibilities and limitations of cloud networks are needed to keep the cloudification process going on. This obviously means that high quality cloud education in the higher and vocational education levels is needed to train specialists to materialize the positive development of applications in different cloud ecosystems. Efficient and developing ecosystems are based on mature collaboration, co-creation, and innovation management of the stakeholders.

References

1. Caithness, N., Drescher, M., Wallom, D. Can functional characteristics usefully define the cloud computing landscape and is the current reference model correct?, 2017, Journal of Cloud Computing: Advances, Systems and Applications, Springer Open, Retriewed 4th May 2021, time 13:00.

2. Suomalainen pilvimaisema, Liikenne- ja viestintäministeriön Julkaisuja 14/2013, The Ministry of Transport and Communications of Finland, Retriewed 4th May 2021, time12:00.

3. What is Hybrid Cloud? NetApp. https://www.netapp.com/hybrid-cloud/what-is-hybrid-cloud/

4. Mell, P. and Grance, T. (2011). The NIST Definition of Cloud Computing

5. Marston, S. et al. (2011). Cloud computing - The business perspective. Decision Support Systems, 51, pp.176-189

6. What is CaaS? 2020. Red Hat. https://www.redhat.com/en/topics/cloud-computing/what-is-caas

7. https://en.wikipedia.org/wiki/Function_as_a_service

8. https://ieeexplore.ieee.org/document/6270601?arnumber=6270601

9. A Europe Fit for the Digital Age. European Commission. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en

10. https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3733

11. The Digital Services Act: ensuring a safe and accountable online environment. European Commission. https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/digital-services-act-ensuring-safe-and-accountable-online-environment_en

12. https://unevoc.unesco.org/home/

13. https://ec.europa.eu/jrc/en

[33] Role of IoT-Cloud Ecosystem in Smart Cities : Review and Challenges, Ridhima R., Vijaita K., Meenu K.,Chitkara University Institute of Engineering and Technology, Chitkara University, Punjab, India, Materials Today: Proceedings, journal homepage: www.elsevier.com/locate/matpr, p.1, Retrieved 24.5.2021

[34] Cloud manufacturing ecosystem analysis and design, Helo, P., Hao, Y., Toshev, R., Boldosova, V., University of Vaasa, Networked Value Systems, School of Technology and Innovations, Robotics and Computer Integrated Manufacturing 67 (2021) 102050, journal homepage: www.elsevier.com/locate/rcim, Retriewed 24..5.2021, 9:55.

14. https://www.etf.europa.eu/en/about

15. https://www.cedefop.europa.eu/en/about-cedefop

16. https://eit.europa.eu/who-we-are/eit-glance

17. https://ec.europa.eu/social/main.jsp?catId=1501

18. https://en.wikipedia.org/wiki/Community_of_practice

19. https://www.eesc.europa.eu/en/sections-other-bodies

20. https://vm.fi/en/programme-for-the-promotion-of-digitalisation

21. https://www.lvm.fi/en/information-en

22. https://www.uudenmaanliitto.fi/en/development_and_planning/regional_programming/helsinki-uusimaa_regional_programme_2.0

23. https://www.uudenmaanliitto.fi/en/development_and_planning/regional_programming/smart_specialisation_in_helsinki-uusimaa_region

24. https://en.wikipedia.org/wiki/Category:Information_technology_organisations_based_in_Finland

25. Suomen virallinen tilasto (SVT): Tietotekniikan käyttö yrityksissä [verkkojulkaisu]. ISSN=1797-2957. 2020, 3. Pilvipalvelut . Helsinki: Tilastokeskus [viitattu: 23.8.2021]. Saantitapa: http://www.stat.fi/til/icte/2020/icte_2020_2020-12-03_kat_003_fi.html

26. M. A. K. Bahrin, M. F. Othman, N. H. N. Azli, M. F. Talib, INDUSTRY 4.0: A REVIEW ON INDUSTRIAL AUTOMATION AND ROBOTIC, Jurnal Teknologi, Vol. 78, No. 6–13, June 2016, pp. 137–143.

27. Anodot. Proactive analysis. https://www.anodot.com/learning-center/proactive-analytics/

28. Kaushal, N. 2021. How cloud computing is transforming the retail sector. Einfochips. https://www.einfochips.com/blog/how-cloud-computing-is-transforming-the-retail-sector/

29. Unearth. Construction Tech: Why is cloud computing critical in the construction industry? https://unearthlabs.com/blog/construction-tech/cloud-computing-in-construction/

30. Buildpoint Oy. 2021. Autodesk Construction Cloud yhdistää tiedostojen hallinnan ja tiimityöskentelyn selainpohjaiselle alustalle. https://buildpoint.fi/2021/05/autodesk-construction-cloud-yhdistaa-tiedostojen-hallinnan-ja-tiimityoskentelyn-selainpohjaiselle-alustalle/

31. https://www.dincloud.com/blog/how-cloud-computing-impacting-transportation-industry

32. Case study: Airbnb and The Power of Amazon Web Services. https://www.softwareadvisoryservice.com/en/blog/case-study-airbnb-and-the-power-of-amazon-web-services/

33. TietoEVRY. 2020. TietoEVRY and Microsoft announce strategic partnership in public cloud services. https://www.tietoevry.com/en/newsroom/all-news-and-releases/press-releases/2020/01/tietoevry-and-microsoft-announce-strategic-partnership-in-public-cloud-services/

34. https://www.kanta.fi/en/notice/-/asset_publisher/cf6QCnduV1x6/content/validointipalvelu-siirtyy-pilveen-1-2-2017

35. Marr, B. 2021. The 5 Biggest Cloud Computing trends in 2021. Forbes. https://www.forbes.com/sites/bernardmarr/2020/11/02/the-5-biggest-cloud-computing-trends-in-2021/?sh=1bafa1ff12d9

36. Role of IoT-Cloud Ecosystem in Smart Cities : Review and Challenges, Ridhima R., Vijaita K., Meenu K.,Chitkara University Institute of Engineering and Technology, Chitkara University, Punjab, India, Materials Today: Proceedings, journal homepage: www.elsevier.com/locate/matpr, p.1, Retrieved 24.5.2021

37. Cloud manufacturing ecosystem analysis and design, Helo, P., Hao, Y., Toshev, R., Boldosova, V., University of Vaasa, Networked Value Systems, School of Technology and Innovations, Robotics and Computer Integrated Manufacturing 67 (2021) 102050, journal homepage: www.elsevier.com/locate/rcim, Retriewed 24..5.2021, 9:55.