
Advanced digital skills towards interoperable e-government services: European and Greek case studies

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Abstract: The recent Covid-19 social distance measures highlighted the need for efficient and effective interoperable electronic services. Public Administrations invest a lot in offering such services and implement actions to close the advance digital skill gap of the Public Administration officials. This paper presents the digital skills policy, frameworks for citizens and professionals, the respective profiles and roles that were developed during the last decade in Europe, focusing on Interoperability. Important case studies such as the National Digital Academy for Citizen in Greece, the ISA Interoperability Academy are being analysed against the above-mentioned frameworks. Finally, the practices of the Greek National Centre of Public Administration and Local Government are being presented, including Open Collaborative Courseware initiatives and a significant reorganisation of the face-to-face courses in online courses. The results from 147 real cases show that process-based learning can improve service interoperability prospects and enhance interoperability capabilities and competencies in public administration.

Keywords: blended learning; OCWs; Open CourseWares; IMAPS; Slidewiki Interoperability Maturity Assessment model; public services; e-Learning; PBL; project based learning; moodle; e-Government; digital skills; Webex.

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1 Introduction

The new Digital Europe Programme (DEP)¹ that is being prepared for the period 2021-2027 is putting emphasis in advanced digital skills, focusing on supercomputing, artificial intelligence, cybersecurity, the use of new technologies and the use of Digital Service Infrastructures (DSIs) developed by the Connecting Europe Facility Programme² (European Commission, 2019). Apart from advanced digital skills the need for a digital transformation platform for interoperability of data and services across border and domains has been recognised as a prerequisite for Citizen-centric public services. Digital Innovation Hubs and interoperability incubators will play a crucial role for innovative gov-tech services.

In addition to that the European skills agenda for sustainable competitiveness, social fairness and resilience that has been published on June 2020 (European Commission, 2020), identified digital skills as a prerequisite for new job opportunities. The new technology disrupts millions of jobs, mainly due to automation of routine manual tasks that do not require high formal education or complex social interaction and creates new opportunities e.g., social media manager, influencer, driverless car engineer, podcast producer, AI expert, big data analyst etc. Apart from that, it is widely accepted that the digital era has an impact to the nature of work and the skills generally required for every job (EC/JRC, 2019).

The digital transformation towards a green economy has been accelerated, especially due to the Covid-19 pandemic since e-services, teleworking and distance learning have become a commodity to the everyday operations of government, businesses, citizens and training and education organisations. The increased demand for user-centric interoperable digital services due to the pandemic on one hand revealed the digital skill gap that exists and on the other hand disrupted the standard government, business, education and training activities (COM, 2020).

In this context interoperable digital services become crucial, because this is the only promising way of implementing social distance measures, without destroying the economic and social activities. It is worth mentioning that during this period e-commerce has increased 146% in retail orders in U.S and Canada (Wertz, 2020). Europe followed a similar trend that is being reflected in the Digital Economy Society Index 2020 report³ regarding the use of internet services by citizens and the use of public services. For example, Germany is expected to have a growth in ecommerce of 16% during 2020.⁴ A recent study presented by the Professional Chamber of Athens in April 2020 reported that ecommerce transactions in Greece were almost doubled during the pandemic lock down period.⁵

Towards this direction, public administrations strive to provide more digital public services. For instance, in Greece during the last six months the e-government services that are being offered by the new government portal (i.e., gov.gr⁶) were increased from 501 to 614. Moreover, the interoperability transactions requesting authentication for e-government services during the first semester of 2020 were doubled from 11.000.000 to 21.000.000.⁷

In this regard European Commission and Member States started providing more distance learning opportunities to improve citizens', professionals' and public sector's digital skills. Typical examples of this trend are the initiatives of the National Citizens' Digital Academy⁸ and the Institute of Training in Greece, the Interoperability Academy for public sector bodies⁹ of the ISA² program,¹⁰ the HelloARIS training course.¹¹

Moreover, both universities and vocational training institutes restructured their academic and training courses so that them can be offered though distance using established teleconference and collaboration synchronous and asynchronous learning platforms and tools.

The National Center of Public Administration and Local Government in Greece (i.e., EKDDA¹²) that focuses on the lifelong training in the Greek public sector, is a typical case study of a training institute that reorganised the existing training courses and currently is offering them at a distance mode. The average number of trainees is about 35.000 public servants per year and over 5.500 thematic areas have been covered during the last twenty years.

This paper focuses on specific case studies in Europe and in Greece aiming to highlight the transformation processes of the courses for digital and interoperability skills development so that they can be offered in a distance mode. The blended learning courses implemented in EKDDA (Papastylianou et al., 2020) before the pandemic and the distance mode respective courses during the Covid-19 pandemic will also be compared.

Apart from the introduction of Section 1 this paper has the following structure:

Section 2 provides background information for Digital Skill's considering the European Digital Competency Framework for citizens,¹³ for professionals¹⁴ and educators.¹⁵ The section will also analyse how the Digital skills as part of the European Skill/Competencies, Qualification and Occupation¹⁶ have been affected by the social distance measures of the Covid-19 Pandemic.

Section 3 presents the main principles concepts and issues that were applied in the National Citizens' Digital Academy in Greece and the Interoperability Academy of European Commission. Moreover, emphasis will be given to courses that are addressed at skills related to interoperability,

Section 4 presents the transformation of the blended learning into a fully distance mode learning course for Interoperability Maturity Assessment Model for a Public Service that has been offered by EKDDA (Papastylianou et al., 2020).

Section 5 presents a 360-degree evaluation of the courses implemented during the pandemic lockdown period in comparison to the ones implemented before. The results reflect the authors view after the analysis they implemented.

Section 6 presents the main conclusions of the work done in the context of this paper and suggests future work in this direction.

The authors were active actors in the implementation of EKKDA actions and contributed to the implementation of the National Digital Citizens Academy in Greece.

2 Digital skills framework and interoperability

In 2015 European Commission announced the digital single market (DSM) Strategy for Europe (EC COM, 2015). DSM highlighted the importance of maximising the growth of Digital Economy putting emphasis in a data economy, in competitiveness through interoperability and standardisation and an inclusive society. In this regard interoperability, digital skills and e-government service were identified as areas for immediate action. These needs have also been reassured in 2019 by the new DEP program that has been mentioned in Section 1.

2.1 *Digital skills frameworks*

In 2017 the Joint Research Centre (JRC) updated the second version of the conceptual model for a Digital Competent Framework for Citizens (Digcomp 2.1 (EC/JRC, 2017a)), i.e., a framework that was initially introduced in 2013, proposing the competent areas of digital skills that a citizen should have in relation with the proficiency levels. The main competent areas that were proposed were:

- a information and data literacy
- b communication and collaboration
- c digital content creation
- d safety
- e problem solving.

Eight professional levels were defined in four categories with two separate levels in each:

- a foundation (with guidance or with autonomy)
- b intermediate (simply on their own or independent and according to their needs)
- c advanced (guiding others or being able to adapt to others in a complex environment)
- d highly specialised (resolve complex problems with limited solutions or resolve problems with many interacting factors).

Currently JRC in close collaboration with the DigComp stakeholders' community, experts¹⁷ is starting the revision process of Digcomp that is expected to be finalised early 2022.¹⁸ Emphasis will be given in competencies that are required in digital world such as artificial intelligence, data-related skills, avoiding misinformation. This new framework will be influenced by the new Digital Education Action Plan 2021–2027.¹⁹

A lot of tools are based on this model such as the self-assessment tool that has been developed by Digital Skills Accelerator²⁰ i.e., a project co funded by Erasmus + Program of the EU. The scope of the self-assessment tool is to evaluate the digital skills of a student using 126 structured alternative choices, according to Digcomp 2.1 competency areas, and propose the suitable learning pathway in order the student to improve them.²¹

Soon after the DSM announcement, the Digital Skills and Jobs Coalition²² (DSJC) was established to bring together European Member States, companies, social partners, non-profit organisations and education providers for supporting actions to tackle the lack of digital skills in Europe. In 2018 the DSJC focused on four broad groups that have different needs regarding the digital skills training actions i.e., Digital Skills

- a for all
- b for the Labour force
- c for ICT professionals
- d for education.

The broad group for education has been further elaborated by EC/JRC introducing a special framework for educators (DigCompEdu (EC/JRC, 2017b)) specifying the competencies in the areas of:

- a professional engagement
- b digital resources
- c teaching and learning
- d assessment
- e empowering learners
- f facilitating learners digital competence.

Similarly, the ICT professional's digital skill competences have been further elaborated in the context of European e-Competency Framework specifying 41 competencies²³ in the areas of ICT business processes for:

- a planning
- b building
- c running
- d enabling
- e managing.

Afterwards CEN has issued the European ICT Professionals Roles and profiles based on the e-Competency Framework identifying 30 ICT professional's profiles (CWA 16458 1) (CEN, 2018). The profiles were grouped in seven families (i.e., Process Improvement, Business, Technical, Design, Development, Service Operations and Support).

In 2016 EC/JRC introduced a variation of the digital skills for Citizens supporting e-commerce usual processes i.e., the Digital Competence Framework for Consumers (EC/JRC, 2016) focusing on the competence areas of:

- a pre-purchasing
- b purchasing
- c post purchasing.

Last but not least the proper training and digital skills, are an essential combination to eGovernment management, hence the strong need for Digital skills in public administration (European Commission, 2020) while more advanced skills are essential to deliver electronic interoperable services (OECD, 2015).

2.2 Interoperability in a public service

Interoperability and standardisation are critical success factors for the online provision of public services (Kubicek and Cimander, 2009).

A hot issue that has attracted many researchers, initiatives, numerous government programs, action plans, and policy documents during the last two decades is the interoperability requirements at national and European level (Cordella and Bonina, 2012). The ISA² program (Decision (EU) 2015/2240, 2015), i.e., a funding instrument for interoperability solutions for European Public Administration Business and Citizens, in 2014 developed and updated as a reusable solution to assess the maturity of electronic public services, i.e., the Interoperability Maturity Model-IMAPS²⁴ (former IMM). The

scope of IMAPS (EC, 2020) is to assist interoperability according to the European Interoperability Framework (EIF) (COM/2017/0134 final, 2017) conceptual model that is one crucial component for eGovernment (Rosic et al., 2019).

The model adopts five levels to indicate the maturity of a public service i.e.,

- a ad hoc
- b opportunistic
- c essential
- d sustainable
- e seamless with the desirable maturity level being at least sustainable.

The assessment of public services is focused on implementation aspects of the following functional areas:

- *Service delivery*: It includes issues related to the public channels available for the delivery of the service to the targeted end users' group, i.e., citizens, businesses, or other administrations.
- *Service consumption*: It addresses issues related to the consumption (reuse) of existing services for the needs of processing of information towards the delivery of the service outcome. The more extensive is the reuse of information consumed from existing services, the more interoperable is considered the service.
- *Service management*: It includes aspects related to managing the service during its life-cycle and service execution, such as procurement, service level management, and controlling and monitoring the process flow.

IMAPS consists of a set of questions which addresses the above three functional areas accompanied by an initial section which defines the scope of the public service under assessment, all available as an online self-assessment survey. The questions seek to assess the maturity with regards to all layers of interoperability, as these are defined in the new EIF, i.e., legal, organisational, semantic, and technical interoperability (EC, 2020).

2.3 Digital skills and roles for interoperable public services

The scope of this sub section is to highlight the relations among the digital skills framework that have been presented in the previous Section 2.1 with the interoperability functional areas presented in Section 2.2 and identify the required skills for using, and providing interoperable e-government services. It is also important to identify, which ICT roles and digital skills required for the delivery of user centric interoperable public services according to the profiles proposed by CEN (2018). For this purpose, we reused the functional areas proposed by the IMAPs model and we tried to identify the digital skill proposed by the analysed digital skills frameworks i.e., Digcom 2.1 (EC/JRC, 2017a), DigCompEdu (EC/JRC, 2017b), digital skills for consumers (EC/JRC, 2016), and digital skills for ICT professionals. The numbers of the competence areas follow the code lists used in the respective frameworks so that the mapping relations can be done easily. The respective roles of ICT professionals are being presented indicating the numbers of the competence areas that are expected to be covered by each role. It is

important to mention that in following tables the roles are mainly related with the ICT skills of the professionals. Citizens are mainly involved in the service delivery because they interact with the user interface of the service.

2.4 Service delivery

Service delivery: As already mentioned in Section 2.2 the service delivery functional area is focusing on the interaction with the end users' group i.e., the Citizens and Business. In this regard the digital skills frameworks for citizens and consumers are the most relevant to this aspect of interoperability, from the view point of the end user. Service Delivery is focusing on competencies areas such as Information and Data Literacy, Communication and Collaboration. Managing the end user digital identity is crucial digital skill for the use public services. In addition, digital skills for browsing, searching, filtering evaluating information, interacting with the public service, managing payments and finances through digital means, managing safely personal data and privacy are crucial.

From public administration point of view, the content creation digital skills so that the necessary information for the service to be presented in a multilingual and interoperable way, e.g., for people with disabilities, is important. Digital skills related to reusing re-elaborating existing information, considering copyright, and licensing issues are mandatory. Modern public services usually have e-learning material, videos, manuals to explain the end users how to use the service. In this regard skills related to teaching and guidance are necessary. Digital skills for the differentiation and personalisation of the service according to end users need, increase the use of the service. Last by not least the competencies considering the user experience are also required, especially from ICT professionals' point of view.

In Table 1, the above-mentioned relations are depicted.

Table 1 IMAPS service delivery related to citizens, professionals and ICT roles¹

<i>Typical IMAPS delivery actions</i>	<i>End-user, competencies areas</i>	<i>Public administration competency areas</i>	<i>ICT professional related roles CWA 16548-1</i>
Browsing, searching, filtering evaluating information	<i>Citizens</i> Information and data literacy (1)	<i>Citizens</i> Digital content creation (3.1) <i>ICT professionals Plan</i> Application design (A.6) User experience (A.9)	<i>Business family</i> Business Information Manager (3.1, A.6, A.9) <i>Design family</i> Business Analyst (3.1, A.6, A.9) Solution designer (3.1, A.6, A.9)
Managing end user digital identity	<i>Citizens</i> Communication and collaboration (2)	<i>ICT professionals</i> <i>Plan</i> User experience (A.9) <i>Manage</i> Information security Management (E.8) Information systems Governance (E.9)	<i>Design family</i> Business Analyst (A.9) Systems Architect (E.8, E.9) <i>Technical family</i> Cyber – Security Manager (E.8, E.9)

Table 1 IMAPS service delivery related to citizens, professionals and ICT roles¹ (continued)

<i>Typical IMAPS delivery actions</i>	<i>End-user, competencies areas</i>	<i>Public administration competency areas</i>	<i>ICT professional related roles CWA 16548-1</i>
Interacting with the public service	<i>Citizens</i> Communication and collaboration (2)	<i>ICT professionals</i> <i>Plan</i> User experience (A.9) <i>Run</i> User Support (C.1) Problem Management (C.4)	<i>Design family</i> Business Analyst (A.9) <i>Technical family</i> Service Manager (C.1, C.4) Quality assurance manager (C.1, C.4) <i>Service and Operations Family</i> Service Support (C.1) <i>Support Family</i> Digital Educator (C.1)
Managing payments and finances through digital means	<i>Consumers</i> Payment (2.3)	<i>ICT professionals</i> <i>Plan</i> User experience (A.9) <i>Manage</i> Information security Management (E.8) Information systems Governance (E.9)	<i>Design family</i> Business Analyst (A.9) <i>Service and Operations Family</i> Data Administrator (E.8, E.9) <i>Technical family</i> Cyber – Security (E.8)
Managing safely personal data and privacy	<i>Citizens</i> Safety (4)	<i>ICT professionals</i> <i>Manage</i> Information security Management (E.8) Information systems Governance (E.9)	<i>Service and Operations Family</i> Data Administrator (E.8, E9) <i>Technical family</i> Cyber – Security (E.8)

¹In the following tables the encoding of the respective frameworks (in parenthesis) used to avoid the text description and minimise the size of the table (e.g., 3.1. for Digcomp stands for Developing digital content, A.6 for CWA 16548-1 3.1 stands for Application Design etc. The framework's families and categories are in italic. See also <https://www.ecompetences.eu/e-cf-overview/>

2.5 Service consumption

Service consumption: Service consumption is mainly focusing on the actions that public administration, ICT professionals should take care for identifying reusable components and existing relevant services and processes for the better provision of the public service. In Table 2 the respective relations are depicted.

Table 2 Service consumption related to citizens, professionals and roles

<i>Typical IMAPS actions</i>	<i>End-user, competencies areas</i>	<i>Public administration competency areas</i>	<i>ICT related roles CWA 16548-1</i>
Service Consumption	Citizens Safety (4)	<i>ICT professionals Plan:</i> Product service planning (A.4), Architecture design (A.5), Application design (A.6) <i>Build:</i> Component Integration (B.2), Testing (B.3), Solution deployment (B.4) <i>Enable:</i> Contract/Service Level Agreement Management (D.8)	<i>Business family</i> Business Information Manager (A.4) ICT Operations Manager (D.8) <i>Design family</i> Business Analyst (A.4, A.5, A.6) Solution designer (A.4, A.5, A.6) Enterprise Architect (A.4, A.5, A.6) System Architect (A.4, A.5, A.6) <i>Service and Operations Family</i> Data Administrator (B.4) Systems Administrator (B.4) <i>Technical family</i> Quality Assurance Manager (D.8) <i>Development Family</i> Developer (B.2, B.3, B.4) Test Specialist (B.3) <i>Service and Operations Family</i> Service Support (D.8)

2.6 Service management

Service management: Service management requires all competencies that have been Identified in the ICT professionals e-Competency Framework considering all proposed competencies areas. Emphasis from interoperability point of view should be given on specific competencies for planning, running, enabling and managing. In the following Table 3 the respective relations are depicted.

Table 3 Service management related to ICT professionals and roles

<i>Typical IMAPS actions</i>	<i>Public Administration competency areas</i>	<i>ICT related Roles CWA 16548-1</i>
Service Management	<i>ICT professionals</i>	<i>Business family</i>
	<i>Plan:</i>	Business Information Manager (A.1)
	Information System and Business Strategy Alignment (A.1)	ICT Operations Manager (A.8, E.6, D.8)
	Service Level Management (A.2)	
	Sustainability Management (A.8)	<i>Technical family</i>
	<i>Build:</i>	Service Manager (A.1, A.2, A8)
	Documentation Production (B.5)	
	<i>Run</i>	Quality Assurance Manager (A.2, A8, B.5, C.4 E.6, D.8)
	Problem Management (C.4)	
	<i>Enable:</i>	<i>Support Family</i>
	Education and Training (D.3)	Digital Educator (D.3)
	Contract/SLA Management (D.8)	Digital Consultant (E.1)
	<i>Manage:</i>	<i>Development Family</i>
	Forecast development (E.1),	Developer (B.5)
	ICT quality management (E6)	

It is obvious from the previous analysis that the use of new technologies does not necessarily imply that the Digital Skills required have been developed (Kampylis, 2019).

Consequently, the training needs on interoperability in public administration are great and immediate in order to develop the appropriate digital skills both for end-users, i.e., Citizens and Business, and Public Administration personnel. Especially during the Covid-19 pandemic the additional needs for distance mode learning have increased the priority for open and massive courses and collaborative platforms for synchronous e-learning courses for the replacement of the face to face (F2F) courses. The awareness of such OpenCourseWares (OCW) courses among users and the popularity of systems providing such courses are increasing (Atkins et al., 2007). The main drawback of the OCW is that frequently are not being updated and after some time they become non-reusable. Moreover, the OCW cover the needs of the program that have been initially developed for e.g., academic, vocational training, lifelong learning purposes and cannot be easily adapted in a collaborative, interoperable way that will provide the ability to reuse specific components of the OCW, creating many variations of the same program that will cover different needs. Many of the courses contain only a syllabus and are only available in one language or format, making them difficult to reuse at European and International Level (Vahdati et al., 2015).

On the other hand, the Covid-19 pandemic imposed an urgent necessity to exploit the courses and the training material that had been designed for F2F courses and exploit disseminate existing material that could be offered in distance mode.

In the following sections we will examine specific case studies for the dissemination of existing courses and good practises in Greece and in Europe focusing on the development of Digital Skills for interoperability.

In addition to that, we will revisit the Blended Learning Courses that were offered by the National Centre of Public Administration and Local Government (EKDDA) for interoperability and were analysed in Papastylanou et al. (2020), putting emphasis in the adaptations made so that it can be offered in a fully distance learning mode.

3 Greek national digital academy and ISA interoperability academy

3.1 Greek national digital academy for citizens

During the Covid-19 pandemic lock down of 2020 in Greece, the Greek Ministry of Digital Governance launched on 6th of May the National Digital Academy for Citizens (NADIA). The scope of NADIA is to gather existing training courses and services that have already been offered by several training providers and could contribute to the improvement of Citizens digital skills. The majority of the courses gathered are offered in Greek and many of them in English. This initiative implements the Digital Skills and Job Coalition guidelines (see Section 2.1) to bring together universities, companies, social partners and generally organisations from the public and private sector in order to reduce the Digital Skills gap of the Citizens and professionals.

By the time that this paper was drafted NADIA had gathered 214 different courses from 32 training service providers.

The content of the National Digital Academy has been organised following the categories already proposed by the different Digital Skills Frameworks of EC/JRC²⁵ i.e.

- a Courses for general competencies for citizens: The categorisation of the thematic groups of the courses for citizens are:
 - a communication and collaboration
 - b internet
 - c everyday works and office applications.
- b Courses for specific competencies for professionals. The thematic groups for professionals are:
 - a digital entrepreneurship
 - b computer science
 - c cutting-edge technologies.

This categorisation is also compliant with the DEP program orientations as far as it concerns the Advanced Digital Skills for e.g., supercomputing and artificial intelligence.

In addition to that, a separate online self-assessment tool is being offered, based on the Proficiency Levels and the 21 competencies proposed by the Digcomp 2.1. The self-assessment tool aims to propose to the users the suitable learning pathway that they should follow in order to improve their proficiency levels regarding digital skills. The self-assessment tool has 63 questions organised following the competence areas of the Digcomp 2.1²⁶ and the proposed learning pathways contains specific courses in each competence area.

The proficiency levels of the self-assessment tool in each competence area have been simplified following a three level (star) rating scale.

Each course has a description for

- a the content of the course
- b the target group that the course is addressed at
- c the prerequisites for someone to be able to follow the course
- d and the licensing terms.

Most of the courses that are being offered by the training service providers have all rights reserved. This fact discourages the reuse, re-elaboration of the training material in other courses or for other purposes.

An additional challenge for the selection of material was to ensure that no personal data will be revealed through this open process. For instance, EKDDA could not provide material in video format since in some cases the interaction among the trainer and the trainees could be considered as personal data and the initial scope for the creation of this material was to be used by the trainees for revision purposes.

Practically NADIA acts as a dissemination catalogue of training courses that are being offered by the training service providers for free. This can be considered as a drawback since the Citizens and Professionals are not being informed for courses that have a cost. In many cases these courses can be necessary for covering the Digital skills gaps especially for professionals. This information can be gathered implicitly by visiting the training service provider's respective sites.

At this stage NADIA does not have any information for the qualifications that can be certified following a specific course and the respective process of certification.

NADIA has an open invitation for new courses that a training provider could offer, in the context of the improvement of digital skills as far as it can be offered for free. Moreover, NADIA has a mechanism to collect feedback, recommendations and issues expressed by Citizens.

Regarding interoperability NADIA does not have any user-friendly way to identify courses that can contribute to the use and the provision of interoperable public services as described in Section 2.3. The search function that is being offered by NADIA does not propose any courses under the term "interoperability". Nevertheless, there are being offered courses that could contribute to interoperability skills e.g., the use of specific banking services that are usually required for payments in government services, the use of computers with safety, issues of cybersecurity that are usually prerequisites for data privacy and identity management.

The sub categories for the professionals include specific courses for Educators putting emphasis in the training of educators in supporting distance learning courses. Dedicated courses for intellectual properties rights, open educational resources can be very useful and important when reusing other components for creating content and when defining the license of a service that will be offered. In this regard interoperability skills considering legal and organisational issues can be enhanced. Moreover, there is a category of courses related to applications and databases development that can enhance the ICT professionals' skills.

380.000 end users have visited NADIA by the 21st of September 2020,²⁷ showing a strong interest from citizens for improving their digital skills in Greece.

The general conclusion is that NADIA although does not offer a user-friendly way to support interoperability issues, through exhaustive search one can find useful courses that can enhance interoperability skills.

3.2 ISA interoperability academy

The ISA Interoperability Academy²⁸ is an action that is funded by ISA² program and was launched on 2019. The scope of the Interoperability Academy is to exchange good practices among Member States for Interoperability and Interoperable Public Services issues, under a specific competency framework for Digital Skills in Interoperability. The ISA Interoperability Academy has already organized events and winter schools for experts from Europe and public authorities that deal with interoperable public services. The first event was organised in 2019 and after the Covid-19 the events were transformed to specific webinars. All events have been recorded and one can find them in YouTube. It is important to mention that in the distance Covid-19 context, interaction was enhanced either through collaborative platform such as the Microsoft Teams for the speakers and the facilitators and Slido.com for questions and comments by the audience.

Interoperability academy is focusing on digital skills required for interoperability.

The ISA Interoperability Academy combined the work that has been done in the context of the European e-Competence Framework (e-CF), the CEN CWA 16458 1 European ICT Professionals Role Profiles (CEN, 2018), the ESCO²⁹ (Skills, Competences, Qualifications and Occupations) classification, ISA and JRC and concluded to the following learning profiles for interoperability:

- chief information officer
- systems architect
- policy manager
- project manager
- software developer.

Based on the Learning profiles ISA Interoperability Academy has proposed specific learning paths and curriculum³⁰ for each learning profile. It is obvious from the analysis of Section 2.3 further learning paths and curriculums are still to be produced to cover all the related roles and profiles have been proposed by CEN and are related with interoperability. Table 4 depicts the relation among the ISA Interoperability Academy learning profiles and the ICT Professionals Role Profiles as these have been presented in Section 2.3.

The ISA² learning profiles can be expanded in a similar way for other occupational roles related to interoperability Business Analyst, Quality Manager, Informatics Manager (clinical, educational), Product/service Owner, Test Engineer and generally public services such as Public Administration Manager, Town/City Councillor, Legal Advisor, Civil Engineer, Financial Manager.

The ISA Interoperability Academy is also collecting Open Educational Resources (OER) for digital skills related to the interoperability. Currently 20 OER have been gathered.³¹

The added value of the ISA interoperability Academy is that has already defined a Digital Skill competency profile for the important roles in interoperability and has

proposed the potential learning paths. Moreover, the ISA interoperability academy has brought together experts from all Europe and is disseminating important OER that can be reused for interoperability purposes.

Table 4 Relation among the ISA interoperability academy learning profiles and the ICT professionals role profiles

<i>IMAPS functional area</i>	<i>ISA interoperability academy learning profile</i>	<i>ICT related roles CWA 16548–1</i>
Service Management	Chief Information Officer	A.1, A.3, E.2, E.4, E.9
Service Management	Systems Architect	A.5, A.7, A.9, B.2, B.6
Service Management	Policy Manager	A.8, C.2, C.4, E.4, E.7
Service Management	Project Manager	A.4, E.2, E.3, E.4, E.7
Service Management	Software developer	B.1, B.2, B.3, B.5, C.4

4 EKDDA case study for interoperability before and after Covid-19

EKDDA, identified the gap in advanced digital skills regarding interoperability in the Greek public sector. It was also crucial to raise awareness among public organisations, about the importance of interoperability in government services. A new systematic approach to cope with this challenge started in 2015, with the addition of training courses with the e-learning module, services and material both in Greek and English (EKDDA, 2016). The courses and the material were developed in depth and cover different levels from Basic Interoperability Concepts and Issues to Interoperability Assessment of Public Services (IMAPS). This was important both at a European and National level since this action contributed to the assessment of real public services using IMAPS. Therefore, the purpose of IMAPS course was twofold i.e., to improve interoperability of the assessed public services and enhance the advanced digital skills of public officials. In parallel, EKDDA promoted the policy of collaboration within other organisations and developed Open Educational resources (OER), related to Interoperability via blended learning programs, Open Coursewares (OCWs) using Moodle and the Slidewiki platform.

As a response to the challenge imposed by suspending face to face activities during Covid-19 EKDDA transformed all courses to fully online training courses.

Toward this transformation EKDDA uses the following tools:

- 1 Services from the Webex platform³² for synchronous training that replaced the face2face training modes of the courses
- 2 Moodle³³ as an asynchronous e-learning platform
- 3 Slidewiki³⁴ as collaborative OCWs and educational resources platform
- 4 Open Broadcaster Software³⁵ for the preparation of microteaching videos
- 5 EKDDA's recorder system
- 6 Camtasia Studio as video editor, and OBS as additional recorder

- 7 Integrated EKDDA's Learning Management and Certification System for the organisation, certification and evaluation of the courses with synchronous and asynchronous systems
- 8 Google Online forms for complex evaluation purposes
- 9 IMAPS online survey³⁶.

New activities were performed by EKDDA personnel in order to support the transformation of the F2F parts of the courses to distance learning, using Webex as a synchronous e-learning platform. More specifically

- a the organisation of virtual classes
- b the invitation of the instructors and the trainees
- c the remote technical support of the trainees was necessary.

Additionally, extensive training of the instructors in the synchronous platform was also required. The instructors updated the training material to exploit the new interactive response facilities in order to increase the remote collaboration in the virtual class.

4.1 Methodologies to promote interoperability

EKDDA cooperated very closely with ISA² in order to create systematic actions to promote interoperability.

EKDDA has established a dynamic interoperable set of actions that includes: 1) consulting, educational needs analysis, educational design, resource development, delivery of training, interoperability maturity assessment of public services, training evaluation, training certification, training assessment and finally dissemination activities for interoperability.

The methodology at each stage is mixed and includes quantitative and qualitative educational methods at all stages as well as the appropriate combination of public participation and service measurement methods. A wide variety of techniques was applied by utilising the appropriate educational digital tools during the learning processes.

Eight training and educational curriculums were designed³⁷ and developed as open educational resources (OER) including text with open licence, questions, case studies, media, and other freely accessible digital assets organised for training, workshops, labs, and dissemination info days. The courses were structured as a learning path for interoperability with three different levels:

- 1 basic interoperability concepts and issues
- 2 interoperability framework
- 3 interoperability assessment of public services (IMAPS), and different delivery methods such as F2F, e-learning, blended learning and OpenCourseWare have established.

The details of the methodology before Covid-19 are described in Papastylianou et al. (2020), therefore in this paper we will focus on the new programs that Covid-19 social distance measures provoked. EKDDA established a new synchronous and asynchronous

learning method and enabled broadcasting full distance web learning with the appropriate set-up of tools.

An important asset of EKDDA is the internal database with the staff of all organisations in Greece and the related certified trainers that are active in e-government and interoperability initiatives. This is a competitive advantage for EKDDA because it accelerated the establishment of the *human network for interoperability and e-government service in the public sector* in Greece.

For IMAP's implementation EKDDA initially invited the staff of the organisations responsible for interoperable e-government services, which are relevant to the Digital Policy of EU and are included in the EIF action plan (COM/2017/0134 final, 2017).

4.2 Face to face learning program

The face to face learning program, that is organised by EKDDA for Basic Interoperability Issues and Concepts, consists of three days. The program aims to familiarise the trainees with interoperability basic concepts, and issues and demonstrate good examples of interoperable services at the national and international level. In the third day the trainees are separated into groups and the instructors assigns to each group a specific task to find a good example of interoperable public service from their organisations, to describe it in an abstract way and present the problems and challenges about it regarding interoperability.

4.3 Blended learning program

The blended learning program that is organised for IMAPS by EKDDA consists of three stages. The first stage is face to face and aims to familiarise the trainees with interoperability concepts, framework, the IMAPS model and the learning tools that will be used. Moreover, the trainees are separated in groups and the instructors assign to each group a specific public service for evaluation using IMAPS.

During the second stage, each group works on the assigned subject while synchronous and asynchronous e-learning platforms are used for online support given by the instructors. Each group has to deliver an essay that will contain:

- a the evaluation results for the public service
- b proposals for the increase of the interoperability maturity of the service
- c potential amendments to IMAPS so that it can better cover the needs of a specific domain or a specific organisation.

The last part of the essay provides important feedback for the ISA² program.

The third stage of the program is a workshop with presentations and discussions regarding the evaluated public services.

The best cases from each course were presented in special innovative workshops and conferences and inspire the audience for further collaboration and synergies.

4.4 Open collaborative courses (OCWS)

EKDDA aiming to increase interoperability skills uptake, decided to offer these courses in an open courseware platform and invited other organisations for further improvement

and collaboration increasing the pace of engagement and training. The OCWS concept arose by expanding the concept of openness to the educational context (Vladoiu, 2011).

Currently EKDDA offers many training courses as OCWS on the Slidewiki platform ((EKDDA, 2017, 2018a, 2018c) in English and on Moodle.³⁸ OCWS material has additional requirements such as specific supporting videos (EKDDA, 2018b) and special assessment questionnaires (EKDDA, 2019). It is important to mention that SlideWiki offers collaboration functionality and semi-automatic translation services that increase the reuse of the training material in different courses.

4.5 Fully online training and education programs on interoperability

The combination of synchronous and asynchronous methods and tools has accomplished to have fully online programs and distance certification processes for all existing interoperability courses. For example, at the first stage of IMAPS the trainers have utilised screen sharing tools, annotations, polls, remote access, etc. of the synchronous platform. Video recording was not used for privacy protection reasons. For better support, asynchronous material was also created on the Moodle platform with immediate reuse, integration and enhancement of existing open source material. Critical factors were the existing open licenses, open architecture and open tools which allowed the immediate integration of the material. In the second stage the asynchronous platform was utilised by trainees in order to upload their essays. In the third stage, the synchronous method was used for presentations, discussions and consultations.

Similar approach was also adopted for the new e-learning program ‘Legal interoperability’ that was offered by the National School for Public Administration and Local Government (ESDDA), to provide specific and highly technical education in relation to legal and semantic interoperability.³⁹

The rapid response support team, which was created ensured constant online access and quick problem resolving for trainees and trainers. Practically a new service desk was organised by EKDDA. An expedited training program was also required for trainers and users in the new e-learning tools. The combination of all the above created an Accelerator Mechanism for Interoperability education.

4.6 Interoperability maturity assessment of public services

IMAPS was among the Covid-19 programs of EKDDA to help the improvement of online interoperability of public services. The services that were selected for evaluation during the training courses should:

- a be suitable for evaluation with IMAPS i.e., not a machine-to-machine service
- b belong to one important sector of public administration.⁴⁰

Each group mentioned in paragraph “Blended Learning Program” evaluated a specific service. The selected trainees in each group reflected the views of the service owner⁴¹ and the other stakeholder authorities, ensuring a holistic evaluation approach of the service. A number of 147 services were evaluated considering the IMAPS evaluation aspects presented in Section 2.2. The trainees used the respective IMAPS template of the full questionnaire (EC/ISA, 2016) for the initial assessment. At a second stage the assessment of each service was amended after the group had presented and discussed with the

instructors and the other trainees. Finally, using the IMAPS online survey, specific recommendations were extracted for the improvement of each service and were included in the assessment results.

5 360-degree evaluation

5.1 Training results

According to EKDDA data, five fully distance learning programs relevant to interoperability and two online labs were run during the first three months of covid-19.

More than 130 trainees successfully completed the programs showing 65% increased demand comparatively to the previous period. More than 17 trainers and 5 instructional designers covered 181 h and 5.700 man-hours of live broadcasting in digital classes.

The total interoperability actions, since 2015, resulted in three pilot courses, 91 training programs, one workshop and 10 labs, that informed and educated 2.035 trainees, all over the country. Over three hundred trainers and fifteen instructional designers have managed over 3.440 training hours and 46.450 man-hours of training. The results were presented in the respective ISA info days and conferences (Papastylianou, 2018).

IMAPS training programs have a higher participation rate of men (59%) than women (41%) in contrast to other programs where women have 58%. The majority of participants (58.2%) belong to the age category 40-49 years. Although there is a significant percentage (27.2%) in senior positions, most participants (72.8%) are public servants. Most participants were ICT professionals with a postgraduate or doctoral degree. Therefore, the typical profile of a trainee was “a middle-aged, highly educated IT professional holding a mid-level position”.

Training needs results: Regardless of the recent political emphasis on interoperability,⁴² the analysis of the training needs revealed that interoperability is not yet a clearly recognised priority in organisations excluding the digitally-skilled employees.

According to the responses to questionnaires provided to participants around 58% of them were self-motivated and had a personal interest for interoperability.

Instructional design results: It is worth mentioning that the evaluation and impact assessment showed that the learning path for interoperability can be considered well organised.

Training material and OER results: The training materials created by EKDDA are certified, open and available to be reused. Notably, IMAPS is available in English and it is ready to be reused in any other country that is interested. As a result, the OER were disseminated to a large number of public employees (+4.000 downloads), reused by many trainees and trainers to create their own material (+500), augmented by contributors providing new educational material and case studies (150 forks, 200 new case studies, 35 new OCWS e.g., Kouroubali et al. (2019), many decks from Ministries, Local Administrations, Cyprus Public Administration Academy etc.), commented on by users and contributors.

Training process results: OCWS inspired organisations to create new OER by augmentation. Another noticeable achievement is the organisational ability to apply IMAPS e.g., in the context of the for Social Security e-Government Service S.A. in

Greece (IDIKA⁴³). Flip classroom phenomenon has been successful because trainees became authors and act as trainers. The programs raised awareness in Greek Public Sector regarding interoperability, service modelling, re-design and evaluation. Trainees can recognise how a service interacts with other services and how it could be interoperable. The consultation phase enhanced collaboration among public servants and promoted the efficient resolution of various issues regarding the interaction among public services. The consultation phase maps the various implementations done across public administrations and public services, revealing cases of duplicate implementations on the one hand, i.e., bad interoperability examples, but also cases of *reusable components*, practices and services, saving unnecessary cost in time and effort. The great challenge faced in the training process was the ability to collaborate, make synergies and act as a *human network* of Public Administration representatives and interested parties for interoperability. In that way, comments and input can continually improve the IMM-IMAPS.

Furthermore, this work was reused creating an additional variation for the use of IMAPS in e-health care services in Greece (Kouroubali et al., 2019). The OCWS for interoperability and IMAPS on Slidewiki were specialised for interoperability in Health producing a new OCWS, which has been awarded in SlideWikis Open Course-Ware competition.⁴⁴

Training evaluation and training impact assessment: It is worth mentioning that during the Covid-19 the new online program of IMAPS had better results regarding usefulness and satisfaction in comparison to the other programs (see details in Table 5). The general context of Covid-19 and social distance measures that highlighted the need for interoperable e-government services and consequently the need for interoperability can explain this trend, apart from the experience from the previous blended program. The impact assessment of the pandemic period is not yet available.

Table 5 Training evaluation for all programs vs IMAPS during Covid-19

	<i>Usefulness</i>	<i>Satisfaction</i>
All programs	9.0	9.1
IMAPS	9.6	9.6

However, participants noticed some problems regarding the e-learning method, including problems with internet connections and/or the electricity supply network, fatigue from long online hours, isolation and lack of interaction with the participants in the educational process and the lack of familiarity of trainees with the e-learning process and platforms.

It is important to mention that trainers (avg. = 7.8) and trainees (avg. = 8.3) evaluated the training in the use of the platforms as adequate (scale 0-10).

Both trainees (avg. = 8.0) and trainers (avg. = 8.25) found the asynchronous education platform easy to use. Nevertheless, there was minimal use of functions such as annotations, polls, distant computer control i.e., 21% by students and 28.8% by teachers. Further utilisation of these functions can result in a more interactive and interesting course. Teacher's found the synchronous (avg. = 8.6) as well as asynchronous (avg. = 8.9) training process valuable and well organised (avg.>9).

5.2 Interoperability maturity results

EKDDA trainees evaluated 147 public administration services. The interoperability maturity of the services are shown in Table 6. The services have been classified into three type of services according to the final user: Administration to Citizens (A2C), Administration to Administration (A2A), and Administration to Business (A2B). The table shows the average results of services by type and IMAPS dimension.

Table 6 Interoperability maturity by type

Type	%	IMAPS maturity level		
		Delivery	Consumption	Management
A2A	17.9	3.5	3.5	3.6
A2B	21.8	3.2	3.3	2.9
A2C	60.3	3.2	3.6	3.4
Total/Average	100	3.3	3.5	3.3

Another classification is given in Table 7, according to the domain that services belong. The selected domains were influenced by the National Public Policy, the priorities of DSM, and Digital Europe. Whenever an e-service was applicable to more than one domain the classification was based on the potential target user group.

Moreover, in Table 8, we can see how similar services can be compared regarding interoperability maturity level. This comparison will help public authorities identify good practices and examples in order to be able to reuse them as well as to improve the quality of the services provided.

Table 7 Interoperability maturity by domain

Domain of service	N*	IMAPS maturity level		
		Service delivery	Service consumption	Service management
Base Registries	12	3.3	3.6	3.5
Cultural services	4	3.3	3.4	3.2
Business	7	2	4.2	3.5
Argiculture	4	3	3.1	3
Social related Services	33	4.2	3.3	3.6
e-Education, e-learning services	10	3.6	3.8	3.9
Healthcare Services	12	3	3.9	4
Public Procurement, Public contracts – Suppliers Registry	6	3	3.8	2.9
Social Security	20	3.5	3.1	3.2
Statistics/intrastat	2	3.2	3.4	3.6
Tax related Services	12	3.4	3.5	3.1
Transportation	7	3.1	3.7	2.9
Economy	8	3.4	3.5	3.2
Military	4	3.6	3.2	3.7
Public Finance Management	6	3.7	3.2	2.8
Total/Average	147	3.29	3.51	3.34

*N: The number of different services in the domain.

Table 8 Maturity comparison for similar services

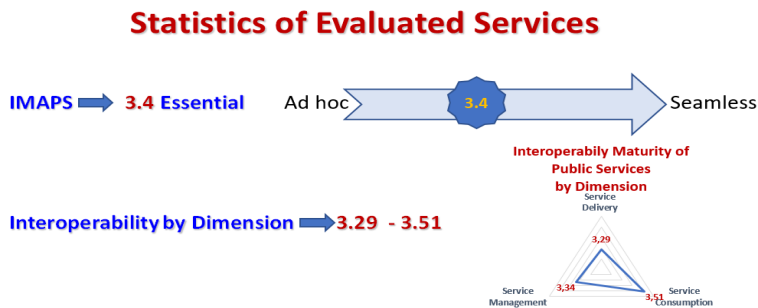
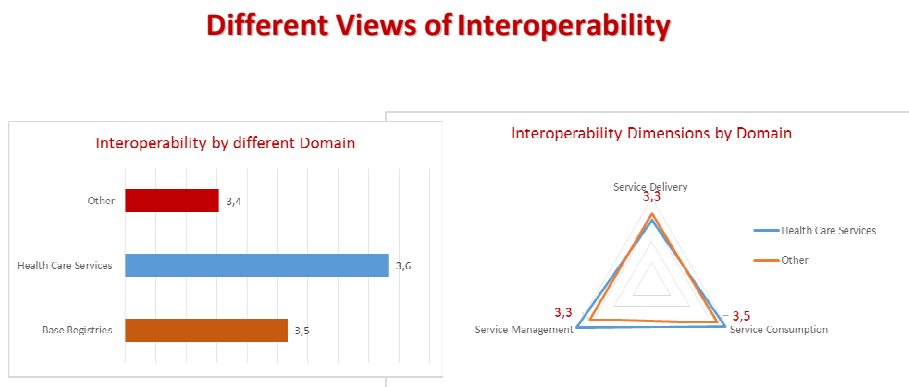
Organisation	IMAPS consumption	IMAPS management	IMAPS average
Hospital 1	3.77	3.77	3.77
Hospital 2	4.30	4.45	4.375

According to IMAPS the average maturity level of all the services that were evaluated in Greece was 3.4, as shown in Figure 1.

Figure 2 demonstrates an example of a diagram that can be derived from the database in order to justify the potential policy decisions that can be made in different domains.

One can see that the healthcare and base registry services are more interoperable than other services of Public administration. It is important to mention that although IMAPS refers to interoperability among different organisations, there are several cases, where different systems that are being supported by different vendors, according to specific different contracts, are using interoperability as a means of communication although they belong to the same organisation. In these cases, the other systems are considered as external environment, although in the same administration organisation.

The systematic evaluation of the interoperability maturity of public services can be used as a quality control mechanism.

Figure 1 Average interoperability maturity level of the evaluated services (see online version for colours)**Figure 2** Average interoperability maturity per domain considering the aspects of IMAPS (see online version for colours)

6 Conclusions and future work

As explained in Section 1, it is widely accepted that the new digital era requires advanced digital skills. The nature of work and jobs is changing due to the new technology capabilities and opportunities, affecting the required skills both for citizens and professionals. The social distance measures (e.g., lockdown) that were applied for the reduction of the Covid-19 pandemic transmission rate, increased the need for teleworking, e-commerce and high quality digital public service. Interoperability contributes to the reduction of social contacts, since the reuse of data, functions, and processes is a key component for high quality aggregated digital services that do not require human intervention. In this regard Private and Public sector require more experts on generally interoperable digital services, intensifying the impact of the advance digital skill gap that exists in the labour market. This was also reconfirmed by the profile of the trainees that participated in the IMAPS courses (i.e., usually graduates or post graduates with a University degree). As a consequence, the demand for relevant advanced digital skills training courses is becoming higher. Open collaborative courses, is a promising way that can cover this demand quickly and involve apart from public administration experts more stakeholders and citizens.

Covid-19 pandemic forced the educational and training institutes to offer distance learning programs, usually online, and transform existing courses by enhancing the online platforms with synchronous and asynchronous ways of training. Although e-learning was already in place the new need required:

- a reorganisation and improvement of the existing systems and telecommunication infrastructures
- b the addition of new service desk for the trainees and the trainers and new ICT systems operations.

Moreover, the trainers should become familiar with the new tools and platforms, implying additional training for the educators. The research work regarding the impact of Covid-19 to the blended learning methods is in its infancy. In 2020 a few research works were published trying to describe methodologies and the respective impact e.g., Alqahtani and Rajkhan (2020) and Siripongdee et al. (2020). The common denominator of these works is the requirement of keeping social distance and the use of e-learning platforms. The tools are similar to the ones used in this work although some diversity exists e.g., do not use open educational resources, using IoT for the evaluation etc. Further research work is needed in order to identify the good practices that can be more effective and efficient in this regard.

A lot of initiatives such as the Greek National Digital Academy for Citizens aimed to cover this new need. In parallel the Interoperability Academy of the ISA² program focused on identifying the digital skills roles and profiles required for interoperable public services, identifying the appropriate learning path for each case and afterwards gathering courses that could contribute to this direction. The appreciation of the interoperability courses offered by EKDDA during the Covid-19 period increased mainly due to the need for more digital public service without the need for F2F visits or social contact and due to the fact that additional online support was offered as a compensation action to the lack of F2F learning courses.

IMAPS during the Covid-19 period remains a useful generic assessment tool that can be applied in different domains and type of services. The requirement for specialisation of the initial model in specific domains and organisation has been reassured. It is too early to say if the pandemic period of Covid-19 has increased the interoperability maturity of the assessed services in Greece, since the average rate did not have a significant change.

IMAPS is still useful for bench marking purposes among similar service offered by different organisations.

Considering the training methods, it was reassured that project-based learning methods even at a distance mode can increase interoperability maturity in the near future. Teamwork had better result both in the objective evaluation of the service and the creation of a common understanding for the improvements that need to be made.

During the training courses it was obvious that the different departments of the same public organisation may need to collaborate using interoperability principles, mainly due to the way that the legacy systems have been developed and the organisational barriers. For instance, different contracts and different head of departments in the same organisation may require interoperable approach for offering aggregated public services.

The next steps required are:

- a further study among the relation of digital skills, roles and profiles and learning pathways for interoperable public services
- b the design of new training courses handling the specific needs of each role and profile, focusing on collaboration, openness, sharing-reuse
- c enhance the interoperability human network and the respective synergies by setting up interoperability incubators and Interoperability Innovation Hubs. The DEP program is supporting such actions
- d further adaptation of the IMAPS model for specific domains that will allow benchmarking, comparison of similar services, and reuse of good practices,
- e certification of interoperability skills in order to response to real organisational and training needs with determined targets and expected results for the improvement of the services delivered to the citizens.

The impact of the courses during the Covid-19 period has not yet been evaluated due to the recent implementation and it will be done in the near future.

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References

- Alqahtani, A. and Rajkhan, A. (2020) *E-Learning Critical Success Factors during the COVID-19 Pandemic: A Comprehensive Analysis of E-Learning Managerial Perspectives*, MDPI Education Sciences, <https://www.mdpi.com/2227-7102/10/9/216> (Accessed 10 January, 2021).
- Atkins, D., Seely Brown, J. and Hammond, L. (2007) *A Review of the Open Educational Resources (OER) Movement: Achievements, Challenges, and New Opportunities*, Report to The William and Flora Hewlett Foundation, <https://hewlett.org/wp-content/uploads/2016/08/ReviewoftheOERMovement.pdf> (Accessed 10 October, 2020).
- CEN (2018) CWA 16458-1 *European ICT Professionals Role Profiles – Part 1: 30 ICT Profiles*, ftp://ftp.cenelec.eu/CEN/WhatWeDo/Fields/ICT/eEducation/WS/eSkills/ICTSkills/CWA%2016458-1_2018.pdf (Accessed 10 October, 2020).
- COM (2020) 275 *Final, Proposal for a Council Recommendation on Vocational Education and Training (VET) for Sustainable Competitiveness, Social Fairness and Resilience*, <https://ec.europa.eu/social/BlobServlet?docId=22780&langId=en> (Accessed 10 October, 2020).
- COM/2017/0134 final (2017) *European Interoperability Framework Implementation Strategy*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2017%3A134%3AFIN> (Accessed 10 October, 2020).
- Cordella, A. and Bonina, C.M. (2012) 'A public value perspective for ICT enabled public sector reforms: a theoretical reflection', *Government Information Quarterly*, Vol. 29, No. 4, pp.512–520, ISSN 0740-624X, <https://doi.org/10.1016/j.giq.2012.03.004>
- Decision (EU) 2015/2240 (2015) Decision (EU) 2015/2240 of the European Parliament and of the Council of 25 November 2015 Establishing a Programme on Interoperability Solutions and Common Frameworks for European Public Administrations, Businesses and Citizens (ISA² programme) as a means for Modernising the Public Sector, Brussels 4.12.2015.
- EC (2020) *Interoperability Maturity Assessment for a Public Service*, IMAPS v1.2.0, https://ec.europa.eu/isa2/solutions/imaps_en (Accessed 10 October, 2020).
- EC COM (2015) 192. *A Digital Single Market Strategy for Europe*, Brussels, 6 May, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52015DC0192> (Accessed 10 October, 2020).
- EC/ISA (2016) *Interoperability Maturity Model Full Questionnaire*, https://joinup.ec.europa.eu/sites/default/files/document/2016-03/imm_full_questionnaire_0.pdf (Accessed 10 October, 2020).
- EC/JRC (2016) *The Digital Competence Framework for Consumers*, <https://publications.jrc.ec.europa.eu/repository/bitstream/JRC103155/lfn28133enn.pdf> (Accessed 10 October, 2020).
- EC/JRC (2017a) *DigComp.2.1: The Digital Competence Framework for Citizens*, [https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp.2.1pdf_\(online\).pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106281/web-digcomp.2.1pdf_(online).pdf) (Accessed 10 October, 2020).
- EC/JRC (2017b) *Assessing Educator's Digital Competencies*, https://ec.europa.eu/jrc/sites/jrcsh/files/digcompedu_leaflet_en-2017-10-09.pdf (Accessed 10 October, 2020).
- EC/JRC (2019) *The Changing Nature of Work and Skills in the Digital Age*, <https://ec.europa.eu/jrc/en/facts4eufuture/changing-nature-work-skills-digital-age> (Accessed 10 October, 2020).
- EKDDA (2016) *Training Material for Interoperability Maturity Assessment for Public Services*, National Center of Public Administration and Local Government, <http://resources.ekdd.gr/gnosis/index.php/3-26/88-interoperability-maturity-assessment-for-public-services> (Accessed 10 October, 2020).
- EKDDA (2017) *Slidewiki, Interoperable Public e-Services – Main Interoperability Issues and Concepts*, <https://slidewiki.org/deck/4507-8/interoperable-public-e-services-main-interoperability-issues-and-concepts?language=en> (Accessed 10 October, 2020).
- EKDDA (2018a) *Slidewiki, OpenGovernment*, <https://slidewiki.org/deck/113098-1/anoikth-diakybernhsh-open-governance/deck/113101-1/113101-1:2/view?language=el> (Accessed 10 October, 2020).

- EKDDA (2018b) *Slidewiki Videos*, <https://slidewiki.org/deck/108796-2/imm-interoperability-maturity-assessment-for-public-services/slide/758164-14/110560-2:1;116012-1:2;758164-14:1/view?language=en> (Accessed 10 October, 2020).
- EKDDA (2018c) *Slidewiki, IMM-Interoperability Maturity Assessment for Public Services*, <https://slidewiki.org/deck/108796-2/imm-interoperability-maturity-assessment-for-public-services?language=en> (Accessed 10 October, 2020).
- EKDDA (2019) *Slidewiki Evaluation Questionnaire*, <https://slidewiki.org/deck/108796-2/imm-interoperability-maturity-assessment-for-public-services/slide/758631-8/116094-1:10;758631-8:1/view?language=en> (Accessed 10 October, 2020).
- European Commission (2019) *Digital Europe Draft Orientations for the Preparation of the Work Programme(s) 2021-2022*, http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=61102 (Accessed 10 October, 2020).
- European Commission (2020) *European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience*, <https://ec.europa.eu/social/BlobServlet?docId=22832&langId=en> (Accessed 10 October, 2020).
- Kampylis, P. (2019) *EU Frameworks and Tools for Digital Competence, Cedefop Workshop*, https://www.cedefop.europa.eu/files/04_p.kampylis_eu_frameworks_and_tools_supporting_digital_competences.pdf (Accessed 10 October, 2020).
- Kouroubali, A., Papastilianou, A. and Katehakis, D.G. (2019) 'Preliminary assessment of the interoperability maturity of healthcare digital services vs public services of other sectors', *Studies in Health Technology and Informatics*, Vol. 264, pp.654–658.
- Kubicek, H. and Cimander, R. (2009) *European Journal of ePractice*, <http://www.dlorg.eu/uploads/External%20Publications/6.1.pdf> (Accessed 10 October, 2020).
- OECD (2015) *Digital Government Toolkit*, [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=GOV/PGC/EGOV.\(2015\)2&docLanguage=En](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=GOV/PGC/EGOV.(2015)2&docLanguage=En) (Accessed 10 October, 2020).
- Papastylianou, A. (2018) *Implementation of IMAPS in Greek Public Administration, ISA2 Mid-Term Conference*, https://ec.europa.eu/isa2/isa2conf18/anastasia-papastilianou_en (Accessed 10 October, 2020).
- Papastylianou, A., Stasis, A., Rantos, K. and Kalogirou, V. (2020) *Blended Learning and Open Courseware for Promoting Interoperability in Public Services*, Published in: *E-democracy – Safeguarding Democracy and Human Rights in the Digital Age*.
- Rosic, Z., Lognoul, M., De Streel, A. and Hocepiet, C. (2019) *Contribution to Growth: European Digital Single Market: Delivering Improved Rights for European Citizens and Businesses*, European Parliament, <http://www.crid.be/pdf/public/8449.pdf> (Accessed 10 October, 2020).
- Siripongdee, K., Pimdee, P. and Tuntiwongwanich, S. (2020) 'A blended learning model with IoT-based technology: effectively used when the COVID-19 pandemic?', *young wise publishing*, *Journal for the Education of Gifted Young Scientists*, <https://dergipark.org.tr/en/download/article-file/1154363>
- Vahdati, S., Lange, C. and Auer, S. (2015) 'OpenCourseWare observatory – does the quality of openCourseWare live up to its promise?', *Fifth International Conference on Learning Analytics and Knowledge 2015*, pp.73–82, <https://arxiv.org/abs/1410.5694> (Accessed 10 October, 2020).
- Vladoiu, M. (2011) *State-of-the-Art in Open Courseware Initiatives Worldwide*, *Informatics in Education*, pp.271294.27.
- Wertz, J. (2020) *3 Emerging E-commerce Growth Trends to Leverage in 2020*, *Forbes*, <https://www.forbes.com/sites/jiawertz/2020/08/01/3-emerging-e-commerce-growth-trends-to-leverage-in-2020/#5e9aafd76fee> (Accessed 10 October, 2020).

Notes

- ¹<https://ec.europa.eu/digital-single-market/en/europe-investing-digital-digital-europe-programme>
- ²<https://ec.europa.eu/inea/en/connecting-europe-facility>
- ³<https://ec.europa.eu/digital-single-market/en/desi>
- ⁴<https://www.businessinsider.com/germany-ecommerce-report-2020>
- ⁵<https://www.euractiv.gr/section/emporio/news/anevainei-to-ilektroniko-emporio-stin-ellada-3-stoys-4-epilegoyn-ellinika-ilektronika-katastimata/>
- ⁶<https://mindigital.gr/archives/1631>
- ⁷<https://mindigital.gr/archives/1560>
- ⁸<https://nationaldigitalacademy.gov.gr/>
- ⁹<https://joinup.ec.europa.eu/collection/digital-skills-public-sector?page=0>
- ¹⁰https://ec.europa.eu/isa2/home_en
- ¹¹<https://eithealth.eu/project/helloairis/> : An introduction to Artificial Intelligence for medical professionals that is supported by the European Institute of Innovation & Technology (EIT)
- ¹²<https://www.ekdda.gr/>
- ¹³<https://ec.europa.eu/jrc/en/digcomp>
- ¹⁴<https://www.ecompetences.eu/e-cf-overview/>
- ¹⁵<https://ec.europa.eu/jrc/en/digcompedu>
- ¹⁶<https://ec.europa.eu/esco/portal/home>
- ¹⁷<https://all-digital.org/invitation-to-digcomp-community-of-practice-cop/>
- ¹⁸https://ec.europa.eu/jrc/sites/jrcsh/files/message_stakeholders_digcomp_2_2_cop.pdf
- ¹⁹https://ec.europa.eu/education/sites/default/files/document-library-docs/deap-factsheet-sept2020_en.pdf
- ²⁰<https://www.digitalskillsaccelerator.eu/>
- ²¹<https://www.digitalskillsaccelerator.eu/wp-content/uploads/2019/12/DSALearningPathways.pdf>
- ²²<https://ec.europa.eu/digital-single-market/en/digital-skills-jobs-coalition>
- ²³<https://www.ecompetences.eu/e-cf-overview/>
- ²⁴<https://joinup.ec.europa.eu/collection/imaps-interoperability-maturity-assessment-public-service/solution/imaps/release/v120>
- ²⁵https://ec.europa.eu/knowledge4policy/organisation/jrc-joint-research-centre_en
- ²⁶a) Information and Data Literacy, b) Communication and Collaboration, c) Digital Content Creation, d) Safety and e) Problem Solving.
- ²⁷<https://mindigital.gr/archives/1631>
- ²⁸<https://joinup.ec.europa.eu/collection/digital-skills-public-sector/solution/interoperability-academy>
- ²⁹<https://ec.europa.eu/esco/portal/news/188d86fd-a04c-4c96-b2ce-01045777f3f4>
- ³⁰https://joinup.ec.europa.eu/sites/default/files/document/2019-12/Interoperability%20Academy%20-%20Learning%20Paths%20and%20Curriculum_Part%20II.pdf
- ³¹<https://joinup.ec.europa.eu/collection/digital-skills-public-sector?page=0>
- ³²<https://www.webex.com/>
- ³³<https://moodle.org/>
- ³⁴<https://slidewiki.org/>
- ³⁵<https://obsproject.com/>
- ³⁶<https://ec.europa.eu/eusurvey/runner/IMAPS>

³⁷Open Government, e- Government for citizens, Distance Learning on E- Government, Basic Interoperability Concepts, Interoperability Maturity Assessment Model for a public service, Digital Governance and Framework, Templates and Interoperability Evaluation of Digital Services, Legal Interoperability.

³⁸<https://elearning.ekdd.gr/course/view.php?id=184>

³⁹<https://joinup.ec.europa.eu/collection/digital-skills-public-sector/news/hellenic-case-report>

⁴⁰e.g., Citizenship, Taxation, Health Care, Social Insurance, Public Procurement, Public Finance Management

⁴¹i.e., the authority responsible for the operation and provision of the service

⁴²<https://mindigital.gr/archives/836>

⁴³<http://www.idika.gr/>

⁴⁴<https://slidewiki.eu/2018/12/12/read-the-interview-of-dimitrios-g-katehakis-angelina-kouroubali-and-ioannis-karatzanis-winners-of-slidewikis-open-courseware-competition/>