ESCALATE

ROMANIA

TIMIS COUNTY

Evidence Base for a Skills Escalator (WP4)

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Contents

List of Abbreviations

ARACIS	Romanian Agency for Quality Assurance in Higher Education
CSIs	County School Inspectorates
DKMT	Danube-Kris-Mureş-Tisza
ESCALATE	Coordinated Higher Institutions Responses to Digitalisation, Erasmus+ KA2 - Cooperation for innovation and the exchange of good practices, KA203 - Strategic Partnerships for higher education
EU	European Union
HEI	Higher Education Institution
ICT	Information and communications technology
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
MER	Ministry of Education and Research
NUTS	Nomenclature of Territorial Units for Statistics
PES	Public Employment Services
RDA	West Euroregion Regional Development Agency West
WP	Work Package

Useful Definitions[1]

Digital Skills: Competences in and / or knowledge of IT tools including computer programs and programming languages.

Digitisation / Digitalisation of Jobs: Job automation by means of computer-controlled equipment.

Baseline Digital Skills: Digital literacy skills that employers ask for in the vast majority of jobs across all sectors in the UK labour market. Includes spreadsheet and word processing tools like Microsoft Excel and Microsoft Word, as well as enterprise management software like Oracle or SAP. These proficiencies are increasingly becoming a basic skill requirement for a majority of occupations.

Individuals with at least 'basic' or 'above basic' digital skills: all individuals aged 16-74 with 'basic' or 'above basic' digital skills in each of the following four dimensions: information, communication, problem solving and software for content creation (as measured by the number of activities carried out during the previous 3 months) (European Commission, DESI 2020).

Individuals with at least 'basic' software skills: all individuals aged 16-74 who, in addition to having used basic software features such as word processing, have used advanced spreadsheet functions, created a presentation or document integrating text, pictures and tables or charts, or written code in a programming language (European Commission, DESI 2020).

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/807830/No_Longer_Optional_Employer_Demand_for_Digital_Skills.pdf

Executive Summary

This report was designed to identify the most important economic sectors in Timis County where digital skills are required, what skills and sectors are going to be critical in the future and, assessing existing provision in both academic and vocational learning.

The report combines data analysis, literature reviews and a review of findings from expert interviews. It was focused on analysing the ICT sector in Timis county contextualised in relation to the national picture/position. The ICT sector's share of Romania's GDP is 6%, one of the highest in the EU reflecting its role as one of the most dynamic economic sectors in the country.

There are over 185,000 specialists working in the ICT sector in Romania and about 50% of them are software developers. Also, the country ranks 10th globally in number of certified IT specialists. Timis ICT market is considered to be the second largest in Romania, after Bucharest, with over 500 relevant companies and almost 10,000 employees. The ICT sector is therefore critical to the future economic success of Timis county.

Regionally software development and the large automotive sector are perhaps the two primary 'smart specialisation sectors' for Timis county. It is the role of software developer that is one of the most required specialisations within the labour market and one of the most difficult positions for employers to fill. Consequently, we have focused our Escalator activities on the skills associated with the role of 'software developer' as our chosen smart specialisation for Timis county.

We have worked with several partners who provided the foundations for the Escalator and who were interested in further developments. Among these were West University of Timisoara and the Computer Science Department of the West University of Timisoara which is nationally recognized as one of the top ten strongest Romanian academic groups involved in fundamental and applied research; Grigore Moisil Highschool which is one of the first Highschool in Romania providing education in Computer Science; Timis County Council which represents the local government; Regional ICT Cluster - West Region Romania and Banat IT NGO.

The main findings show consistent skills gaps within ICT employees, particularly regarding software development. However, on a very competitive IT market, skills gaps became of a secondary concern, as employers are struggling primarily with labour supply deficiencies. As such, the problem is rather quantitative and then qualitative. Labour shortages force employers to accept any candidate, no matter their skills level, and the employers then need to provide them with on-the-job training and work-based learning.

We found that local policies aimed the ICT sector are almost non-existent. However, this aspect should be analysed taking into account the fact that Romania is a very centralised country and local administration have limited 'skills' policy independence. The education system is also centralised and all key responsibilities for developing an education strategy, policy and delivery are concentrated within the Ministry of Education and Research.

We suggest three directions for action around monitoring the situation in the labour market: regular analysis to identify and analyse current skills gaps; the anticipation of trends and of future needs for skills; translating this information into actions though the better matching of the supply and demand for skills.

We suggest a further number of recommendations which incorporate examining how universities could have a pivotal role in tackling digital skills gap and labour shortages. At least two measures should be implemented: (1) tracer studies – for monitoring the insertion of graduates on the labour

market and (2) a new employer skills survey – to more precisely define the need for skills in this sector.

Developing the Escalator was an original step for Timis county as to best of our knowledge this approach is one of a kind in the region. This approach could be developed further through a collaborative platform which can bring together all stakeholders involved in providing specific skills or looking for specific positions/jobs.

Introduction

With the project "Coordinated Higher Institutions Responses to Digitalisation", six partners (West University of Timisoara, University of Exeter, University of Stirling, University of Milano-Bicocca, Otto von Guericke University Magdeburg and Prospektiker Instituto Europeo de Prospectiva y Estrategia SA,) from five countries (Romania, Germany, Italy, Spain and UK) aimed to assist universities in implementing activities designed to increase the levels of digital competences for employability, upskilling, according with a growing range of employment generated by the digital economy, aligned with the needs of and opportunities offered by the labour market and linked to professional profiles.

Context

This Report is a part of the ESCALATE project and contains the contribution of the West University of Timisoara to the Working Package 4 - Digital Skills Escalator Development. An overview of the ESCALATE project is drawn in the next sections.

Background to the ESCALATE Project

The ESCALATE project was the subject of a successful application to Key Action 2 – Cooperation for Innovation and the Exchange of Good Practices – of the Erasmus+ programme submitted by West University of Timisoara to the Romanian National Agency. The project has been developed by six partners from five EU countries, namely five universities and an independent company, which specializes on foresight and prospective - strategic studies for the public and private sector.

The official start of the ESCALATE project is 01.11.2019 and it is a 24-months project with the end date being 31.10.2021.

The aim of the project is to assist universities in implementing activities designed to increase the levels of digital competences for employability, upskilling, according with a growing range of employment generated by the digital economy, aligned with the needs of and opportunities offered by the labour market and linked to professional profiles.

The primary focus is to understand digital education disruption and to enable open-source technology and innovative solutions for both educators and students, leading to increased learning-outcomes that meet the learning needs of students whilst also being relevant to the labour market and societal needs (creating a 'better' digital future).

Our target groups are higher education institutions (HEI), education providers, teachers, learners for existing and new digital skills provision. Indirect target group consists primarily of those citizens with low levels of digital skills at risk from digitalization facing a keen need to acquire the digital knowledge and use of digital technologies, but also labour market (LM) forecasters such as labour market observatories.

The project has two linked objectives. Firstly, to help universities understand the scale and depths of the challenges they face from digitalisation - to enable them to formulate effective policy and education system governance - by developing and making freely available new methods and techniques in digital skills acquiring, foresighting and forecasting. We will explore the state-of-the-art before developing and testing the new materials across 6 major themes.

Secondly the project will trial the potential of a new innovative practice (a Digital Skills Escalator) across a selected region in each partner country to test its potential as a mechanism for both identifying where there is unmet demand and subsequent need for new digital skills provision and as

a means of building a more holistic offer from education providers. This report addresses this objective for Timis county.

The University of Exeter has summarized existing practices and lessons learned from their work developing the Exeter Data Analytics Skills Escalator and has passed this onto partners who will then build policy and stakeholder relationships to enable testing of the model in their own region and policy landscape.

This report will be presented at Partner Meeting 3 where a methodology for utilising the findings with policymakers will be devised. This is likely to include meetings, regional reports, workshops, and events.

The Concept of a Skills Escalator

Escalators are relatively new developments that seek to achieve the following two related, but not identical, aims.

To ensure a region has sufficient citizens skilled in a particular field/sector critical to economic success.

To ensure that the skills and training needed to enter or progress in this field/sector are available locally, at all levels.

The former can be understood as a driver of economic success and the latter is more concerned with inclusive growth. As a project we are looking specifically to develop Digital Escalators where the skills at the 'lower end' of the qualifications can be quite generic but will link into a very specific key sectoral need at the higher end. Linked to a City or Region's 'smart specialisation'.

A good example of this is the existing Exeter Data Analytics Skills Escalator is relatively broadly defined. It encompasses topics such as:

- Statistical understanding
- Digital and programming skills
- Use of AI and high-end algorithm development for the analysis of 'big data'
- The translation of environmental intelligence into new products and services and local growth.

Put simply the Escalator is a pipeline of skills, or perhaps more accurately a 'funnel of skills', linked to a specific smart specialisation sector. The fact that a significant proportion of individuals may apply these skills usefully outside the prioritised smart specialisation sector is not problematic. Having a relatively broad, and some might say flexible focus (in which the 'environmental' focus can be picked up or dropped, as convenient) enables engagement across a wide range of educational and other partner organisations and access to a wider range of opportunities.

The Escalator Model is not intended to be a fixed journey from school to Higher Education and CPD but instead is designed for people to enter and leave when necessary. Its purpose is to promote discussion, engagement and coordinated partnership activity.

Geography of the Escalator: Timis county

The administrative structures

The territory of Romania is divided into Counties, Towns and Communes. There are eight development Regions on Romanian territory (NUTS II level), but this are not administrative-territorial units and have no legal status. Timis county is positioned in the west part of the country at the crossroads of Hungary and Serbia (figure 1). It is a part of the Vest region together with three other counties: Arad, Caraș-Severin and Hunedoara.

Timis is the largest county of Romania, covering 3.65% of the country's territory. It is also the fourth in terms of population, representing 3.63% of the country. It is characterised by a high skilled workforce, proximity to Western markets (neighbourhood with Serbia and Hungary), significant natural resources, cosmopolitan mentality and multilingualism for a large part of the population.

At the European level, Timis county is part of the Danube-Kris-Mureş-Tisza (DKMT) Euroregion, established to enhance international cooperation between local communities and regional authorities in order to encompass the economic and social development of the area. The main city of the county – Timisoara – was designated in 2016 by Forbes, for the second time in a row as the most dynamic city of Romania and the best place for doing business.

Figure 1. Geographical positioning of the Timis county

Timis County Council is the elected local government. It coordinates the county's activities and the public services of the Town Councils, in the interest of the county .

Economic overview of the Timis county

Timis county has a high level of GDP per capita, ranking third after Bucharest and Cluj county. Timis GDP represents 4.74% of the national GDP in 2019 and was equivalent to a GDP of 14,727 euro per inhabitant, which is slightly above the Vest region average (11,747 euro) and the national average

(11,333 euro) according to the National Commission for Strategy and Prognosis (2019), but it is still far below the EU average (31,000 euro, Eurostat, 2019).

Timis county also registered the lowest level/rate of unemployment in Romania, being slightly below 1% (figures from first quarter of 2020, before the pandemic crisis).

The research and education system in Timis county

In Timis county there are about 133 lower secondary schools (ISCED 2, grade 5-8) with nearly 22,000 pupils[2]. There are also 57 upper secondary schools where 21,010 pupils learn and acquire knowledge and new skills. Among these there are 20 schools with classes in the area of Science – Mathematics and Computing. Within these schools a discipline/course in computer programming is offered 4–8 hours weekly, for 4 years. In this area there are some specialist schools - the Computer Science High School "Grigore Moisil" in Timisoara which offers a program in Science (only mathematics and computer programming), CD Loga National College, Carmen Sylva National Pedagogical College, and CNB High School (with classes on mathematics and computer science.

Timisoara also hosts five Universities. Among these, Politehnica University is the oldest one (founded in 1920) and the West University of Timisoara is the largest (about 24,000 students). The others are Banat University of Agricultural Sciences and Veterinary Medicine, University of Medicine and Pharmacy and Tibiscus University. They act as important providers of knowledge and drivers of local and regional development. Two of them - West University of Timisoara and Politehnica University Timisoara - are distinguished as important providers of digital competencies through their bachelor's, master and PhD programs in Mathematics-and Computer Science (ISCED 6-8).

Methodology

The information that forms the basis of this report is the result of an extensive desk research into secondary data analysis using datasets, studies and reports from governmental and private providers. In addition, semi-structured, individual qualitative interviews were conducted with employers from the ICT sector, HEI representatives and policymakers to explore in more depth findings on how to meet the emerging digital skills needs of the region. It was also an opportunity to seek validation of the projects previous results, identify the strategic local developments, and the role of primary and secondary education providers. We could also look at the involvement of higher education in covering the existing educational gaps and providing key digital skills needed to boost growth in various economic sectors and particularly the ITC sector, as well as how they could enhance the economic development of the region, with spill over effects on national economic welfare.

Data for development of the Escalator was obtained through five specific methodological steps.

First stage consisted of defining the area for the Escalator. For this phase we considered the social, economic and administrative specificities of Romania. Therefore, we focused our analysis at the county level, by enhancing the regional context as well. The Vest region was initially selected, as it is characterised by key features such as a skilled workforce and has provided a very good space for digitalization and innovation with concerted efforts in this direction, in spite of low public investments in research, development and innovation (RDI). Another key credential is the industrial infrastructure of the region, which is quite well developed and diverse, including ICT, automotive, machine building, electronic parts, agro-food, textiles, wood processing, mining and chemical, but it is based on a long tradition of ICT research with strong contribution to value added production

[2] National Institute of Statistics, 2018

(European Commission, Regional Innovation Monitor Plus, 2019). Ultimately Timis county (NUTS III) was selected as being representative for our study, as it is one of the most developed counties in Romania but of sufficient scale to allow potential impact.

In **the second stage**, the research was focused on analysing of the datasets from National Institute of Statistics (NIS) and National Trade Register Office. In order to identify the representative sectors in Timis county, we used as a landmark, the number of employees by sectors. Both, National Institute of Statistics (NIS), National Trade Register Office provide statistical data about employees by NACE level. Additionally, data extracted from www.topfirme.ro were used to get a more accurate picture regarding the main economic domains in Timis county.

In **the third stage**, we analysed the number of employees by occupations (ISCO 08) and job vacancies. Datasets provided by National Institute of Statistics (NIS) have allowed to identify the most required occupations in the Timis county. Additionally, information from the various reports, study and surveys were also used. Online job vacancies were explored to identify the most required (digital) skills.

Based on data collected and analysed in phase 2 and 3, presented above, there were identified the representative sector(s) for Timis county and the sector where digital skills are going to be critical to future success.

The fourth stage consisted of identifying the existing provision and education providers in the analysed area. The current structure of Romanian's formal education is based on 4-4-4-3+ (4 years primary - ISCED 1; 4 years secondary lower- ISCED 2; 4 years secondary superior - ISCED 3; and 3 years+ higher education - ISCED 5-8). Additionally, the education system comprises also the non-university tertiary education (ISCED 4) and adult education (training programmes at all qualification levels, organized in the public or private sector).

The education providers and provision were extracted from the website of Timis County School Inspectorates and Ministry of National Education and Scientific Research.

In the **fifth stage** our information and findings were enriched through interactions with stakeholders and local policy makers. Formal and informal discussion with HEI and local employers' representatives were held to explore in-depth the subject of digital skills supply and demand. A set of interviews were conducted with representatives of HEi's, local and regional public administration and business.

The digital skills pipeline

Digital literacy has been recognised, including at the European Union level, as part of literacy, and the ability to use the digital technology is considered to be essential for both individual and professional life.

In Romania, the ability of using ICT is considered a key competency that should be provided by school and its importance is highlighted including by the Romanian National Education Law.

However, for primary level (ISCED 1) there is only an optional separate subject[3] which includes providing some basic digital skills, but according to the national curriculum[4], a discipline in the field

[3] Math and Science in Knowledge Society

[4] The Romanian Education System is a centralised one and learning is guided by a national curriculum compulsory for all schools of the country. The national curriculum is also available for private schools. However, private

of ICT is compulsory starting with the lower secondary level (ISCED 2). This discipline is usually titled "Informatics and ICT" and it is designed to provide basic and moderate digital skills.

The main digital skills that are trained at ISCED 2 level (for each grade, from 5 to 8) are listed below[5]:

Fifth grade

- Understanding hardware and software components of a PC (e.g. role of hardware, role of OS, types of devices);
- Understanding algorithms and procedures (e.g. properties, classifications);
- Browsing, searching and filtering data, information and digital content (e.g. adjusting searches according to specific needs);
- Copyright and licences (e.g. knowing how to licence own digital production, knowing how to find information on copyright and licence rules);
- Protecting personal data and privacy (e.g. acting prudently regarding privacy issues);
- Developing digital content (e.g. using basic packages to create content in different forms - text, audio, numeric, images);
- Managing data, information and digital content (e.g. downloads/uploads and classifies information and content).

Sixth grade

- Integrating and re-elaborating digital content (e.g. using edit functions to modify content in simple, basic ways, remixing different existing content into something new, creating knowledge representations (e.g. mind maps, diagrams) using digital media);
- Interacting through digital technologies (e.g. sending an email, write a blog post, an SMS, editing information in order to communicate it through several means (from sending an email to making a presentation in slides);
- Protecting devices (e.g. installing an anti-virus, taking steps to mitigate risk of fraud by using a password, protecting different devices from threats of the digital world - malware, viruses etc.);
- Using algorithms and procedures (e.g. stages, structures, representations);

Seventh grade

- Creatively using digital technologies (e.g. building meaningful knowledge through interaction with digitally available resources, using a variety of media to express oneself creatively - text, images, audio, and movie);
- Developing digital content (e.g. using a variety of media to express him/herself creatively (text, images, audio, and movie), editing content in order to enhance the final output);
- Programming (e.g. coding and programming digital devices, changing basic settings);
- Collaborating through digital technologies (e.g. using the collaborative features of software packages and web-based collaborative services such as track changes, comments on a document or resource, tags, contribution to wikis, etc.);
- Using algorithm (e.g. building basic algorithms, developing a source code, implementing algorithms using a source code).

education system is relatively poor in Romania, for instance, in 2019 only 4.9% of all pupils learn in the private system. Complete curriculum is available at: http://programe.ise.ro/Actuale/Programeinvigoare.aspx

[5] Adjusted according to EU DigComp 2.0. framework

Eighth grade

- Managing data, information and digital content (e.g. structuring and classifying information and content according to a classification scheme/method, using information management services, software and applications);
- Integrating and re-elaborating digital content (e.g. creating new by mixing and matching old such as a web page)
- Evaluating data, information and digital content (comparing, contrasting and integrating information from different sources, using spreadsheet calculation);
- Programming (editing a source code implementing algorithms using a source code, virtual robots).

At seventh and eighth grade, programming includes Python, C, C++, Ruby. For programming virtual robots, are recommended Scratch, V-Rep (Coppelia Robotics), MORSE (OpenRobots).

Digital competencies are also provided through the national curriculum at the upper secondary level (ISCED 3, grade 9-12). Romania has the highest amount of instruction time allocated for ICT as a compulsory separate subject in compulsory upper secondary education (168 hours)[6]. At this level there are targeted both basic and intermediate digital skills in all upper secondary schools.

According to the national curriculum, digital skills that are trained at ISCED 3 level (upper secondary education – four years) are:

- Computer architecture (e.g. understanding the rules and methods of the functionality, organization, and implementation of computer systems, logic design);
- Protecting health and well-being (e.g. managing the distracting aspects of working/living digitally, taking preventive steps to protect his/her own health and the health of other she/he is responsible for);
- Protecting the environment (e.g. using digital services without being completely dependent on them/helpless without), knowing how to use digital equipment cost-efficiently and also time-efficiently);
- Protecting devices (installing an anti-virus, taking steps to mitigate risk of fraud by using a password, protecting different devices from threats of the digital world - malware, viruses etc.);
- Computer Network (e.g. LAN, MAN and WAN);
- Interacting through digital technologies (e.g. sending an email, write a blog post, an SMS);
- Evaluating data, information and digital content (comparing, contrasting and integrating information from different sources, using spreadsheet calculation);
- Managing data, information and digital content (e.g. using various classification schemes to store and manage resources and information, e.g. Access);
- Developing digital content (e.g. creating knowledge representations (mind maps, diagrams) using digital media)

These types of digital skills are usually provided through discipline titled “ICT”, compulsory for all schools. More targeted digital skills are also trained through disciplines such as: “Database management system” (Natural Sciences specialisation), “Computer aided documentation techniques” (for classes with specialisation in Pedagogy and Public Order), “Computer-aided word processing” (for classes with specialisation in Philology), “Digital image processing” (for classes with

[6] eacea.ec.europa.eu/national-policies/eurydice/sites/eurydice/files/en_digital_education_n.pdf

specialisation in architecture, environmental arts, design, plastic arts, decorative arts etc.) or "Computer Network Administration" (optional).

Additionally, advanced digital skills are provided in high schools in the area of Science7 - Mathematics-and Computer programming. A summary of these are listed below:

- Solving technical problems (e.g. using a widely diverse and well-balanced mix of digital and non-digital technologies for different problems and will dynamically change options over time, solving a technical problem or to decide what to do when technology does not function);
- Identifying needs and technological responses (e.g. taking informed decisions (with human or technological assistance where appropriate) about whether and how to use technologies to pursue personally relevant goals, choosing the most appropriate technologies according to the problem);
- Programming (e.g. coding and programming digital devices, creating complex models, simulations and visualisations of the real world using digital information, applying advanced settings).

Within these schools the focus is on programming (including SQL, Java, Python, C, C++), database management (SQL - Oracle, Microsoft SQL Server, MySQL - Visual FoxPro - Microsoft).

Within the National Curriculum, there are 80% compulsory disciplines, but 20% disciplines can be optional. Within the optional disciplines, in addition to those that are offered at the national level, there is the possibility for schools to offer disciplines which are congruent with the schools' specificities, local economy or community needs (School Decided Curriculum, are usually extensions to the compulsory subjects).

A broad observation is that all schools use solely the national curriculum and local needs-oriented disciplines are almost inexistent.

At the local level weren't identified disciplines which provide digital skills, other than those are recommended according to national curriculum.

An important landmark in providing digital skills is higher education. Universities have high autonomy, unlike the pre-university segment. Each university is free to decide everything from their management to the organization of classes. However, curriculum is developed in accordance with the framework provided by the ARACIS[8] and is based on compulsory and optional disciplines.

The main digital skills provided at bachelor's level (ISCED 6) are in the area of:

- Programming (Python, C++, Java), Programming for Mobile Devices (Android applications);
- Databases (SQL, Oracle, SQLite);
- Web Design (developing web sites using HTML, CSS, ECMAScript, PHP and MariaDB);

[7] Area of science (high schools type) is divided in two sections, both offering classes suited accordingly: Intensive Mathematics-and Computer programming — *Mate-info* which provides more classes of Math and Computer programming (up to 5 hours per week each), and Natural Sciences — *Științe ale naturii* which extends knowledge in Biology, Chemistry and Physics (up to 3 or 4 hours per week each).

[8] ARACIS is the Romanian Agency for Quality Assurance in Higher Education and has the main purpose to carry out the quality external evaluation of education provided by higher education institutions and by other organizations providing higher education study programs in Romania (for more details, please see https://www.aracis.ro/en/about-aracis/#)

- Software Engineering (data analysis in R, operational research and optimization, advanced logical and functional programming, software systems programming, distributed systems, architectures and security models in various network, quality and reliability of software systems, data mining, software engineering oriented on cloud, processes and management in software engineering, multi-agent systems, computer vision, automatic learning);
- Artificial Intelligence (cloud computing, high performance computing, multi-agent systems, machine learning, deep learning models, data analytics, distributed systems, advanced logical and functional programming, data analysis in R, network security models and architectures, modelling and verifying algorithms in Coq, logical and functional programming);
- Network Administration (advanced data structures, formal methods in software development, computer networks, operating systems, design patterns, artificial intelligence, network design and administration, security and cryptography, intelligent systems, management information systems);
- Cloud Computing (Amazon, Google, Microsoft);
- Mechatronics and Robotics (mathematics, CAD, mechatronic systems dynamics, dynamic electromechanical systems, construction, testing and programming of advanced robotic systems).

At the ISCED 7-8 level, the digital competencies provided by universities are much more advanced. Particular study programmes offered by the two largest higher education institutions and main providers of digital competencies in the Timis county (West University of Timisoara and Politehnica University Timisoara) and the associated skills acquired by graduates are synthesized in table 1.

Table 1: Master programmes ISCED 7 level providing digital skills (ISCED 7 level)

Program	Skills
Automotive Embedded Software	Implementation of testing and diagnosis models and of quality engineering principles to software applications implemented on embedded systems, development of hardware and software applications for automotive systems using up-to-date informatics technologies, innovative solving of core problems in inter-disciplinary co-operation and team-working
Mechatronic and Robotic/ Ergo engineering in Mechatronics	Developing complex project, identification of complex structures and solutions for special requirements, identifying appropriate modes, components and knowledge of methods for analysis of ergonomic systems dynamics, creative use of CDA methodology, using computer-assisted methods for analyzing the quality systems, set design and analysis software for assisted systems, structure optimization
Artificial Intelligence and Distributed Computing	Theoretical and practical knowledge useful in modelling designing and implementing systems based on artificial intelligence methods and parallel and distributed approaches, performing cloud computing and high-performance computing; designing multi-agent systems; Configuring machine learning, deep learning models, configuring network security models and architectures, modelling and Verifying Algorithms in Coq

Mechatronic and Robotic/ Artificially Intelligent Robotic Systems	Advanced knowledge of mathematics, CAD and dynamic electromechanical systems, capabilities in construction, testing and programming of advanced robotic systems
Big Data – Data Science, Analytics and Technologies	Skills in the design of efficient and robust models for statistical analysis of data, design implementing and using data mining algorithms, in using technologies for big data processing and in implementing scalable applications, Big Data Technologies, Data Warehouses, Cloud Computing, Data Mining, Machine Learning, Data Analysis and Programming in R, designing and implementing Probabilistic Models for Data Science, Predictive Models and Analytics, Optimization, Biostatistics
Automated Systems Engineering	Implementation and exploitation of complex control systems in condition of autonomy and professional independence, designing of control systems with different levels of intelligence for practical applications using current information technologies, application of testing and diagnosis methods at control systems, implication in the management of research projects in the field of control systems
Information Technology and Computer Engineering	Depth level knowledge of the main issues and topics in the field of information technology, advanced knowledge in computer engineering, critical, innovative and advanced digital capabilities
Applied Informatics Systems in Production and Services	Solving applied informatics problems by adequate data acquired methods and processing tools selection, processing and interpretation of relevant results, innovative problem solving based on interdisciplinary cooperation teamwork, automation structures design and implementation (hardware and software) including as embedded systems, using modern processing systems, developing automation application using modern computer technologies
Information Systems in Healthcare/ Bioinformatics	Interdisciplinary capabilities, based on engineering and medical knowledge, from an informatics perspective of healthcare service applications, interdisciplinary cooperation in engineering-medical domain, identifying and solving problems specific to healthcare information systems, design, implementation, testing, evaluation, deployment of information healthcare systems using different information technologies, advanced knowledge on biostatistics and programming in R, databases in bioinformatics, using software instruments for bioinformatics, designing computational models in biology.
Information Systems for Businesses	Advanced knowledge of business intelligence, MS SQL Server Business Intelligence, Oracle Business Intelligence Tools and Technology, IBM – Cognos BI, advanced capabilities on SAP Enterprise applications, modelling business processes, advanced methods and techniques for software engineering, web design, web programming, Enterprise reporting: SAP BEx, Crystal Reports, Web Intelligence, Design Studio, Lumira, Analysis for Office 2.2 report outputs in SAP BEx Query Designer, advanced methods and techniques to approach and investigate informatics systems (Agile, SCRUM, XP, DevOps, UP, MDA, MVC, ASAP), advanced use of supportive informatics applications to

	develop information systems (MS VISIO, MS WorkFlow, UI Path, Python, IBM INNOV8, IBM Websphere Business Modeller, ARIS, SAP Solution Manager), developing websites and online businesses, Web performance optimization.
Software Engineering	Ability to understand and operate with fundamental concepts in computer science, ability to model, simulate and solve problems in areas based on the use of a computational system, knowledge of current technologies and ability to apply them in project development, designing architectures for software systems, computer vision, applying methods and techniques based on XML, performing advanced logical and functional programming, designing software systems
Cybernetic Security	Developing architectures and models of network security, ensuring the quality and reliability of software systems, developing robust applications, processing large amount of data, developing multi-agent systems, data mining, applying methods and techniques based on XML, security and share of public interest data
Information Technology	Advanced technical knowledge essential to identify, design and implement software applications, advanced capabilities on modeling, design and programming, the ability to use information technology for design, implementation, testing, assessment, administration and maintenance of complex information systems

Both Universities also organise occasionally various postgraduate courses which provide advanced digital skills in different domains. Postgraduate courses offered in the current (2020-2021) and previous academic years are listed in table 2, below.

Table 2: Postgraduates programmes providing digital skills (ISCED 7 level)

Course	Skills trained
Blockchain Entrepreneurship	Advanced capabilities and knowledge on cryptocurrencies programming and transactions, the blockchain technology, programming applications on various blockchain platforms, blockchain entreprenurship and financial skills
Applied Web Technologies	Advanced analysis of software specifications, web technologies and applications, Git, Github, JavaScript, React/Angular/Node.js, generating sequence, diagrams, developing software prototypes, implementing the front-end design, using the software libraries
Technologies and Digital Resources for Online Training	Efficient use of resources and digital instruments, communication and collaboration based on digital technologies, problem solving in terms of digital technology, G-suite for Education, Microsoft Teams for Education, (Learning Management System - LMS) Moodle

Information and Cybernetic Systems Security	Effective use of advanced cryptographic techniques, computer network security, mobile and cloud apps security, embedded security and automotive, viruses and vulnerabilities of the information systems
Digital Skills in Services	Efficient use of computer systems, operating systems and the Internet by the employees from various organizations in the ICT sector, adequate use of office supplies software products to solve specific problems

At ISCED 7 level, many programs are more congruent with the labour market needs. Some of them are even developed with the support of local or regional companies to fill skill gaps for those companies. Actually, these sort of partnerships with local companies represent the only instrument through which skills provided are connected to labour market needs.

At ISCED 8 level, specific digital skills, including those necessary for a software developer could be obtain in two Doctoral Schools, at the West University of Timisoara and Politehnica University. However, many PhD graduates don't target jobs on industry, but mainly in academic area or research, including abroad.

Throughout the analysis we noted that except for these advanced study programmes and courses provided by the higher education institutions solely and in partnership with companies, to the best of our knowledge, at the county level, there aren't any other customised policies and programmes deployed to ensure the provision or constant development of digital skills, much less those tailored to the labour market needs and linked to professional profiles.

For instance, training courses in the area of digital skills offered by local Public Employment Services (PES) are poor and usually focused on providing basic digital skills (e.g. using a PC, tablet or mobile device for emailing or internet browsing). However, these aspects should be analysed in the context of the unemployment rate in Timis county, which is below 1%, the lowest from Romania[9], practically PES register only a few applicants.

Different private initiative financed by ESF are also focused on providing only basic digital skills.

However, experts interviewed noticed that there is a discrepancy between skills that should be trained (according to curriculum) and skills that are really trained. For instance, teachers decide the level of complexity of applications (computer programs) that they teach, universities don't work very close with employers (on one hand the educational system being strongly centralised, the curriculum is very rigid, on the other hand, the employers tend to develop their own training programs).

The Policy context in West region and Timis county

In 2013, Romania started a process to identify the national smart specialisations. They were prioritised and included in a National Research, Development and Innovation Strategy. Romanian smart specialisation priority areas include: (1) Manufacturing & industry, (2) Information & communication technologies (ICT), (3) Services, (4) Sustainable innovation and (5) Key Enabling Technologies.

[9] June 2020 – National Institute of Statistics

As a result, each region has developed its own innovation strategy. Moreover, each county has to develop its own socio-economic development strategy.

Smart specialisations

In 2013, the Regional Development Agency West (RDA West – which contain Timis county launched a study[10] in which explored five potential smart sectors for the region that will be most important to securing long term high quality jobs, namely:

- Automotive: focused on two main activities that bring about 75% of the total value added employed by the sector, such as the production of various parts/components and accessories for vehicles and the production of electrical and electronic equipment for vehicles; hence, this sector has an increased potential as regards the electronics, wires, tyres, but also requires further improvement and advanced skills on design and material testing;
- ICT: an advanced sector with clear smart specialisation potential for telecommunication, software development, and hardware design, yet the sector still needs further improvement and advanced skills in embedding new technologies, cloud computing and Big data. These skills are widely provided by higher education institutions in Timis county, particularly by the West University of Timisoara and Politehnica Timisoara, therefore concerted efforts between the education providers and ITC companies are needed to enhance the value added of this sector; if we consider the data provided for the entire ITC sector in the Vest region of Romania, we note that about 75% of the total value added by this sector during 2008-2011 was grasped by three main activities, namely wireless telecommunication activities, production of electronic parts and computer programming; at the same time, smart specialisation opportunities associated with this sector also emerge from inter-sectorial demands, on three fields, respectively: e-health services, electronic medical assistance and information services platforms between patients, hospitals, professional, health information networks that emerge in the current advanced aging process in Europe, web portals for tourism activities and online marketing in the context of an expanded tourism sector, personalized software products for automation of commercial processes and production activities in the automotive sector.
- Textiles: a wide sector with specialisation potential in terms of clothes making, that also requires the adoption of technology in production and other human activities deployed in order to significantly increase the value added;
- Agri-food: a sector with latent specialisation potential in cereals, horticulture and animal production, that essentially needs the implementation of technologies and processing support to boost productivity and provide a complete chain "from farm to fork".
- Constructions and tourism: the construction sector grasps an unclear specialization that could possibly forward energy efficiency and renewable energy, while the tourism sector has a great potential but still an unclear specialization mostly directed towards eco-tourism and cultural tourism.

The study was followed by a regional strategy for smart specialisation developed for the Vest region of Romania in 2016. Another study done in 2018[11], identified the ICT, web application development

[10] Romania Western Region Competitiveness Enhancement and Smart Specialization Report

[11] Report developed within the project SIPOCA 27 - Project - "Developing the administrative capacity of MCI to implement some actions set in the National Strategy for Research, Technological Development and Innovation 2014-2020" implemented by Ministry of Research.

and cloud services as the domains with the most potential for the region, considering them as smart specialisation priorities.

For Timis county, automotive and ICT sectors (mainly software and IT services) are representative, considering the number of employees that they have and the number of existing companies.

In fact, the largest local employers are multinational companies in the area of automotive, such as: Continental Automotive Products, Continental Automotive Romania, ContiTech, Delphi Packard Romania, Hella Romania, Mahle etc. In the last years, many important companies in the field of IT&C started to operate in Timisoara targeting for employing specialists with competencies in software development, software testing, web development etc. At the moment, on the local market there are present numerous companies with activity in telecommunication (Nokia), cloud based technologies and sofware as a service (Syneto, Microsoft, Avaelgo, Genisoft, Binbox, IBM, SAP, CloudBase, uRad Monitor), optimisation and ICT infrastructure development (Eta2U, Deltatel, Endava), fleet management (Safe Fleet), mobile application (Canvy). Local ICT industry also comprise business process outsourcing services (Wipro and Accenture), business transformation services (Atos), electronic payments solutions (ACI Worldwide), software development (3Pillar Global, MHP Consulting – Porsche subsidiary), etc.

The emergence and fast-growth ICT sector was due to the presence of a high skilled labour force in the area and a long tradition in this domain. For instance, the first computer in the university environment and the first alphanumeric calculator in Romania was put into operation at the Timisoara Politehnica University in 1961. Since in 1970 in Timisoara was set up a branch of the Institute for Computer Technology (ITC) where were produced microcomputers and PCs. This activity, as well as the presence of academic programs in Mathematics-and Computer Science at the Politehnica University and West University of Timisoara, since 60's, produced over the time an important pool of specialists in ICT.

They were the main driver of the development of this sector after 1990's in Timisoara. Thus, at the moment Timisoara is an important technological hub for Central Europe, and it is one of the largest recruitment pool for specialists in ICT.

A quarterly research employed by the Regional Labour Market Observatory[12] based on analysing online job vacancies also identified the ICT as one of the most dynamic sectors for Timis county. At the same time, software developer was identified as one of the most needed positions in the ICT sector for Timis labour market.

Even though the local HEI's provide yearly about 1,000 graduates in ICT, they are insufficient for labour market needs. Interviews with representative of local companies revealed that most of ICT graduates are employed in "front end" and „telecom" domains (where skills provided by school are usually sufficient), and it is very difficult to recruit, for instance a skilled software developer or software tester (usually, school-provided skills need to be updated through extra training).

According to the evidences found during desk research, OJV analysis and expert interviews, we have focused our Escalator on software developer specialisation. This is considered to be one of the potential smart specialisations for Timis county.

[12] SCOPE web

Timis county 'education and skills' strategic priorities on ICT sector

Romania is a very centralised country, local administration having limited policy independence. The County Council (e.g. Timis County Council) is the local government authority, constituted at county level to coordinate the activity of communal, city and municipal councils. The budget is controlled by central administration and allocation are strongly politicised.

However, in 2014 Timis elaborated the Economic and Social Development Strategy for the period of 2014-2023. The importance of the ICT sector is highlighted, but there are not any clear statements regarding the development or supporting of the software domain.

Overall, local policies aimed the sector of ICT are almost non-existent.

In terms of local education and skills strategic priorities, the situation is similar. The education system is centralised and all key responsibilities for developing an education strategy, policy and delivery are concentrated within the Ministry of Education and Research (MER, https://www.edu.ro/). Locally elected authorities play very little role in the design and delivery of education policies. Therefore, autonomy and schools' decision-making are very limited. The MER is responsible for setting the education system's overall strategy and national policies, from pre-school and compulsory education to vocational education and training and higher education. As such, the curriculum is similar across the country. The MER directly steers and monitors the implementation of national policies at the local level through the County School Inspectorates (CSIs).

Private initiatives are also almost inexistent.

However, it should be noticed that West University and Politehnica Timisoara provide yearly about 1,000 graduates in Computer Sciences.

Several meetings and interviews were at the heart of interaction with policy makers, employers and the education and training providers. These also created strong synergies between them providing the opportunity to work together to meet the emerging digital skills needs of the region.

National priorities influencing ICT sector

In 2019 there were about 185,000 specialists employed in ICT sector in Romania. About 96,000 of these work in software development. Their number is expected to increase to about 125,000 in 2021. The software Romanian's companies offered a broad range of services, with focus on web application development (79%), mobile app development (65%), software testing (35%), design and architecture (33%), user experience & Design (29%), cloud computing & system development (16%), Big Data & Analytics (16%), eCommerce (11%), engineering (9%) and Machine Learning (5%).

Despite this, Romania does not have a national strategy that targets the ICT industry and software development. However, in 2015, Romania adopted National Strategy on the Digital Agenda, setting out four areas of action[13], among them being supporting the growth of the ICT sector added value by supporting research, development and innovation in the field.

[13] 1. e-Government, Interoperability, Cyber Security, Cloud Computing and Social Media - field which aims to increase efficiency and reduce costs in the public sector in Romania by modernizing the administration;
2. ICT in education, culture and health - field which aims to support these technologies at the sectoral level;
3. ICT in e-commerce, and research, development and innovation in ICT - area aimed at regional comparative advantages of Romania, and backs growth in the private sector;
4. Broadband and digital infrastructure services - aimed at ensuring social inclusion field.

Several fiscal incentives have been approved and are valid for the development of the ICT industry: no income tax for IT graduates, no income tax for employees hired as software developers, no income tax for employees hired in R&D companies, no income tax for R&D companies for the first 10 years, significant subventions for serious commitment of over 200 new IT positions kept by one company for more than three years, some incentives for young entrepreneurs.

Escalator partners

Partners we worked with and provided the foundations for the escalator and were interested in further developments are listed in below:

- West University of Timisoara ranked 71 in the EECA (Eastern Europe and Central Asia) University Rankings. It comprises 11 faculties which cover all the main directions of study in the fields of exact sciences, economics, law, social and political sciences, humanities and arts. The Mathematics and Computer Science Faculty was founded in 1948 and has two departments: Department of Mathematics and Department of Computer Science, the last starting its activity in 1971. The Computer Science Department of the West University of Timisoara is nationally recognized as one of the first ten strongest Romanian academic groups involved in fundamental and applied research, teaching and development activities in computer science and information technologies. The main research activities are focused on: multi-agent systems, knowledge engineering, expert systems, data mining, evolutionary computing, neural networks, parallel / distributed / Web / Grid / cloud computing, workflow technologies, image processing, e-learning, computational mathematics.
- Grigore Moisil Highschool was set up in 1971, being one of the first Highschool in Romania providing education in Computer Science.
- Timis County Council represents the local government, elected by the County citizens. It is in charge to coordinate the county's activities and the public services of the Town Councils, to achieve the county interest.
- Regional ICT Cluster - West Region Romania was setup with the aim of promoting and supporting the regional ICT enterprises in becoming global market players, with their own products, under a strong regional brand.
- Banat IT is an NGO based in Timisoara, Romania and is conceived to keep the IT community connected and informed about various opportunities to drive this industry towards continuously leveraging its strengths as a major pole of IT excellence.

Aligned Investments

In the last years, at the county levels multiple infrastructures aimed developing of ICT market and digital skills were set up. The most important are described in the next sections.

Multifunctional County Center for Businesses – Timişoara

In 2010 an infrastructure project was set up, backed through Regional Operational Program for 2007 – 2013[14], named „Multifunctional County Center for Businesses – Timişoara". It was initiated by Timiş County Council with the aim to provide ITC companies with incubation, business support and start-ups assistance services.

[14] Programme under Convergence objective co-funded by European Regional Development Fund (ERDF)

Regional ICT Business and Innovation Infrastructure – Incuboxx

A similar infrastructure also backed through Regional Operational Program for 2007 – 2013, initiated by Timişoara City Hall was the Regional ICT Business and Innovation Infrastructure – Incuboxx. This provides services for product development and marketing.

ICT Regional Cluster

In 2011 regional ICT stakeholders (local public authorities, academic and reasearch organizations, business support entities) set up an ITC Cluster in the West Region, based in Timisoara, as a focal point of development of this sector in the region. The main goal of the organisation is to generate innovative products, services and solutions to boost Region's economy.

In 2014 ICT Regional Cluster initiated a project for development of an Excellence Center in Data Analytics in West Region to serve as a joint Research – Development – Innovation platform. The concept integrates multiple components including: public service delivery based on processing of high data volumes, development of innovative products, including multidisciplinary, using data analytics technologies and delivery of data science and big data training courses (http://www.digivest.ro/en/ict-regional-cluster).

Technological and Industrial Park Timisoara (PITT)

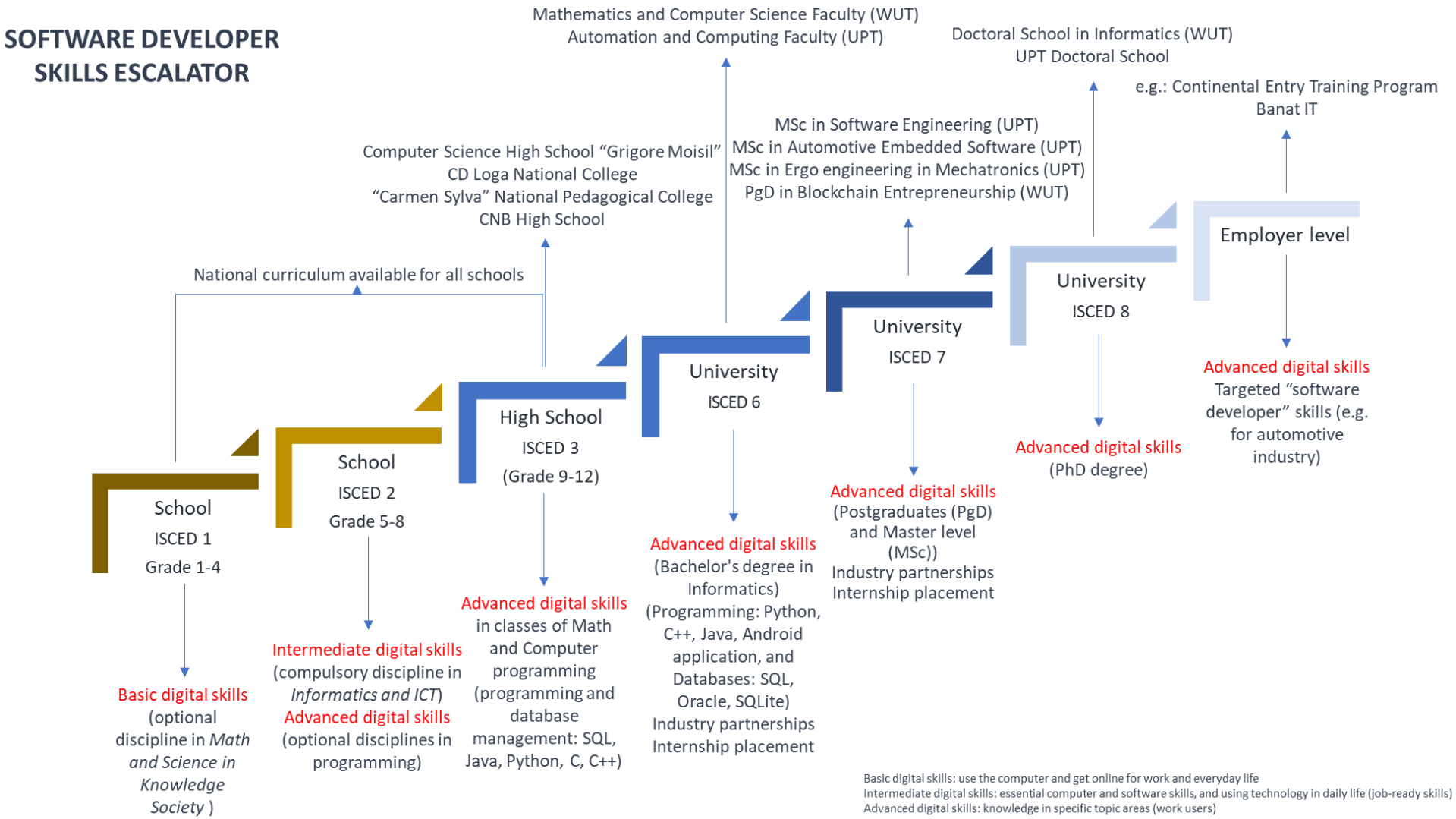
A Technological and Industrial Park Timisoara (PITT) existing near Timisoara. This is a project achieved by Timis County Council and ADETIM - Economic Development Agency of Timis County. It was co-financed by Phare ISF 2001, the National Fund for Regional Development. Its purpose is to support the development of SME' s in the fields of software, IT & Communications, electronics and electrical technology, automotives and other types of industries that are utilizing advanced and non-polluted technologies, designing, researching & development activities, logistics.

Public Higher Education Institutions

Public Higher Education Institutions are also involved in supporting and boosting the local ICT sector, both, West University of Timisoara and Politehnica University creating a series of spin-offs and research institutes. For instance, a successful project is e-Austria Timisoara Institute created in 2002 as a private non-profit research association between Research Institute for Symbolic Computation, Linz, Austria, West University of Timisoara, and Politehnica University Timisoara. The institute is focused on promotion the excellence in scientific research and technological transfer in the field of information technologies.

However, to best of our knowledge this approach is one of a kind in the region.

Software Developer Skills Escalator



Resultant Skills Priorities and Recommendations

This section contains the main conclusions and recommendations as a result of our research.

Digital Skills Gaps in the Timis county needing to be addressed

Digital skills gaps are widening quickly, with more and more recruiters stating that is difficult to find appropriate candidates. In our research we tackled this issue primarily through interviews with employers from ICT sector of Timis county. There were only targeted interventions in advanced ICT skills (e.g. developing software, applications or programming; using computer syntax or statistical analysis packages).

The ICT sector is critical for Timis county. There are over 500 companies in this field and almost 10,000 employees. The ICT market in Timis is the second largest one, after Bucharest. According to statistics[15], Timisoara is vibrant technology environment and a great centre for possible candidates in the IT sector.

Despite this, there are consistent gaps between demand and supply when it comes to IT professionals. Even though there are about 1,000 graduates per year in the field of ICT, the experts interviewed reported difficulties in finding enough employees. For instance, both interviews and OJV analysis (e.g. time to fill a position and number of jobs posted) found that the hardest-to-fill job was Java software developer followed by software tester. However, it should be noted that all IT positions are hard to fill and this task is very difficult given the notably low unemployment rate in Timis county, below 1% (according Eurostat, EU unemployment rate in 2019 was 6.7%, 3.9% in Romania, respectively).

Experts interviewed also reported consistent skills gaps of ICT employees, particularly regarding software developers. However, on a very competitive IT market, skills gaps became secondary, as employers are struggling primarily with labour supply deficiencies. As such, the problem is rather quantitative more than qualitative. Labour shortages force employers to accept 'any candidate', no matter their skills level, and to provide them with training and work-based learning. For example, there are situations in which a candidate specialised on C+ applied for a job where Java is required. They are accepted without problems, employer preferring to pay for the training, and to wait until they acquire new skills, instead of rejecting them (not employing).

However, in the long term, experts consider that the market is going to be more selective. Economic contraction due to CoVid19 pandemic may cause a relaxation of IT labour market shortages and companies which are still active in local labour market may have a larger pool for recruitment. This is not automatically a long-term solution due to the possibility of increased rates of emigration of high skilled graduates.

Higher Level Smart Specialisation Sector skills gaps needing to be addressed

Smart Specialisation policy is closely related to higher education, research and innovation policies, which are also organised at national level. This poses significant constraints on the implementation of the regional strategies. Therefore, regional administrations have weak capabilities and little or no experience with innovation policy. There are no formal regional innovation policies in Romania. However, RIS3 strategies can provide a foundation for regional innovation policies.

Usually, the Computer Science degree, offered by the HEI's are not been specifically designed to match with employer's needs. Moreover, the Universities don't work in close collaboration with the

[15] InvestRomania (2018), Romania's Business Service Sector IT&C, SSC & BPO

employers in elaborating the curriculum. The academic courses provide wide specialisations and are not devised to provide a highly practical skills congruent with local labour market needs.

On the other hand, as we stated previously, the IT companies are struggling to employ any IT graduates, no matter their skills. Experts interviewed (both, employers and academics), indicated that many IT workers are employed since they are still students (e.g. starting with the second academic year), even though they still lack the skills they need to do their job effectively. Due to the labour shortages, companies prefer to secure their positions in this way, and then invest in training to reduce the skills gap.

Recommendations to tackle the above Skills Gaps

This research provides clear evidences that software developers are the most required ICT professionals in the local labour market and, their shortage is resulting in hard-to-fill positions, both due to labour shortages and digital skills gaps (in context, digital skills means advanced ICT skills, e.g. developing software, applications or programming; etc.).

We suggest a number of interventionstackle these skills gaps:

1. Monitoring labour market dynamics to identify and analyse current skills gaps
2. The anticipation of trends and of future needs for skills
3. Translating this information into actions though the better matching of the supply and demand for skills.

HEIs have a pivotal role in tackling digital skills gap and labour shortages through monitoring skills gaps and skills shortages and informing policymakers. At least two measures should be implemented:

- Tracer Studies – for monitoring the insertion of graduates on the labour market;
- Employers skills survey – to assess the needs of skills.

Further, the following changes to curricula and delivery would be beneficial to helping overcome these skills shortages and skills gaps:

4. A modified approach to Curricula reform in education (both secondary and higher education) to equip graduates with the right skills. The majority of higher education graduates consider that the skills required for jobs are acquired through “on-the-job” training and not through the education system[16]. Therefore a requirement to better prepare students and graduates for the world of work perhaps through extra-curricula provision of ICT skills would help remove the burden form employers.
5. Universities have some autonomy, however their flexibility in developing the curricula (and matching it with local needs) is limited (imposed by ARACIS). However, some measures could also be taken:

- Developing courses at the postgraduate level (where the curriculum is more flexible);
- Involving the private sector in developing postgraduate courses;
- A better orientation for optional courses;
- Improving internship schemes;
- Implementing professional and life-long learning schemes
- Local administration

[16] See Scope Tracer study 2018

- Increase the local investment in education and training initiatives aimed at developing advanced digital skills, as well as for research, development and innovation activities
- Develop partnerships with education providers and companies in order to increase human capital investment for upskilling linked to key professional profiles and thus facilitate the acquisition of advanced digital skills
- Additional investments and supportive measures designed to improve the regional rates of participation in secondary and tertiary education and lifelong learning programs
- Developing and expanding the educational services and other services offered by regional clusters/ local educational organisations, PES
- Develop local integrated digital skills programmes drawing together education providers to meet the needs of employees and companies
- Enhancing the role of education, research, development and innovation by inferring in the configuration and organisation of RDI systems and creating tighter links between education at all levels (primary, secondary, tertiary), and particularly academic education and research, with the business environment, to ensure increased outcomes and RDI results transfer to the private sector
- Modernizing the existing local infrastructure for education and research activities

Business sector

- Direct investments in skills and innovation to improve productivity and competitiveness of enterprises from various strategic areas, including building up new centres and laboratories in key areas with a clear specialization potential
- Developing new partnerships with higher education institutions to set-up new programmes and support existing study programmes and research centres in universities as main providers of advanced digital competencies and highly skilled labour
- Connecting with the local education providers and research centres in order to develop new products and processes
- Recruit new staff from local start-ups to boost innovation and develop young talent
- Support work-placements and various business programmes, including vocational training, in partnerships with higher education institutions for students in science, technology, engineering, mathematics (STEM)
- Support digital apprenticeships and internships

NGO's

- Organize multiplier events for digital upskilling in partnership with various organisations
- Organize debates with policy makers, local authorities, business representatives and education providers to increase awareness on the importance of digital skills and the value of youth work
- Promote policy initiatives on digital skills

Recommendations for how the Escalator Model can be improved if used again

- For further development of the Escalator it can be explored alongside the development of a collaborative platform.
- Another idea is to develop a specialised network or Task and Finish Group to explore the education ecosystem in the County and to make recommendations.